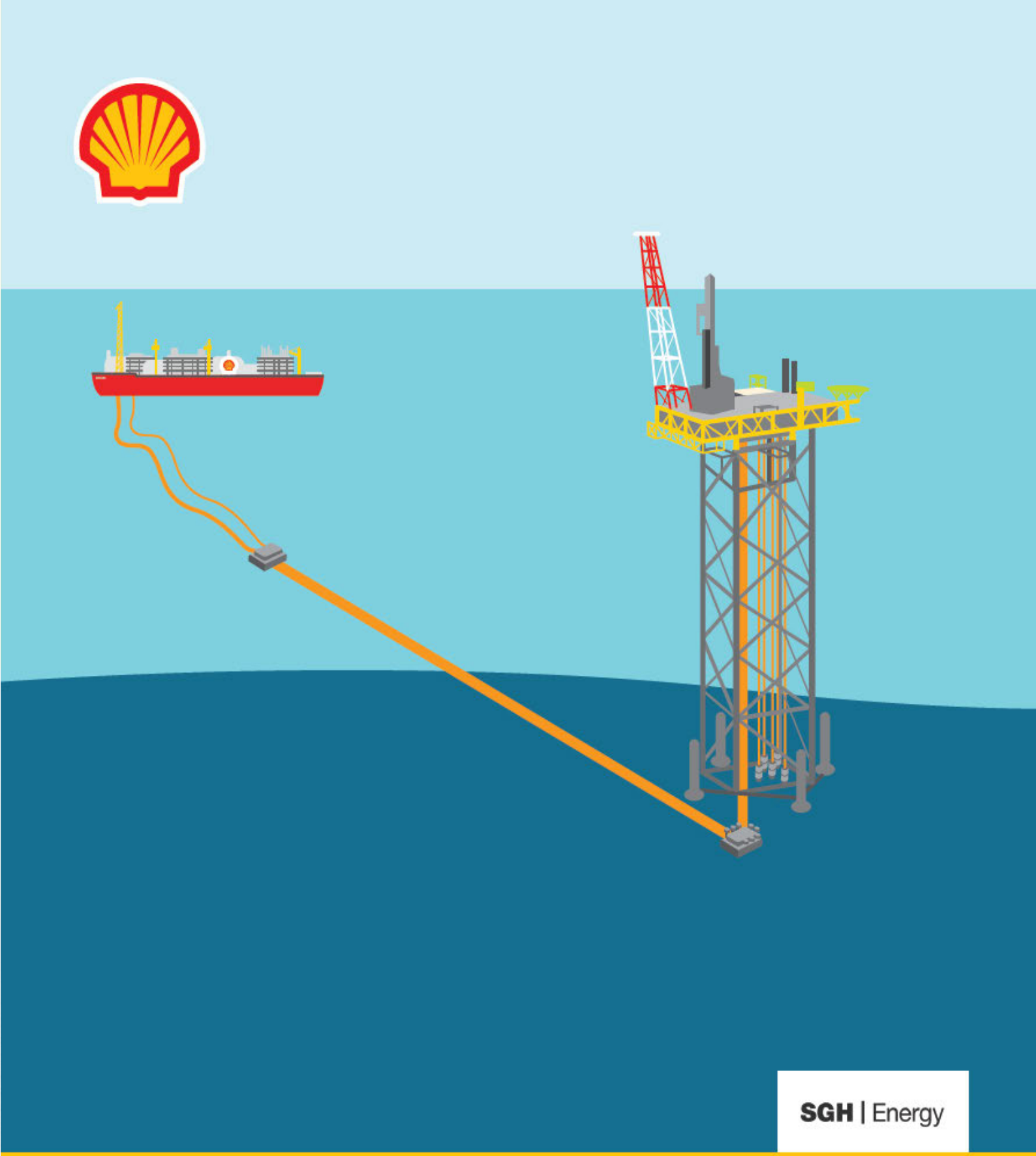

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Crux Completions, Hot Commissioning, Start-up, and Operations Environment Plan

Crux Completions, Hot Commissioning, Start-up and Operations Environment Plan

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1 Environment Plan Summary Statement

The Crux Completions, Hot Commissioning, Start-up, and Operations Environment Plan (EP) summary has been prepared from material provided in this EP. The summary comprises the following, as required by section 35(7)(a) of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023* (Cth) (OPGGS(E) Regulations):

Summary material requirement	Relevant section of this EP
The location of the activity	6.2
A description of the receiving environment	7
A description of the activity	6
Details of the environmental impacts and risks of the activity	9
The control measures for the activity	9
The arrangements for ongoing monitoring of the titleholder's environmental performance	10.7
Response arrangements in the oil pollution emergency plan	9.14 and 10.14
Consultation already undertaken and plans for ongoing consultation	5
Details of the titleholder's nominated liaison person for the activity	10.12

2 Introduction

The Crux Project is operated by Shell Australia Pty Ltd ('Shell') as a subsidiary of Shell plc, which is a member of the Shell Group of Companies (in this EP, references to global activities use the term 'Shell Group'). The Crux Project 'Activity Area' is located in Commonwealth waters in the northern Browse Basin, 190 kilometres (km) offshore north-west Australia and 620 km north-east of Broome, in waters ~165 metres (m) deep (Figure 2-1).

The Crux Offshore Project Proposal (OPP) (referred to as the Crux OPP) was accepted in August 2020 by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA), the independent regulator for offshore petroleum resources. The Crux OPP describes the Crux Project, as depicted in Figure 2-2. Shell has been granted production and pipeline licences for the Crux Project, has had the Crux OPP accepted by NOPSEMA, and is developing a suite of EPs to enable the development of the Crux Project (which took a final investment decision in May 2022).

Shell has developed separate EPs for the various stages of the Crux Project. The scope of this EP covers:

- Well Completions (refer to Section 6.8).
- Hot Commissioning (refer to Section 6.9).
- Start-up (refer to Section 6.10).
- Production Operations (refer to Section 6.11).

This EP is prepared in accordance with the OPGGS(E) Regulations and describes the following:

- Shell's Health, Security, Safety and Environment and Social Performance (HSSE & SP) Commitment and Policy and the environmental performance objectives that derive from the Policy (Section 4.2).
- The consultation process undertaken with relevant persons and the associated resolution of and/or responses to any objections or claims (Section 5).
- The area of operations, the proposed activities, and the Project's expected time frame (Section 6).
- The environmental management framework for the activity including legislation and other relevant requirements (Section 4).
- The existing physical, natural, social, and economic environments of the region, including issues or sensitivities particular to the activity (Section 7).
- The impacts and risks to the environment from both planned (normal) and unplanned (abnormal) operations (Section 9).
- The Environmental Performance Outcomes (EPOs), Environmental Performance Standards (EPSs) and measurement Criteria (MC) against which environmental performance is measured (Section 9).
- The Implementation Strategy, including key roles and responsibilities that are employed to achieve the program's environmental performance goals[1] (Section 10).
- A system for documenting, monitoring, reporting, and reviewing the success of the Implementation Strategy to facilitate improvement of environmental performance and external reporting as required (Section 10).

[1] The Shell Browse Oil Pollution Emergency Plan (BROPEP) (HSE_GEN_016765), and Shell's Browse Regional Operational and Scientific Monitoring Bridging Implementation Plan (HSE_PRE_016370) are presented as standalone documents, submitted together with this EP.

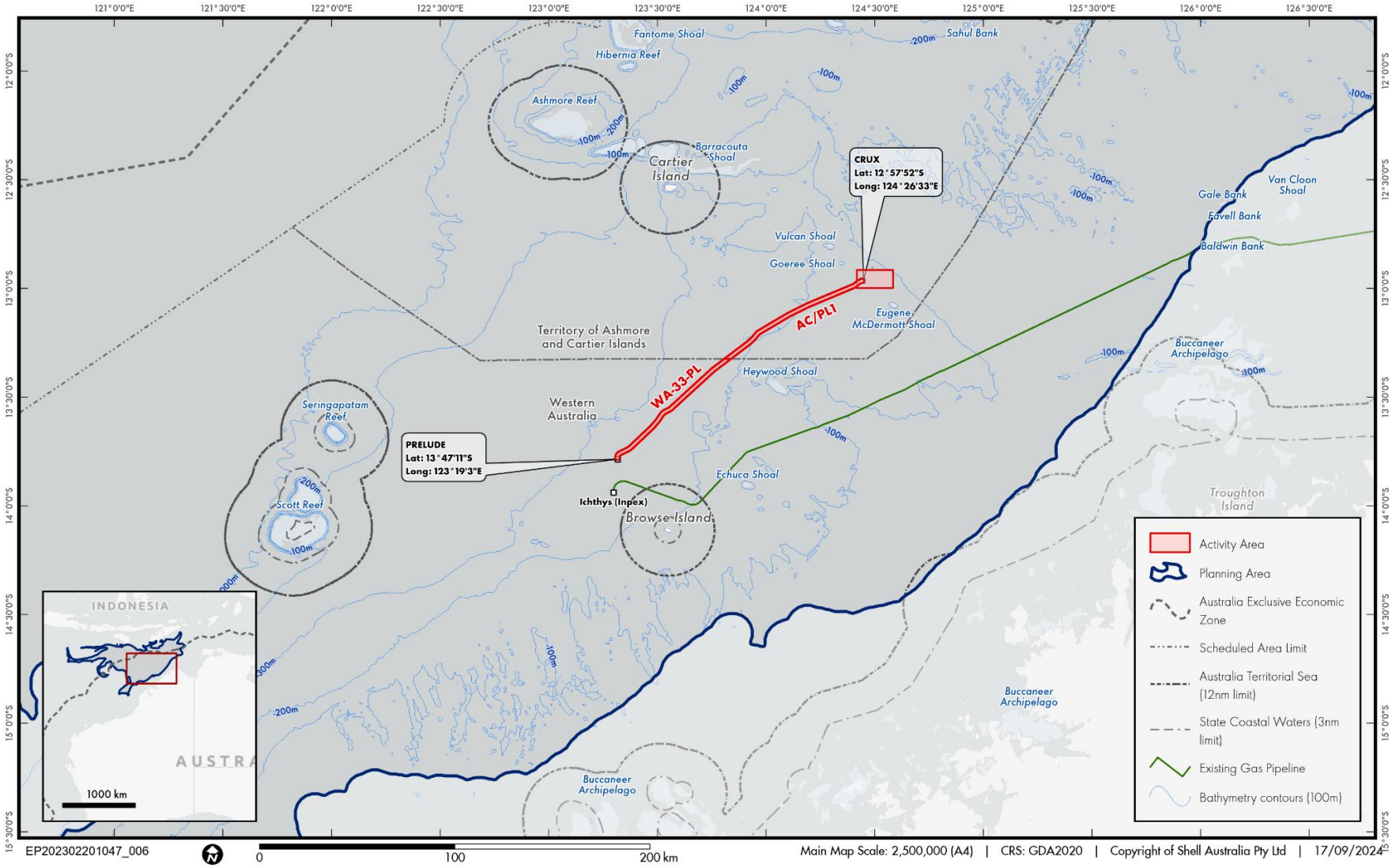


Figure 2-1: Location of the Activity Area

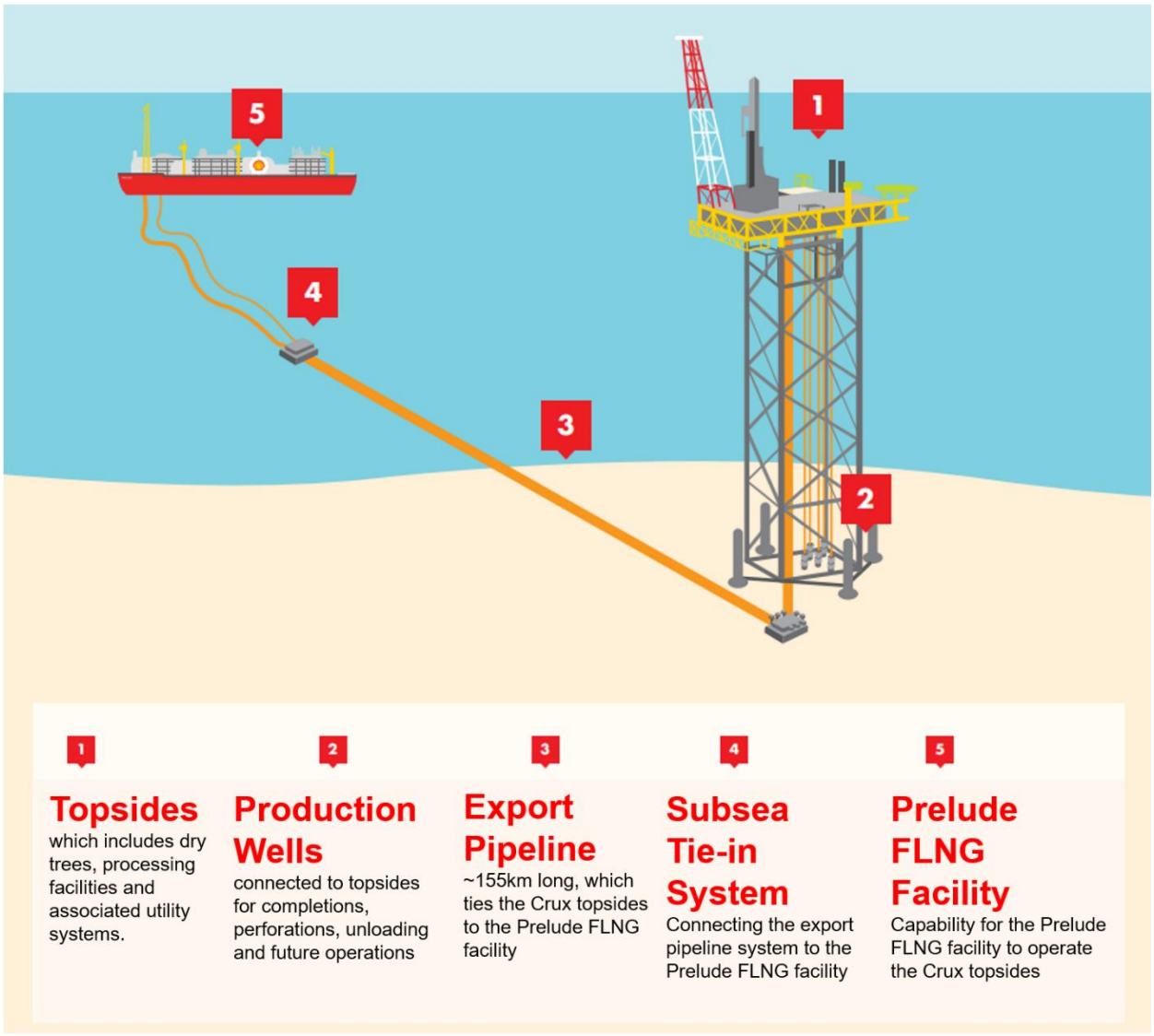


Figure 2-2: Crux Infrastructure Schematic

3 Requirements

This section is intended to fulfil the requirements of Section 21(4) of the OPGGS(E) Regulations and meet NOPSEMA's expectations stated in the EP Content Requirements Guidance Note (NOPSEMA 2024a). Section 21(4) stipulates that an EP must:

(a) describe the requirements, including legislative requirements, that apply to the activity and are relevant to the environmental management of the activity; and

(b) demonstrate how those requirements will be met.

NOPSEMA does not expect that requirements that are not relevant to the environmental management of petroleum activities be included in the EP (NOPSEMA 2024a).

These subsections are intended to meet the requirements stated above:

- Commonwealth policy (Section 3.1)
- Commonwealth legislation (Section 3.2)
- International agreement and conventions (Section 3.4)
- GHG Legislative Framework (Section 3.5).

3.1 Commonwealth Policy

3.1.1 Australia's Oceans Policy

Australia's Oceans Policy 1998 (CoA 1998) provides a framework for integrating environmental, economic, social, and cultural ocean uses. This policy details a comprehensive approach to exercising and protecting Australia's marine jurisdiction, and aims to:

- Fulfil Australia's obligations under the United Nations Conventions on the Law of the Sea 1982;
- Understand and safeguard the marine environment; and
- Promote ecologically sustainable development (ESD) through integrated planning and management.

Under this policy, the federal, state and territory governments have established a system of Australian Marine Parks (AMPs) and state/territory reserves (such as state marine parks). These parks are managed using the principles of ESD (including multiple use), which balance conservation with economic activity.

The AMPs were established under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act), and states and territories established their reserves under the National Representative System of Marine Protected Areas. Section 3.2.2.1.1 gives further information on AMPs management plans.

3.2 Commonwealth Legislation

Various Commonwealth legislation applies to the environmental management of petroleum activities. Each piece of legislation relevant to the environmental management of the petroleum activities is summarised in this section. Links to other sections of this EP are also provided below to show how these legislative requirements were considered in the development of this EP.

The activities considered in this EP will take place entirely in Commonwealth waters; therefore, legislation relating to the environmental management of the petroleum activities considered in this EP are primarily Commonwealth Acts and their subsidiary legislation and regulations. The key Acts are the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Cth) (OPGGS Act) (Section 3.2.1) and the EPBC Act (Section 3.2.1.1.1).

The Australian Government (Commonwealth) encourages investment in, and the development of, petroleum resources in Commonwealth waters. Offshore petroleum resources are regulated by NOPSEMA. The National Offshore Petroleum Titles Administrator (NOPTA) administers and manages oil, gas, and Greenhouse Gas (GHG) titles in accordance with the OPGGS Act. Together, NOPSEMA and NOPTA identify and release prospective acreage, and grant, regulate, and surrender exploration and development titles. Additional Commonwealth legislation is considered in detail in Table 3-2.

State legislation that may apply to the environmental management of an emergency event is also detailed in Table 3-2.

3.2.1 Offshore Petroleum and Greenhouse Gas Storage Act 2006

The OPGGS Act provides the regulatory framework for petroleum exploration, production, and GHG storage activities in Commonwealth waters. The OPGGS Act is supported by a range of subsidiary legislation, including the *Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009* (OPGGS (Safety) Regulations) and the OPGGS(E) Regulations.

The OPGGS Act regulates all offshore petroleum activities, including decommissioning, under sections 572 and 270. Sections 10.4.7 and 10.4.12 describe the property maintenance and decommissioning planning, including ongoing asset management and maintenance, and decommissioning and removal strategy.

The OPGGS(E) Regulations (see Section 3.2.1.1) require the environmental impacts and risks of offshore petroleum and GHG storage activities be managed to a level that is acceptable and as low as reasonably practicable (ALARP).

3.2.1.1 Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023

The OPGGS(E) Regulations provide for the protection of the environment in Commonwealth waters by requiring that petroleum and GHG storage activities be managed in a way that:

- reduces the environmental impacts and risks of the activity to a level that is ALARP;
- reduces the environmental impacts and risks of the activity to an acceptable level (see Section 8.2); and
- is consistent with the principles of ESD, as defined in Section 3A of the EPBC Act (see Section 8.1).

The method applied to assess environmental impacts and risks from the petroleum activities considered in this EP details how impacts and risks are managed to a level that is acceptable, ALARP and consistent with the principles of ESD. Sections 8, 9.1 and 9.2 of this EP describe this method, while Sections 9.3 to 9.15 detail aspect-specific demonstrations for each impact and risk assessment (RA).

Sections 21(2) and (3) of the OPGGS(E) Regulations require an EP to include details of relevant values and sensitivities of the environment that may be affected by the activity including Matters of National Environmental Significance (MNES) protected under the EPBC Act, including:

- world heritage values of a declared World Heritage property;
- national heritage values of a National Heritage place;
- the ecological character of a declared Ramsar wetland;
- the presence of a listed threatened species or listed threatened ecological community;
- the presence of a listed migratory species; and
- any values and sensitivities that exist in, or in relation to, part or all of:
  - Commonwealth Marine Area; or
  - Commonwealth land.

Section 7 describes the MNES that may credibly be impacted, or are at risk of being impacted, and these are considered in the assessment of environmental impacts and risks.

Section 34 of the OPGGS(E) Regulations states the criteria for acceptance of an EP for an activity. Table 3-1 summarises these criteria and links to the sections in this EP that relate to each[2].

Appendix G details a concordance table of the Crux OPP to the requirements and commitments within this EP.

[2] See Doctors for the Environment Australia v National Offshore Petroleum Safety and Environmental Management Authority (No 2) [2025] FCA 989, [134-142] 135 "*These are matters left to assessment by NOPSEMA in determining whether it is reasonably satisfied that an environment plan meets the environment plan acceptance criteria*."

Table 3-1: Relationships between Section 34 of the OPGGS(E) Regulations Requirements and this EP

OPGGS(E) Regulation	Requirement	Relevant Section of EP
34(a)	The EP is appropriate for the nature and scale of the activity	Sections 6 and 10 detail the nature and scale of the petroleum activities considered within this EP. Section 7 describes the environmental receptors that may credibly be impacted, or are at risk of being impacted, by the planned activities and unplanned events. Sections 9.3 to 9.15 details the environmental impact and risk assessments based on the context provided by Sections 5 and 7 (as well as Shell's internal context and the context provided by relevant persons).
34(b)	The EP demonstrates that the environmental impacts and risks of the activity will be reduced to ALARP.	Sections 9.1 and 9.2 detail the method Shell uses to demonstrate that environmental impacts and risks are managed to a level that is ALARP. Aspect-specific ALARP demonstrations are detailed in the impact and risk assessments in Sections 9.3 to 9.15.
34(c)	The EP demonstrates that the environmental impacts and risks of the activity will be of an acceptable level.	Section 8 details the method Shell uses to demonstrate that environmental impacts and risks are managed to a level that is acceptable. Aspect-specific demonstrations of acceptability are detailed in the impact and risk assessments in Sections 9.3 to 9.15.
34(d)	The EP provides appropriate environmental performance outcomes (EPOs), environmental performance standards (EPSs), and measurement criteria (MCs).	EPOs, EPSs, and MCs are detailed in Sections 9.3 to 9.15. The Crux OPP Concordance analysis provided in Appendix G provides a comparison of the EPOs and EPSs provided within this EP against those provided for in the Crux OPP.
34(e)	The EP includes an appropriate implementation strategy and monitoring, recording, and reporting arrangements.	Section 10 describes the implementation strategy for the EP.
34(f)	The EP does not involve the activity or part of the activity, other than arrangements for environmental monitoring or for responding to an emergency, being undertaken in any part of a declared World Heritage property.	Section 6 details the planned petroleum activities considered in this EP, none of which will occur within a World Heritage Area.
34(g)	The EP demonstrates that: (i) the titleholder has carried out the consultations required by Section 25; and (ii) the measures (if any) that the titleholder has adopted, or proposes to adopt, because of the consultations are appropriate.	Appendix B and Section 5 detail the consultation undertaken in relation to the EP, including Shell's responses to any claims or objections made by relevant persons. Any management measures adopted in response to consultation outcomes are considered in the aspect-specific impact and risk assessments in Sections 9.3 to 9.15 and also within Sections 5, 7, 8 and 10.
34(h)	The EP complies with the Act, this instrument and any other regulations made under the Act.	Section 3.2.1 shows the relationship between the Act, regulations, and components of the EP.

3.2.1.1.1 Assessment of Concordance with the Crux Development OPP

An assessment of concordance with the Crux Development OPP is provided in Appendix G.

3.2.2 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act and supporting regulations provide for the protection of the environment and the conservation of biodiversity in Australia. Amendments to the OPGGS Act and OPGGS(E) Regulations in February 2014,

undertaken as part of streamlining environmental approvals for petroleum activities in Commonwealth waters, require that impacts and risks to matters protected under Part 3 of the EPBC Act (i.e. MNES) be considered in an EP. Following these streamlining arrangements, NOPSEMA became the sole environmental regulator for petroleum activities in Commonwealth waters (i.e. NOPSEMA regulates activities under the OPGGS Act and EPBC Act).

The matters protected under Part 3 of the EPBC Act that are required to be managed under the OPGGS(E) Regulations are outlined in Section 3.2.1.1. As part of the streamlining arrangements, matters protected under Part 3 of the EPBC Act must be considered by NOPSEMA when assessing an EP.

3.2.2.1 EPBC Act Management Publications

3.2.2.1.1 Australian Marine Park Management Plans

The EPBC Act provides for the declaration of AMPs based on the International Union for Conservation of Nature (IUCN) principles and guidelines for categorising protected areas. Australia has established a network of AMPs throughout Commonwealth waters, which are managed under a series of regional management plans. These plans detail the management objectives of the AMPs, the environmental values within each AMP, and the activities that are permissible within AMP zones. AMPs are part of the Commonwealth Marine Area (Section 7.3.1.1), which is a MNES.

The planned petroleum activities considered within this EP will not credibly impact any AMPs; however, an emergency event may potentially impact several AMPs. Section 7.3.1.2 describes these AMPs, which are managed under the Australian Marine Parks – North-west Marine Parks Network Management Plan 2018 (DNP 2018b).

The requirements of relevant AMP management plans were considered as part of Shell's setting acceptable levels of environmental impacts and risks.

3.2.2.1.2 Recovery Plans and Conservation Advice

Species and communities listed as threatened under the EPBC Act are MNES and receive protection under Commonwealth law. The Threatened Species Scientific Committee (TSSC) may publish Conservation Advice for a threatened species, which provides information on threats and conservation management. The Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) has developed recovery plans relating to threatened species. Recovery plans provide a framework to prevent further decline and facilitate the recovery of threatened species. Recovery plans may contain actions that warrant consideration when assessing environmental impacts and risks. Recovery plans may also identify habitat critical for the survival of a species; such habitat is protected under the EPBC Act.

Shell identified a number of threatened species that may credibly be impacted, or are at risk of being impacted, by the petroleum activities considered in this EP. Section 7.7.7.6 details these species and relevant information from their recovery plans and Conservation Advice.

3.2.2.1.3 Other

Other EPBC Act publications, such as guidance and policy statements, are described in Section 3.3.

3.3 Standards and Guidelines

3.3.1 Industry, Australian and International Standards and Guidelines

In Australia, the petroleum exploration and production industry operates within an industry code of environmental practice developed by the Australian Petroleum Production and Exploration Association (APPEA), now Australian Energy Producers (AEP). The code provides guidelines for petroleum activities and has evolved from the collective knowledge and experience of the oil and gas industry both nationally and internationally. The code provides the Australian petroleum industry with guidance on management measures to protect the environment during exploration, production, and decommissioning phases. Shell is a signatory to the APPEA guidelines and will align with their intent in the implementation of this EP.

The following Australian guidelines are also applicable to the activity (as defined in Section 9):

- NOPSEMA Guidance Note GN1344 – Environment plan content requirements – January 2024
- NOPSEMA Guideline GL2086 – Consultation in the course of preparing an environment plan – May 2024

- NOPSEMA Guideline GL1887 – Consultation with Commonwealth agencies with responsibilities in the marine area – November 2024
- NOPSEMA Information Paper IP1765 – Acoustic impact evaluation and management – January 2024
- NOPSEMA Guidance Note GN1343 – Petroleum activity – January 2024
- NOPSEMA Guidance Note GN1785 – Petroleum activities and Australia Marine Parks – January 2024
- NOPSEMA Guidance Note GN1488 – Oil pollution risk management – October 2024
- NOPSEMA Information Paper IP1349 – Operational and scientific monitoring programs – January 2024
- NOPSEMA Information Paper IP2002 – Planning for proactive decommissioning – January 2024
- NOPSEMA Policy PL1903 – Section 572: Maintenance and removal of property – December 2022 (NOPSEMA 2022d)
- Australian Ballast Water Management Requirements (Department of Agriculture, Water and the Environment (DAWE 2020)
- National Biofouling Management Guidelines for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee 2009)
- Australian biofouling management requirements version 2 (Commonwealth Department of Agriculture, Fisheries and Forestry [DAFF] 2023)
- Technical Guideline for the Preparation of Marine Pollution Contingency Plans for Marine and Coastal Facilities (AMSA 2015)
- Matters of National Environmental Significance – Significant Impact Guidelines 1.1 (DoE 2013)
- EPBC Act Policy Statement 'Indirect consequences' of an action (Department of Sustainability, Environment, Water, Population and Communities [DSEWPaC] 2013)
- National Plan for Maritime Environmental Emergencies – 2020 edition (AMSA 2020)
- Marine Oil Pollution: Response and Consultation Arrangements (Department of Transport 2020)
- EPBC Act Policy Statement 3.21—Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (Commonwealth of Australia 2017)

The following international guidelines are also applicable to the project:

- Environmental Management in Oil and Gas Exploration and Production (United Nations Environment Program and Oil Industry International Exploration and Production Forum 1997).

3.4 International Agreements and Conventions

Australia is a signatory to several international agreements and conventions that are relevant to the environmental management of the petroleum activities considered in this EP. These agreements and conventions are typically implemented by Commonwealth legislation (see Section 3.2). Table 3-3 lists the relevant international agreements and conventions, along with a justification of their relevance to the petroleum activities considered in this EP.

Table 3-2: Summary of Relevant Legislation

Legislation	Summary	Relevance to this EP
Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Cth)	Protects areas and objects that are of particular significance to Aboriginal and/or Torres Strait Islander People	There are no requirements arising under this Act that apply to the environmental management of the activity. The EP considers heritage features and values (see Sections 7.10.3 and 7.11.3).
Aboriginal Heritage Act 1972 (WA)	This Act provides for the recognition, protection, conservation, and preservation of Aboriginal cultural heritage in Western Australia (WA).	There are no requirements arising under this Act that apply to the environmental management of the activity. The EP considers heritage features and values (see Sections 7.10.3 and 7.11.3).
Aboriginal Land Rights (Northern Territory) Act 1976 (Cth)	This Act allows for the granting of Aboriginal freehold title to Traditional Owners.	Spatial mapping of Aboriginal freehold land across the NT, and the identification of the associated Aboriginal Trusts was undertaken as part of the search for potentially relevant persons. This included a search for any Aboriginal Trusts associated with Aboriginal freehold land that intersected with or was adjacent to the Planning Area. Refer Section 5.7.1.4.
Australian Heritage Council Act 2003 (Cth)	This Act identifies areas of heritage value, including those listed on the National Heritage List and the Commonwealth Heritage List (of which are MNES under the EPBC Act) and establishes the Australian Heritage Council.	There are no requirements arising under this Act that apply to the environmental management of the activity. The EP considers protected areas (Section 7.3.1.4).
Australian Maritime Safety Authority Act 1990 (Cth)	Establishes the Australian Maritime Safety Authority (AMSA) and provides for its functions, including to combat pollution in the marine environment. AMSA is also responsible for administering Marine Orders in Commonwealth waters. The Act also aims to promote maritime safety, protect the marine environment from pollution and environmental damage from ships, provide for a national search and rescue service and promote the efficient provision of service by AMSA. AMSA is the control agency for vessel-based non-petroleum activity spills in Commonwealth waters.	AMSA has been consulted as a Relevant Person – see Section 5 in preparing the EP, and will be notified throughout activities in accordance with Section 10.10. AMSA's relevant functions are vessel emergencies, including oil spills in Commonwealth waters (Section 9.14).
Biodiversity Conservation Act 2016 (WA) *Biodiversity Conservation Regulations 2018* (WA)	Requires WA conservation management agencies to take a lead role in oiled wildlife response (OWR) in WA. The WA Department of Biodiversity, Conservation and Attractions (DBCA) has the responsibility and statutory authority to conserve, protect and manage wildlife, including threatened species	Any OWR will comply with this Act and the WA Oiled Wildlife Response Plan.

Legislation	Summary	Relevance to this EP
Biosecurity Act 2015 (Cth) *Biosecurity Regulations 2016* (Cth) Australian Ballast Water Management Requirements, Version 8 Australian Biofouling Management Requirements (Version 2, 2023)	Provides for managing the risk of pests and diseases entering Australian territory that may cause harm to human, animal or plant health or the environment. The Act includes requirements for pre-arrival reporting, ballast water management plans and certificates.	This Act applies to foreign vessels operating in Australian waters which must comply with the requirements of this Act and the Regulations. The activity will comply with biosecurity requirements, specifically in relation to vessel biofouling and ballast water requirements (Section 9.8).
Climate Change Act 2022 (Cth)	This Act commenced in September 2022 and sets out Australia's net-zero commitments and codifies Australia's net 2030 and 2050 GHG emissions reductions targets under the Paris Agreement.	The oil and gas sector is not subject to direct obligations under this Act; however, this Act legislates Australia's emissions net-zero targets by 2050. Refer to the Shell climate target (Shell 2024) and Section 10.6.
Emergency Management Act 2005 (WA)	Provides for processes for hazard management. Requires the WA Department of Transport (WA DoT) (Hazard Management Agency) to be the control agency for spills within or entering WA state waters. The WA State Emergency Management Plan for Marine Oil Pollution was made in accordance with the Act.	Emergencies, including oil spills that enter WA waters will comply with this Act (Sections 9.14 and 9.15).
Environmental Protection Act 1986 (WA) Environmental Protection (Unauthorised Discharges) Regulations 2004 (WA) (Unauthorised Discharges Regulations) Environment Protection (Controlled Waste) Regulations 2004 (WA) (Controlled Waste Regulations)	This Act provides for the prevention, control and abatement of pollution and environmental harm and for the conservation, preservation, protection, enhancement and management of the environment. The Act also establishes offences for certain environmental harms. The Unauthorised Discharges Regulations regulate certain discharges into the environment that do not cause pollution or harm for the purposes of the EP Act, but which result from business or commercial activity. The Controlled Waste Regulations regulate the transportation of controlled wastes, including the storage, handling, labelling, transport and tracking of such wastes. The Unauthorised Discharges Regulations will apply to the activity to the extent that there are unplanned hydrocarbon and chemical releases during spill response actions in WA waters. The Controlled Waste Regulations apply to the transportation of controlled wastes during spill response actions in WA waters.	Emergencies, including oil spills that enter WA waters will comply with this Act (Sections 9.14 and 9.15).

Legislation	Summary	Relevance to this EP
Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth)	While the OPGGS(E) Regulations under the OPGGS Act (see below) regulate day to day petroleum activities and apply to any activity that may have an impact on the environment, the EPBC Act regulates the assessment and approval of proposed actions that are likely to have a significant impact on a matter of National Environmental Significance (MNES). See Section 3.2.1.1.1 for a detailed description of the requirements.	The Crux Project is approved under the EPBC Act via the Class Approval[3]. This Act is relevant to the environmental management of the activity. See Sections 7 and 9 for a description and treatment of MNES respectively.
Fisheries Management Act 1991 (Cth)	This Act sets out specific functions which apply to the Australian Fisheries Management Authority (AFMA), including in relation to the regulation of fishing and the development of management plans for fisheries. Commonwealth fisheries are managed by the AFMA under the Act.	This Act is not directly relevant to the environmental management of the activity. However, AFMA has management responsibilities under this Act in respect of the Commonwealth managed fisheries which overlap the Activity Area (of which there are three) and the Planning Area (of which there are four) as provided for in Table 7-18). Accordingly, this Act has been identified for the purpose of contextualising the consultation undertaken with the AFMA in the course of preparing this EP, as set out in Section 5/Appendix B.
Fish Resources Management Act 1994 (WA)	This Act applies provides for the management of fish resources and fisheries in WA, the conservation of fish and the protection of their environment. Under this Act, Joint Authorities are established with specific responsibilities for the management of fisheries in WA waters. Additionally, WA–managed fisheries are managed by DPIRD in accordance with the regulatory requirements applicable under this Act.	The Act is not directly relevant to the environmental management of the activity. However, there are 10 WA managed fisheries within the Activity Area, with the Planning Area overlapping an additional fishery (as provided for in Table 7-18). Accordingly, this Act has been identified for the purpose of contextualising the consultation undertaken with the WA Department of Primary Industries and Regional Development in the course of preparing this EP, as set out in Section 5/Appendix B.
Hazardous Waste (Regulation of Exports and Imports) Act 1989 (Cth)	Regulates the export, import and transport of hazardous waste to ensure that hazardous waste is managed appropriately so that human health and the environment are protected from the harmful effects of the waste. The Act gives effect to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, 1972 (commonly referred to as the Basel Convention).	The activity does not involve transboundary movement of hazardous wastes.

[3] as defined in the Minister for the Environment's Final Approval Decision for the Taking of Actions in Accordance with an Endorsed Program under the *Environment Protection and Biodiversity Act 1999* (Cth) (DOE 2014)

Legislation	Summary	Relevance to this EP
Marine Safety (Domestic Commercial Vessel) National Law Act 2012 (Cth) *Marine Safety (Domestic Commercial Vessel) National Law Regulation 2013* (Cth) Marine Orders	This Act is a single regulatory framework for the certification, construction, equipment, design and operation of domestic commercial vessels inside Australia's exclusive economic zone (EEZ). The Act names AMSA as the National Marine Safety Regulator and confers functions on AMSA in relation to marine safety, including that AMSA may make and maintain Marine Orders. The Regulations under the Act set out the definition of a vessel and details and requirements of the accredited marine surveyor scheme.	Shell will ensure the vessels undertaking activities under this EP comply with applicable maritime law and regulations.
National Environment Protection (National Pollutant Inventory) Measure 1998 (established under the *National Environment Protection Council Act 1994*) (Cth)	Provides the framework for developing and establishing the National Pollutant Inventory (NPI), which provides publicly available information on the types and amounts of listed toxic substances being emitted into the Australian environment. These substances were identified as important due to their possible effect on human health and the environment.	The activity will comply with the NPI National Environment Protection Measure (NEPM) by reporting relevant NPI substances (Section 9.11).
National Environment Protection Council Act 1994 (Cth)	Establishes the National Environment Protection Council, whose primary functions are to: • define NEPMs to ensure Australians have equivalent protection from air, water, soil, and noise pollution. • assess and report the implementation and effectiveness of NEPMs.	The activity will comply with the requirements of the relevant NEPMs (Section 9.11).
National Greenhouse and Energy Reporting Act 2007 (Cth) *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015* (Cth)	Provides a single, national framework for reporting and distributing information related to GHG emissions, GHG projects, energy production and energy consumption. Reporting obligations are imposed upon corporations that meet emissions and/or energy thresholds. In addition to the Act's reporting requirements, the Safeguard Mechanism is administered under the Act. The Safeguard Mechanism provides a framework for Australia's largest emitters to measure, report and manage their emissions. The Safeguard Mechanism requires, among other things, that large facilities whose net emissions exceed the safeguard threshold of 100,000 tonnes (t) of carbon dioxide equivalent (CO_2-e) per annum keep their net emissions at or below emissions baselines set by the Clean Energy Regulator (CER).	Shell reports as a corporate group under the Act; this includes reports related to emissions from activities under its operational control (Section 9.12). If operational control is determined to sit with Shell's contractors, it is each contractor's responsibility to adhere to the Act. Although Shell does not anticipate that Scope 1 emissions from the Crux facility will exceed 100,000 tCO_2-e (0.1 M tCO_2-e)per year during normal operations, it is possible this threshold may be exceeded during initial start-up (Sections 3.5.6 and 9.12.11). In that case, the Safeguard Mechanism would be directly applicable to this activity (Sections 3.5.6 and 9.12.11). The Safeguard Mechanism will also be relevant to GHG emissions at the Prelude FLNG facility (which is a Designated Large Facility under the NGER framework),

Legislation	Summary	Relevance to this EP
		including emissions generated at that facility while processing Crux gas. Specifically, the Responsible Emitter of the Prelude FLNG facility will be required to surrender prescribed carbon units equal to 100% of reservoir CO_2 separated from Crux feed gas at the facility, being an estimated 9.78 Mt CO_2-e over the life of the reservoir (Sections 3.5.6 and 9.12.11). The Crux reservoir CO_2 is the responsibility of the facility from which it is emitted, in this case, the Prelude FLNG for the Crux reservoir (Sections 3.5.6 and 9.12.11).
Native Title Act 1993 (Cth)	The Act recognises the rights and interests of Aboriginal and Torres Strait Islander people in land and waters according to their traditional laws and customs and creates processes through which native title can be recognised and protected. Under s 280(2) of the OPGGS Act, petroleum activities must be carried out in a manner that does not interfere with the enjoyment of native title rights and interests under the Native Title Act to a greater extent than necessary.	The Planning Area does not overlap any native title determinations. The activity will not interfere with the enjoyment of native title rights and interests under the *Native Title Act 1993* (Cth) to a greater extent than necessary (i.e. to acknowledge compliance with Section 280(2) of the OPGGS Act). Based on the summary column, this is the relevant obligation in relation to native title. See Section 7.10.3.2.2. Refer also to Section 5 in relation to consultation.
Navigation Act 2012 (Cth) *Navigation Regulations 2023* (Cth) Marine Order 21 (Safety and emergency arrangements) 2016 (Cth) Marine Order 27 (Safety of navigation and radio equipment) 2023 (Cth) Marine Order 30 (Prevention of collisions) 2016 (Cth) Marine Order 71 (Masters and deck officers) 2014 (Cth)	Relates to maritime safety and the prevention of pollution of the marine environment in Australian waters. It gives effect to several international conventions relating to maritime issues to which Australia is a signatory. Under the Act, AMSA has the power to make Marine Orders regarding any matters that provision must or may be made by the Regulations.	The activity, including vessels, will adhere to the Act and subsidiary legislation enabled by the Act, such as Marine Orders relating to the international conventions listed in Table 3-3.
Northern Territory Aboriginal Sacred Sites Act 1989 (NT)	This Act establishes procedures for the protection and registration of sacred sites and the avoidance of sacred sites in the development and use of land. The Act also provides for entry onto sacred sites and specifies the conditions that apply to such entry and establishes the Aboriginal Areas Protection Authority (AAPA), which is responsible for, among other things, the enforcement of the Act.	A search of the NT AAPA Sacred Sites Register was undertaken to identify potential sacred sites (registered and recorded) that overlap with the Planning Area (refer Section 7.11.3.2.4.3).

Legislation	Summary	Relevance to this EP
Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth) *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023 (Cth)* *Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009* (Cth)	Petroleum exploration and development activities in Australia's offshore areas are subject to the environmental requirements specified in the OPGGS Act and associated Regulations. See Section 3.2.1 for a detailed description of the requirements.	Requirements under the OPGGS Act and associated Regulations are addressed throughout this EP and it demonstrates that the environmental impacts and risks resulting from the activity are reduced to ALARP, are acceptable, and will be undertaken in line with the principles of ESD.
Ozone Protection and Synthetic Greenhouse Gas Management Act 1989 (Cth) Ozone Protection and Synthetic Greenhouse Gas Management Regulations 1995 (Cth)	Aims to protect the environment by reducing emissions of ozone depleting substances (ODSs) and synthetic greenhouse gases (SGGs). It controls the manufacture, import and export of ODSs and SGGs and products containing these gases.	The activity will adhere to restrictions on importing and using ODSs/SGGs by implementing appropriate measures that control procuring of products which contain these gases. The Act will only apply to Shell if it manufactures, imports or exports ozone depleting substances.
Protection of the Sea (Harmful Anti-fouling Systems) Act 2006 (Cth) Marine Order 98 (Marine pollution prevention — anti-fouling systems) 2023 (Cth)	Aims to protect the marine environment from the effects of harmful antifouling systems. Under the Act, the negligent application of a harmful antifouling compound to a ship by a person or persons is an offence. The Act also requires that all Australian ships (that meet specific criteria) must hold 'antifouling certificates'.	Vessels associated with offshore petroleum activities are required to adhere to this Act. See Section 9.8 in relation to the environmental impact assessment for Invasive Marine Species.
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Cth) Protection of the Sea (Prevention of Pollution from Ships) (Orders) Regulations 1994 (Cth) Marine Order 91 (Marine pollution prevention — oil) 2014 Marine Order 93 (Marine pollution prevention — noxious liquid substances) 2014 Marine Order 94 (Marine pollution prevention — packaged harmful substances) 2014 Marine Order 95 (Marine pollution prevention — garbage) 2018 Marine Order 96 (Marine pollution prevention — sewage) 2018 Marine Order 97 (Marine pollution prevention — air pollution) 2023	Regulates discharges from ships to protect the sea from pollution. These discharges include oil or oily mixtures, noxious liquid substances, packaged harmful substances, sewage, and garbage. The Act imposes a duty to report certain incidents involving prohibited discharges and to maintain record books and management plans. The Act and its subsidiary Marine Orders enact the International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL).	Vessels are subject to this Act and will adhere to the requirements for discharges and waste management outlined in the relevant MARPOL and Marine Orders (as appropriate to vessel class). See Section 9.
Protection of the Sea (Powers of Intervention) Act 1981 (Cth)	Under this Act, the Commonwealth is empowered to take measures to protect the sea from pollution by oil and other noxious substances which may be discharged from ships. The AMSA is established as	Shell will be required to comply with the Act in the event of a spill of oil or noxious subjects from Activity vessels. Further, AMSA's powers under the Act are relevant to any event of

Legislation	Summary	Relevance to this EP
Protection of the Sea (Powers of Intervention) Regulations 1983 (Cth)	the Authority under this Act, and has broad powers which include the power to take such measures it considers necessary to prevent pollution of the sea from oil and other substances.	an MDO spill arising from activities under this EP. See Section 9.14.
Underwater Cultural Heritage Act 2018 (Cth) (UCH Act)	Aims to protect Australia's underwater cultural heritage. The UCH Act came into effect on 1 July 2019, replacing the *Historic Shipwrecks Act 1976* (Cth). The Act protects Australia's shipwrecks and broadens protection to sunken aircraft and other types of Underwater Cultural Heritage (UCH).	There are no declared protected UCH sites within the Activity Area. Multiple known shipwrecks, sunken aircraft, and historic (more than 75 years old) aircraft and shipwrecks and other sites occur within the Planning Area. Planned petroleum activities will not interfere with any known UCH site (see Section 7.11.1).

Table 3-3: Summary of Relevant International Agreements and Conventions

Agreement/Convention	Summary	Relevance to this EP
Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment 1974 (JAMBA)	This agreement aims to conserve migratory bird species that travel between Japan and Australia. This includes many species of shorebirds that use the East Asian–Australasian Flyway (EAAF). It is implemented in Commonwealth law by the EPBC Act, which makes provision for species listed under JAMBA to be listed as migratory under the EPBC Act. Species listed as migratory under the EPBC Act are MNES.	Several birds listed as migratory under the EPBC Act were identified as potentially being impacted by the petroleum activities considered in this EP. See Section 7.7.7.4.
Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment 1986 (CAMBA)	This agreement aims to conserve migratory bird species that travel between China and Australia. This includes many species of shorebirds that use the EAAF. It is implemented in Commonwealth law by the EPBC Act, which makes provision for species listed under CAMBA to be listed as migratory under the EPBC Act. Species listed as migratory under the EPBC Act are MNES.	Several bird species that use the EAAF were identified as potentially being impacted by the petroleum activities considered in this EP. See Section 7.7.7.4.
Agreement between the Government of Australia and the Government of the Republic for Korea for the Protection of Migratory Birds and their Environment 2007 (ROKAMBA)	This agreement aims to conserve migratory bird species that travel between the Republic of Korea and Australia. This includes many species of shorebirds that use the EAAF. It is implemented in Commonwealth law by the EPBC Act, which makes provision for species listed under ROKAMBA to be listed as migratory under the EPBC Act. Species listed as migratory under the EPBC Act are MNES.	Several birds listed as migratory under the EPBC Act were identified as potentially being impacted by the petroleum activities considered in this EP. See Section 7.7.7.4.
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal 1989 (Basel Convention)	This convention deals with the transboundary movement of hazardous wastes, particularly by sea. The *Hazardous Waste (Regulation of Exports and Imports) Act 1989* (Cth) gives effect to the Basel Convention in Australian law. The overarching objective of the Basel Convention is to protect human health and the environment against the adverse effects of hazardous wastes.	The activity does not involve transboundary movement of hazardous wastes.

Agreement/Convention	Summary	Relevance to this EP
Convention on the Conservation of Migratory Species of Wild Animals 1979 (the Bonn Convention)	This convention aims to conserve migratory fauna species throughout their ranges, particularly where their range crosses international jurisdictional boundaries. It is implemented in Commonwealth law by the EPBC Act, which makes provision for species listed under the Bonn Convention to be listed as migratory under the EPBC Act. Species listed as migratory under the EPBC Act are MNES.	Several species listed as migratory under the EPBC Act were identified as potentially being impacted by the petroleum activities considered in this EP. See Section 7.7.7.
International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001	This convention prohibits the use of harmful organotins in antifouling paints applied on ships. Additionally, this Convention establishes a mechanism to prevent the potential future use of other harmful substances in antifouling systems. The *Protection of the Sea (Harmful Anti-fouling Systems) Act 2006* (Cth) and subsidiary Marine Order give effect to the Convention.	Vessels are required to comply with this Convention. See Section 9.8.
International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004	This Convention was adopted by the International Maritime Organization (IMO) and entered into force globally in 2017. It aims to prevent the spread of harmful aquatic organisms from one region to another, by establishing standards and procedures for managing and controlling ships' ballast water and sediments. Thus, ballast water management systems must be approved in accordance with this Convention. From 8 September 2017, all vessels that use ballast water are required to meet the Regulation D2 discharge standard of this Convention at their next renewal survey. Implementation of the convention in Australia occurs through the *Biosecurity Act 2015* (Cth) and the Australian Ballast Water Management Requirements (DAWE 2020).	Vessels must manage their ballast water and sediments to a certain standard, according to a ship-specific ballast water management plan. All ships will also have to carry a ballast water record book and an international ballast water management certificate. This Convention is relevant in preventing the introduction of invasive marine species (IMS). See Section 9.8.
International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL)	This convention is an agreement to minimise the pollution of the marine environment by ships caused by operational or accidental causes. The convention provides a standardised approach to the environmental management of international and domestic shipping. The convention is implemented in Commonwealth law by the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth), the *Navigation Act 2012* (Cth) and a series of Marine Orders made under this legislation.	Vessels are required to comply with MARPOL. See Sections 8 and 9.
International Convention for the Safety of Life at Sea 1974 (SOLAS) and its Protocol of 1988	This convention provides internationally agreed minimum standards for the construction, equipment and operation of vessels. It is implemented in Commonwealth law by the *Navigation Act 2012* (Cth) and a series of Marine Orders made under this Act.	Vessels are required to comply with SOLAS. See Sections 9.3 and 9.14.
International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 (STCW Convention)	This convention provides a standardised approach to the qualifications and competencies of masters, officers and watch personnel. It is implemented in Commonwealth law by the *Navigation Act 2012* (Cth) and a series of Marine Orders made under this Act, specifically Marine Order 71 (Masters and Deck Officers).	Vessels and crew are required to comply with STCW Convention. See, for example, Sections 9.3 and 9.4.

Agreement/Convention	Summary	Relevance to this EP
Convention on Wetlands of International Importance 1975 (Ramsar)	This convention aims to conserve and promote the sustainable human use of wetlands. Many wetlands provide important habitat for migratory bird species, and Ramsar wetlands are important for conserving many species of migratory shorebirds and waders. Ramsar wetlands are protected under the EPBC Act and are MNES.	The Ashmore Reef Ramsar wetland was identified as potentially being impacted if an unplanned release of large volumes of hydrocarbons was to occur (e.g. vessel collision). See Section 7.3.1.3.
International Regulations for Preventing Collisions at Sea 1972 (COLREGS)	These regulations provide internationally agreed rules on vessel navigation, which are intended to reduce the likelihood of vessel collisions. COLREGS are implemented in Commonwealth law by the *Navigation Act 2012* (Cth)and a series of Marine Orders made under this Act, specifically Marine Order 30 (Prevention of Collisions) 2016.	Vessels are required to comply with COLREGS. See Sections 9.3 and 9.14.
Memorandum of Understanding between the Government of Australia and the Government of the Republic of Indonesia Regarding the Operations of Indonesian Traditional Fishermen in Areas of the Australian Exclusive Fishing Zone and Continental Shelf 1974	This memorandum of understanding (MOU) recognises the long history of traditional Indonesian fishermen exploiting biological resources within Timor Sea waters within Australia's EEZ. The MOU provides for an area (commonly referred to as the MOU Box) within which traditional Indonesian fishing is permitted within sections of the Australian EEZ. The area includes several offshore reefs, including Ashmore Reef, Cartier Island, Scott Reef and Seringapatam Reef.	The Activity Area[4] is situated within the MOU Box. See Section 7.11.2.
Minamata Convention on Mercury	This convention aims to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds. The convention came into force in Australia on 7 March 2022 and is implemented through various legislative instruments, including the OPGGS Act and the OPGGS(E) Regulations. The National Implementation Plan: Minamata Convention on Mercury (October 2024) (DCCEEW 2024j) informs how the obligations of the convention are being implemented in Australia, and states "*The Regulations [OPGGS(E)] require that environment plans describe legislative and other requirements that apply and demonstrate how they will be met. NOPSEMA requires offshore oil and gas projects to be compliant with the Minamata Convention and to apply best available techniques and best environmental practices to control mercury releases and manage mercury waste in an environmentally sound manner.*" Compliance is achieved through the requirement in the OPGGS(E) Regulations that environmental impacts and risks of an activity be reduced to ALARP and an acceptable level.	The Crux Project aligns with relevant environmental conventions, including those related to mercury management. The activity will comply with the convention. There is a possibility that mercury from the Crux wells may partition into various parts of the process including gas condensate, produced water and fuel gas. The Crux project will control mercury releases and manage mercury waste to ensure that environmental impacts and risks of the activity are reduced to ALARP and an acceptable level. Shell has considered the intent of the Guidance on Best Available Techniques and Best Environmental Practices - Minamata Convention on Mercury (United Nations Environment Program, 2019) which applies to emission point source and facilities listed in Annex D of the Minamata Convention, updated by the more recent Guidance on Best Available Techniques and Best

[4] Defined as the petroleum title AC/L10 and pipeline licences WA-33-PL and AC/PL1.

Agreement/Convention	Summary	Relevance to this EP
		Environmental Practices to Control Releases of Mercury from Relevant Sources (UNEP/MC/2024/3, October 2024) ('Minamata Guidelines'). Although the Crux Financial Investment Decision (FID) was made in May 2022 (prior to the 2024 Minamata Guidelines), the Crux project applied best available techniques (BAT) and best environmental practices (BEP) to control mercury releases and manage mercury waste through the ALARP process during the design and execute phase (post FID). BAT and BEP are equivalent to an ALARP assessment, therefore the term ALARP (in the context of assessment on mercury removal and reduction) will be used in this EP. Additionally, the project must comply with national reporting requirements, ensuring transparency and accountability in its mercury management practices. Design aspects and considerations are outlined in Section 9.
Paris Agreement on Climate Change (2015)	The Paris Agreement is an instrument made under the United Nations Framework Convention on Climate Change, with the central aim of strengthening the global response to the threat of climate change by keeping the global temperature rise this century well below 2° C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5° C in order to prevent dangerous human caused interference with the climate system. It deals with GHG emissions mitigation, adaptation, and finance. The agreement's language was negotiated by representatives of 196 state parties, including Australia, and adopted by consensus on 12 December 2015, before entering in to force on 4 November 2016. Australia has since ratified the Paris Agreement. The Paris Agreement requires each party to: • volunteer its own Nationally Determined Contributions (NDCs), to report against them annually, and improve them if it is determined that the collective commitment to NDCs is considered ineffective or insufficient to keep global temperature increases to less than 2° C below pre-industrial levels. This allows for variation in emissions reduction performance according to the development status of the country. • determine, plan, and regularly report on the contribution that it undertakes to mitigate global warming. No mechanism forces a country to set a specific	See Section 9.12 which refers to the Shell Group's climate target (Shell 2024).

Agreement/Convention	Summary	Relevance to this EP
	emissions target by a specific date, but each target should go beyond previously set targets. Under the Paris Agreement, Australia has set an NDC of a 43% reduction in GHG emissions by 2030 (based on 2005 levels). The Intergovernmental Panel on Climate Change (IPCC) released a report in October 2018 on the 1.5° C target, which concluded that global emissions need to reach net zero around mid-century to give a reasonable chance of limiting warming to 1.5° C.	
The East Asian–Australasian Flyway Partnership 2006	The EAAF Partnership was adopted in the list of the World Summit on Sustainable Development as a Type II initiative, which is informal and voluntary, and was launched on 6 November 2006. This partnership aims to protect migratory waterbirds, their habitat and the livelihoods of people who depend upon them.	Several migratory bird species that use the EAAF were identified as potentially being impacted by the petroleum activities considered in this EP. See Section 7.7.7.4.

3.5 Greenhouse Gas Legislative Framework

3.5.1 United Nations Framework Convention on Climate Change

The United Nations Framework Convention on Climate Change (UNFCCC) came into force in 1994 and has been ratified by 198 Parties (197 States and one regional economic integration organisation). The aim of the UNFCCC is to prevent anthropogenic interference with the climate system.

The Kyoto Protocol is an instrument made under the UNFCCC. It operationalises the UNFCCC by committing industrialised countries (Annex I Parties) to limit and reduce GHG emissions. The Protocol is based on the principle of common but differentiated responsibilities. It acknowledges that individual countries have different capabilities in combating climate change, owing to economic development, and therefore puts the obligation to reduce current emissions on developed countries on the basis that they are historically responsible for the current levels of GHG in the atmosphere.

3.5.2 Paris Agreement

The Paris Agreement is also an instrument made under the UNFCCC, with the central aim of strengthening the global response to the threat of climate change by keeping the global temperature rise this century well below 2 Degrees Celsius (° C) above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5° C. It deals with GHG emissions mitigation, adaptation, and finance. The agreement's language was negotiated by representatives of 196 state parties, including Australia, and adopted by consensus on 12 December 2015, before entering in to force on 4 November 2016. Australia has since ratified the Paris Agreement. The Paris Agreement requires each party to:

- Volunteer its own NDCs, to report against them annually, and improve them if it is determined that the collective commitment to NDCs is considered ineffective or insufficient to keep global temperature increases to less than 2° C below pre-industrial levels. This allows for variation in emissions reduction performance according to the development status of the country.
- Determine, plan, and regularly report on the contribution that it undertakes to mitigate global warming. No mechanism forces a country to set a specific emissions target by a specific date, but each target should go beyond previously set targets.

3.5.3 Australia's Legislative Frameworks for Regulating and Reporting GHG Emissions

The Australian Government ratified the Paris Agreement and the Doha Amendment to the Kyoto Protocol on 10 November 2016. Australia's first commitment under this agreement was to reduce emissions by 26–28% of 2005 levels by 2030. With the change of government, this was superseded in June 2022 by an NDC that committed to a more ambitious 2030 target. The updated NDC:

- commits Australia to reduce GHG emissions by 43% below 2005 levels by 2030, which is an increase on Australia's previous 2030 target of 26 - 28%.
- reaffirms Australia's commitment to net zero emissions by 2050.
- commits the government to providing an annual statement to parliament on progress towards these targets.
- restores Australia's Climate Change Authority as a source of independent policy advice.

3.5.4 Climate Change Act

The *Climate Change Act 2022* (Cth) sets out Australia's net-zero commitments and codifies Australia's net 2030 and 2050 GHG emissions reductions targets under the Paris Agreement.

3.5.5 National Greenhouse & Energy Reporting Scheme

Australia's commitments under the Paris Agreement are delivered through the primary legislation for emissions management, the NGER Act. The NGER Act provides a single, national framework for the reporting and distribution of information related to GHG emissions, GHG projects, energy production and energy consumption to meet the following objectives:

- inform government policy.
- inform the Australian public.

- help meet Australia's international reporting obligations.
- assist Commonwealth, state and territory government programmes and activities.
- avoid duplication of similar reporting requirements in the states and territories.

Under the NGER Act corporations which meet certain thresholds are required to report on scope 1 and scope 2 GHG emissions, energy production and energy consumption from the operation of facilities under the entity's operational control, enabling the capture of data on energy flows and transformations occurring throughout the economy. Shell reports as a corporate group under the Act; this includes reports related to emissions from activities under its operational control (Section 9.12).

3.5.6 Safeguard Mechanism

The Safeguard Mechanism under the NGER Act ensures Australia's largest emissions intensive industries measure, report and reduce their Scope 1 GHG emissions. It applies a decline rate to facilities' baselines so that they are reduced predictably and gradually over time on a trajectory consistent with achieving Australia's emission reduction targets of 43% below 2005 levels by 2030 and net zero by 2050.

- Facilities with GHG emissions exceeding 100,000 tCO_2-e per year (0.1 $MtCO_2$-e per year) must keep GHG emissions at or below set baselines;
- If a facility exceeds its baseline, it must manage excess GHG emissions, such as by purchasing and surrendering Australian Carbon Credit Units;
- A requirement to offset 100% reservoir CO2 from new reservoirs feeding existing LNG facilities;
- Facilities must meet reporting and record-keeping requirements, including audits;
- Penalties for non-compliance.

Although Shell does not anticipate that Scope 1 emissions from the Crux facility will exceed 100,000 tCO_2-e (0.1 $MtCO_2$-e) per year during normal operations, it is possible this threshold may be exceeded during initial start-up. In that case, the Safeguard Mechanism would be directly applicable to this activity (Section 9.12.11).

The Safeguard Mechanism will also be relevant to GHG emissions at the Prelude FLNG facility (which is a Designated Large Facility under the NGER framework), including emissions generated at that facility while processing Crux gas. Specifically, the Responsible Emitter of the Prelude FLNG facility will be required to surrender prescribed carbon units equal to 100% of reservoir CO_2 separated from Crux feed gas at the facility, being an estimated 9.78 $MtCO_2$-e over the life of the reservoir. The Crux reservoir CO_2 is the responsibility of the facility from which it is emitted, in this case, the Prelude FLNG facility for the Crux reservoir (Section 9.12.11).

4 Shell Environmental Management Framework

4.1 Shell Performance Framework

The Shell Performance Framework (SPF) (Figure 4-1) is the overarching framework adopted by Shell Group to deliver on its strategy. The SPF applies to all Shell Group companies and provides a consistent approach for how each company in the Shell Group operates.

The SPF provides a common language for how Shell Group talks about activities. It encourages a focus on business outcomes, a holistic approach to business challenges and the use of a plan-do-check-adjust loop (Improvement Cycle) to ensure continued learning and improvement. It also helps Shell Group companies think about how each part of the SPF (structure, processes, behaviours, skills, etc.) comes together to achieve the best performance (Figure 4-1) and how the Improvement Cycle aids in implementation of the framework using a plan-do-check-adjust cycle (Figure 4-2). Fundamental to the SPF is the Health, Safety, Security and Environment & Social Performance (HSSE & SP) Policy and Commitment (Section 4.2) and the Safety, Environment & Asset Management (SEAM) Standards (Section 4.3).

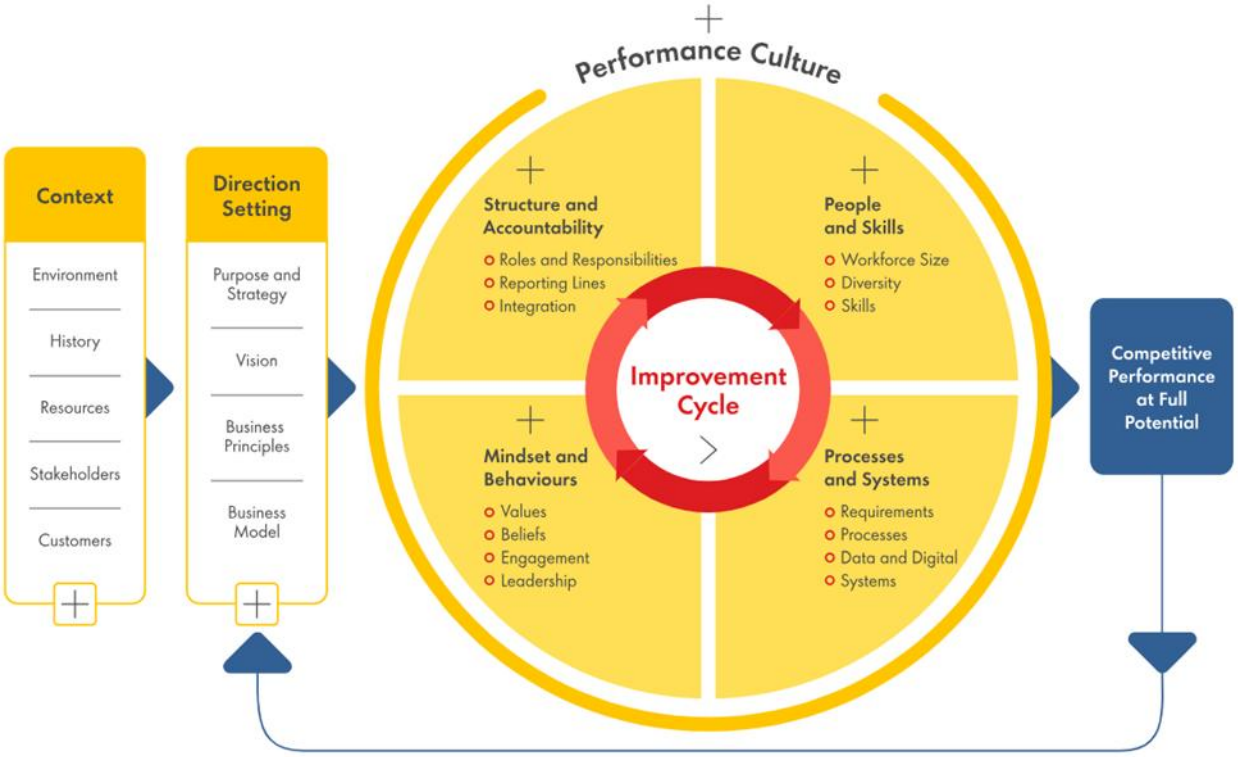


Figure 4-1: Shell Performance Framework

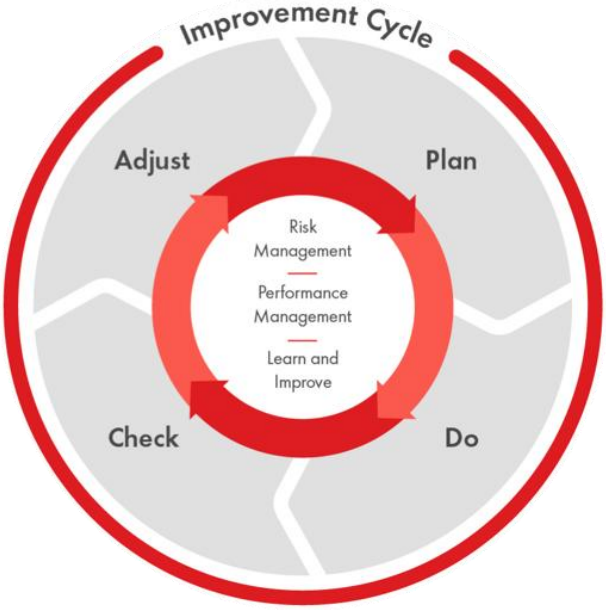
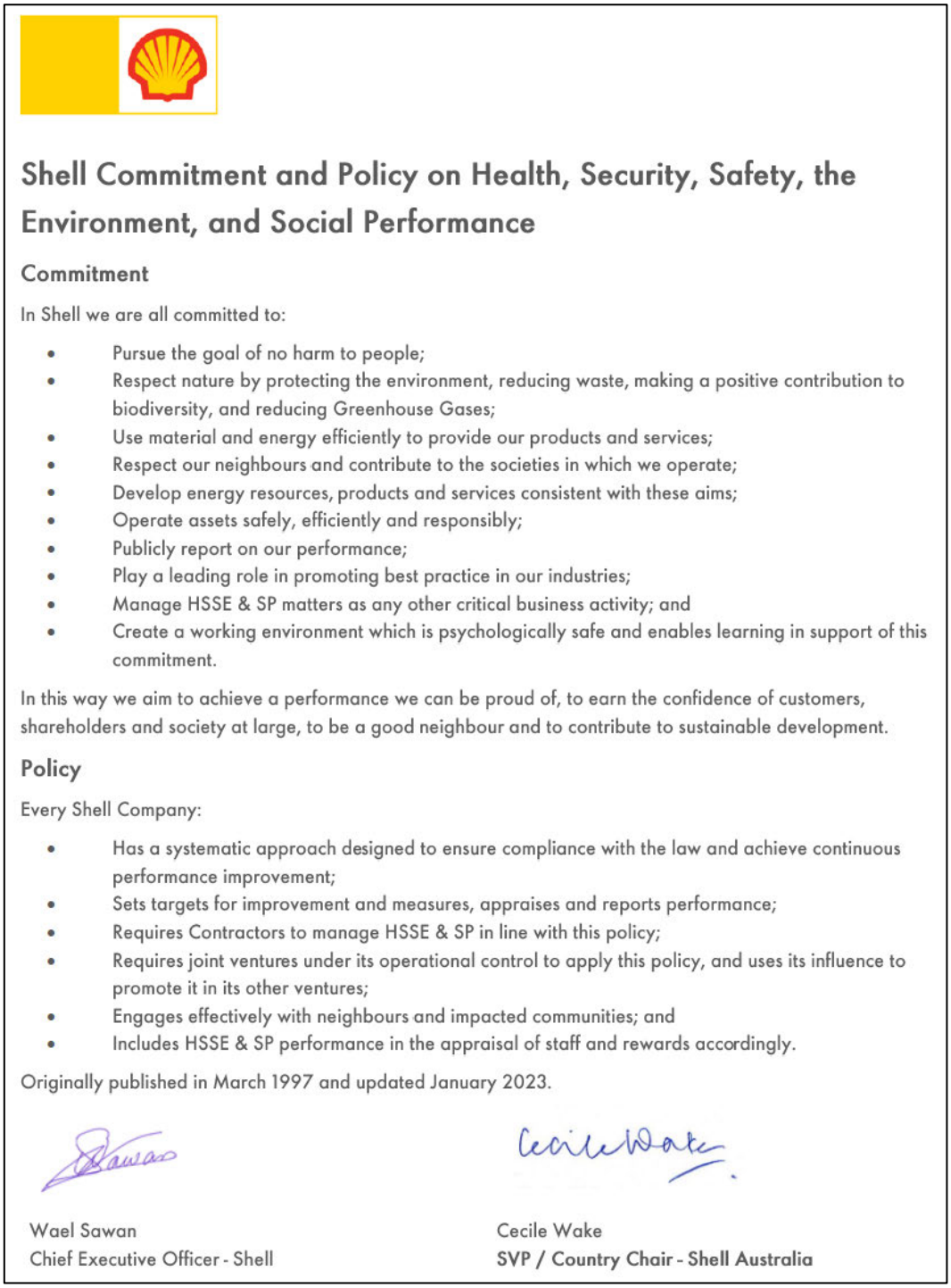


Figure 4-2: Shell Performance Framework Improvement Cycle

4.2 HSSE & SP Policy and Commitment

The Shell Commitment and Policy on HSSE & SP (Figure 4-3) is endorsed and adopted by the Chief Executive Officer of the Shell Group and Country Chair of Australia and displayed in Shell's offices and field asset workplaces. Some key features of the policy are to:

- Manage HSSE & SP requirements to ensure compliance with the law and to achieve continuous performance improvement.
- Set targets for improvement and measurement, appraise and report performance.
- Require contractors to manage HSSE & SP in line with Shell's expectations.
- Effectively engage with neighbours and impacted communities.



Shell Commitment and Policy on Health, Security, Safety, the Environment, and Social Performance

Commitment

In Shell we are all committed to:

- Pursue the goal of no harm to people;
- Respect nature by protecting the environment, reducing waste, making a positive contribution to biodiversity, and reducing Greenhouse Gases;
- Use material and energy efficiently to provide our products and services;
- Respect our neighbours and contribute to the societies in which we operate;
- Develop energy resources, products and services consistent with these aims;
- Operate assets safely, efficiently and responsibly;
- Publicly report on our performance;
- Play a leading role in promoting best practice in our industries;
- Manage HSSE & SP matters as any other critical business activity; and
- Create a working environment which is psychologically safe and enables learning in support of this commitment.

In this way we aim to achieve a performance we can be proud of, to earn the confidence of customers, shareholders and society at large, to be a good neighbour and to contribute to sustainable development.

Policy

Every Shell Company:

- Has a systematic approach designed to ensure compliance with the law and achieve continuous performance improvement;
- Sets targets for improvement and measures, appraises and reports performance;
- Requires Contractors to manage HSSE & SP in line with this policy;
- Requires joint ventures under its operational control to apply this policy, and uses its influence to promote it in its other ventures;
- Engages effectively with neighbours and impacted communities; and
- Includes HSSE & SP performance in the appraisal of staff and rewards accordingly.

Originally published in March 1997 and updated January 2023.

Wael Sawan
Chief Executive Officer - Shell

Cecile Wake
SVP / Country Chair - Shell Australia

Figure 4-3: Shell's HSSE & SP Policy

4.3 Safety, Environment & Asset Management (SEAM) Standards

The Shell Group SEAM Standards are made up of one or more requirements related to a specific risk or activity area with the intent to empower Shell Group Businesses and Assets to effectively address risk and drive performance. Shell Group companies are expected to adopt and apply relevant SEAM Standards which apply to their local context. The SEAM Standards include (see Figure 4-4):

- HSSE, SP and Asset Management Foundations Standard;
- Carbon, Environment, Social Performance, Product Stewardship and Quality Standard;

- Process Safety and Asset Management Standard;
- Transport Safety Standard; and
- Workplace Health, Safety and Security Standard.

SEAM Requirements are mandatory rules that are designed to result in a consistent approach to major, Shell Group-wide risks or opportunities, external stakeholder expectations or external disclosures. They define the 'what' as opposed to the 'how'.

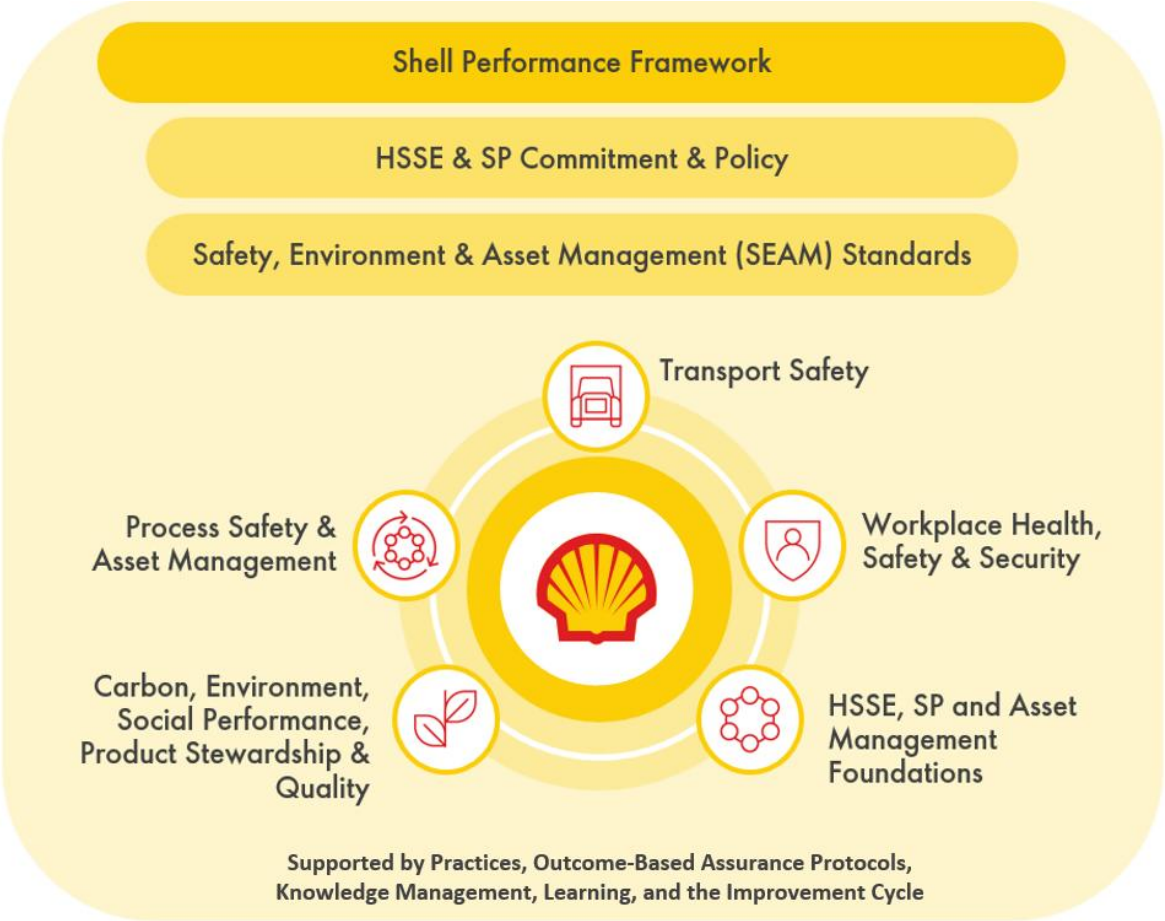


Figure 4-4: Shell Group Safety, Environment, and Asset Management Standards

The five standards include Shell Group requirements intended to manage the common/foundational elements of common risks and controls. It is the responsibility of the Country Chair, Business, or respective Functional Support Heads to operationalise the standards.

4.4 Shell Management System

The Shell Management System (Management System), including the 'HSSE & SP-MS', is a structured and documented system for effectively managing impacts and risks which demonstrates how Shell meets local legal requirements and implements the Requirements of the Shell Group SEAM Standards.

Environmental management for the Crux Project occurs through the implementation of the Management System, applied by combination of Shell Group SEAM Standard Requirements and project and asset systems/procedures as set out in this EP.

5 Relevant Persons Consultation

5.1 Background

Pursuant to Section 25(1) of the OPGGS(E) Regulations, a titleholder must carry out consultation in the course of preparing an EP.

In carrying out its duty to consult with relevant persons the titleholder must:

i. give each relevant person sufficient information to allow the relevant person to make an informed assessment of the possible consequences of the activity on the functions, interests, or activities of the relevant person

ii. allow a relevant person a reasonable period for the consultation; and

iii. tell the relevant person that they may request that particular information provided by the relevant person in the consultation not be published.

Effective consultation enables a titleholder to engage with relevant persons, understand how each relevant person's functions, interests or activities may be affected by the proposed activity and adopt appropriate measures in response to any concerns conveyed by the relevant person.

As a source of backfill to Prelude FLNG, proactive engagement has been ongoing for the Crux Project since the Prelude gas field was discovered in early 2007. A range of relevant persons have been consulted throughout this time, including the Commonwealth and State Governments, commercial fishing associations, industry bodies, non-government organisations and local relevant persons in Broome and the Dampier Peninsula as well as Indigenous Peoples.

As part of the ongoing stakeholder engagement Shell undertakes, specific consultation for the Crux Project commenced in relation to the drilling of the first appraisal wells in 2007. Consultation carried out includes:

- February - August 2018: consulted with stakeholders who may have functions, interests or activities affected by the Crux Project as detailed in section 4 of the Crux OPP.
- 4 February 2019 to 18 March 2019: public invited to comment on the Crux OPP by NOPSEMA.
- August 2020: NOPSEMA accepted and published Crux OPP.
- July 2021: consultation undertaken for the Field Development Plan, Production and Pipeline Licences submitted to NOPTA.
- March 2023: consultation commenced for the Crux Seabed Survey, Development Drilling and Installation and Cold Commissioning Environment Plans (EPs).
- March 2024: consultation commenced for this EP.

Table 5-1 provides a timeline for the consultation completed during the course of preparing this EP. This timeline is provided by way of illustration only and does not capture all of Shell's consultation activities (which are discussed in detail below).

Table 5-1: Crux Project Consultation Timeline (2024)

ID	Activity	Start date	End date	Jan-24					Feb-24				Mar-24				Apr-24					May-24				Jun-24				Jul-24					Aug-24				Sep-24					Oct-24				Nov-24				Dec-24				
				1	8	15	22	29	5	12	19	26	4	11	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25	2	9	16	23	30
1	**Advertising / Public notices**																																																					
1.1	Print advertising campaign - calling out for self-identification of RPs	01-Apr-24	30-Jun-24														■	■	■	■	■	■	■	■	■	■	■	■	■																									
1.2	Radio advertising campaign - calling out for self-identification of RPs	01-Apr-24	30-Jun-24														■	■	■	■	■	■	■	■	■	■	■	■	■																									
1.3	Social media campaign - calling out for self-identification of RPs	01-Apr-24	30-Jun-24														■	■	■	■	■	■	■	■	■	■	■	■	■																									
1.4	Drop-in session promotion via print and digital																																																				
1.41	Derby	01-Apr-24	05-Apr-24														■																																						
1.42	Broome	06-May-24	10-May-24																			■																																	
1.43	Kununurra	04-Nov-24	08-Nov-24																																															■					
1.44	Wyndham	04-Nov-24	08-Nov-24																																															■					
2	**Website**																																																			
2.1	Website optimisations	01-Feb-24	15-Mar-24					■	■	■	■	■	■	■																																									
2.5	Draft Crux Completions, Hot Commissioning, Start-up, & Operations EP published	02-Oct-24	n/a																																																			
3	**Consultation material**																																																			
3.1	Consultation material mail out - sufficient information	25-Mar-24	19-Apr-24													■	■	■	■																																					
3.2	Follow up emails	01-Jun-24	30-Jun-24																							■	■	■	■																									
3.3	Reminder emails	01-Aug-24	30-Aug-24																																■	■	■	■															
3.5	Final call emails sent to all RPs, including link to draft EP	01-Oct-24	31-Oct-24																																												■	■	■	■					
3.4	Follow up phone calls, texts or other channels	01-Apr-24	30-Nov-24														■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■					
4	**Drop-in sessions**																																																				
4.1	Derby	09-Apr-24	09-Apr-24															■																																					
4.2	Broome	16-May-24	16-May-24																				■																															
4.3	Djarindjin	27-Jun-24	27-Jun-24																										■																									
4.4	Kununurra	12-Nov-24	12-Nov-24																																															■					
4.5	Wyndham	13-Nov-24	13-Nov-24																																															■					
5	**Community information sessions**																																																					
5.1	Broome	16-May-24	16-May-24																				■																															
5.2	Djarindjin	26-Mar-24	26-Mar-24													■																																							
6	**Indigenous Consultation**																																																			
6.4	Targeted consultation sessions with NTRB's, RNTBC's, PBC's or Aboriginal Corporations		*Ongoing*	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Consistent with Section 4 of the OPGGS(E) Regulations, Shell ensures that the environmental impacts and risks of the activity are reduced to ALARP and to an acceptable level.

The consultation process enables a titleholder to ascertain, understand, and address all the environmental impacts and risks that might arise from its proposed activity, including information that the titleholder would otherwise not be aware of. The consultation process informs the titleholder's understanding of the environment, including (amongst other things) people and communities, the heritage value of places, and their social and cultural features which may be affected by a titleholder's proposed activities.

Shell recognises the need to consult on both planned and unplanned activities. The Environment that May Be Affected (EMBA), which in this EP is referred to as the 'Planning Area', has been determined based on the unlikely event of a hydrocarbon release from Shell's activities described in this EP. The Planning Area is further described and depicted in Section 6.1. The Planning Area is used as an initial input to develop a broad list of persons and organisations that may have functions, interests or activities in the geographical area that may be affected. Each person's or organisation's functions, interests or activities are then further assessed in the context of the effect that Shell's activities may have on their functions, interests, or activities, to determine whether the person or organisation is a relevant person for the purposes of consultation.

The scope and duration of Shell's operations in Australia, along with a track record of consistent engagement with a diverse group of individuals and organisations, has allowed Shell to compile a comprehensive list of contacts for the consultation process. This list was not intended to be an exhaustive list of those to be consulted, but rather served as a starting point to identify relevant persons for consultation on Shell's proposed activities. The list has been developed through years of experience and consultation. It contains valuable insights on the specific information that different individuals and organisations want to receive during consultation. Additionally, it includes the most appropriate means of communication and up-to-date contact information, which Shell regularly reviews and updates.

For all relevant persons, Shell consults on the basis of informed consultation, participation and co-design:

- Relevant persons are free to raise issues without being under pressure (e.g. unreasonable timeframes due to approval timeline) or duress.
- Relevant persons are made aware of the consultation period and have the opportunity to be consulted.
- Sufficient and appropriate information is provided to enable persons to identify whether they are relevant or have a connection to the EP.
- Shell advises each relevant person that they may request information provided during consultation not be published, reflecting the requirements in section 25(4) of the OPGGS(E) Regulations.

Shell recognises the *Consultation in the course of preparing an environment plan* guidance released by NOPSEMA in May 2024 and the judicial guidance in *Santos NA Barossa Pty Ltd v Tipakalippa* [2022] FCAFC 193 (Tipakalippa Decision), on the purpose of consultation as follows:

- At paragraph 54 of the Tipakalippa Decision: The information that the titleholder is obliged to provide NOPSEMA is also designed to provide a basis for NOPSEMA's considerations of the measures, if any, that a titleholder proposes to take or has taken to lessen or avoid the deleterious effect of its proposed activity on the environment, as expansively defined.
- At paragraph 89 of the Tipakalippa Decision: …its purpose [section 25] is to ensure that the titleholder has ascertained, understood, and addressed all the environmental impacts and risks that might arise from its proposed activity. Consultation facilitates this outcome because it gives the titleholder an opportunity to receive information that it might not otherwise have received from others affected by its proposed activity. Consultation enables the titleholder to better understand how others with an objective stake in the environment in which it proposes to pursue the activity perceive those environmental impacts and risks. As the Regulations expressly contemplate, it enables the titleholder to refine or change the measures it proposes to address those impacts and risks by taking into account the information acquired through the consultations. Objectively, the scheme intends that this is likely to improve the minimisation of environmental impacts and risks from the activity.

Consultation supports this outcome by providing the titleholder an opportunity to receive information from relevant persons that may be affected by its proposed activity. Consultation enables the titleholder to:

- Gain a better understanding of how relevant persons with an objective stake in the Planning Area perceive those environmental impacts and risks.

- Refine or modify the measures it proposes to address those impacts and risks by taking into account the information gained through the consultations. This is likely to minimise any environmental impacts and risks of the activity.

The consultation process also assists the titleholder to meet its obligation under section 280 of the OPGGS Act which requires that it must carry out the petroleum activity in a manner that does not interfere with navigation, fishing, conservation of resources of the sea and seabed, other offshore electricity infrastructure and petroleum activities, and the enjoyment of native title rights and interests (within the meaning of the *Native Title Act 1993* (Cth)) to a greater extent than is necessary for the reasonable exercise of the titleholder's rights and obligations.

Shell recognises that whilst it is required to consult with each relevant person pursuant to the OPGGS(E) Regulations, participating in consultation is not obligatory for relevant persons and the OPGGS(E) Regulations do not impose any obligation to seek or reach an agreement on the subject for consultation. Shell understands there may be individuals within a community (who hold communal interests) who are unable to participate in consultation for various reasons and the absence of their participation does not invalidate the consultation process, provided that reasonable efforts were made to identify the relevant persons and to consult with them.

An overview of Shell's consultation methodology for this EP is set out below, including how section 25(1) of the OPGGS(E) Regulations has been applied to identify relevant persons, the application of the consultation methodology and assessment of relevant persons for this EP, as well as the consultation information provided to relevant persons, feedback provided and Shell's assessment of the merit of objections or claims. This section also includes engagement with persons or organisations that Shell contacted directly on an individual basis.

The consultation methodology set out in this EP demonstrates that consultation has occurred with relevant persons in accordance with section 25 of the OPGGS(E) Regulations. The consultation methodology incorporates Shell's increased understanding of relevant persons through updates to its known relevant persons list, experience with other EPs, and other external feedback. Other adjustments to the consultation methodology were made in response to discussions, and suggestions made by relevant persons during the regulatory process of submitting and assessing this EP.

To ensure that organisations and individuals who may be affected by the proposed activity are aware of Shell's consultation process for the EP and can provide feedback in accordance with the intended outcome of consultation, an adaptive methodology has been implemented. For the purposes of this EP, Shell identified that some PBCs had been difficult to reach and that additional sessions in Wyndham and Kununurra were appropriate to ensure individual relevant persons were provided with an opportunity to respond. This approach includes advertising in local, state, and national newspapers. This section summarises consultation activities with relevant persons, as well as engagement with individuals or organisations that were not relevant persons, but who Shell nonetheless contacted.

5.2 Key Principles for EP Consultation

Key principles for consultation in preparation of an EP in accordance with section 25 are outlined in Table 5-2.

Table 5-2: Key Principles for EP Consultation

Key principle	Key concept
Consultation provides an opportunity for free and open exchange of information to occur between a titleholder and relevant person that may be affected by a proposed activity.	• The process provides a genuine opportunity for relevant persons to be heard and provide feedback. • An inclusive approach is taken by which the titleholder seeks to identify and consult with relevant persons throughout the development of the EP, takes reasonable measures to allow relevant persons an opportunity to self-identify, and identifies potentially relevant persons taking a broad (rather than narrow) approach to functions, interests or activities within the Planning Area. • The process includes mechanisms for titleholders to receive information from relevant persons that they might not have otherwise received. • The process enables a titleholder to gain better understanding about the environment that may be affected and measures that may be

Key principle	Key concept
	necessary to mitigate the potential environmental impacts and risks associated with the petroleum activity. • Consultation does not carry with it any obligation on the titleholder either to seek or reach agreement; nor requires consent on the activity subject to the consultation; however, the titleholder should be receptive to suggestions from a relevant person, where these may improve the overall environmental outcome. • Appropriate engagement techniques are selected, and consultation is tailored to the needs of relevant persons, including location, timing, cultural sensitivities and the most suitable way to conduct engagements.
The consultation process must be capable of practicable and reasonable discharge.	• The obligation to consult is a real-world obligation that must be construed in a practical and pragmatic way that makes a process both reasonable and workable. • Where communal interests are held, the process of consultation needs to reasonably reflect the characteristics of the communal interests affected and does not necessarily require communications with each and every person who is a member of the relevant community. • The obligation to identify relevant persons for the purpose of consultation must be reasonably capable of being discharged (i.e. relevant persons need to be ascertainable) within a reasonable time.
Consultation involves provision of sufficient information on a proposed activity to relevant persons and allows for a reasonable period of time for a relevant person to consider the information.	• Information provided to a relevant person should be sufficient to allow them to make an informed assessment of the possible consequences of the proposed activity on their functions, interests or activities. • The nature, scale, and complexity of a proposed activity, as well as the extent of potential impacts and risks on a relevant person's functions, interests, or activities, is considered when determining a reasonable period for consultation.
Relevant person participation in the consultation process is voluntary.	• The voluntary participation of relevant persons in the consultation process is respected. The titleholder collaborates with them to determine their preferred method of consultation where possible. • Relevant persons are not obligated to respond to a titleholder's request to participate in the consultation process. • A titleholder is not required to wait indefinitely for a response where sufficient information and reasonable period of time has been afforded to the relevant person.

5.3 Regulations & Guidance

This methodology has been developed in accordance with the relevant regulations and guidelines, including:

- Tipakalippa Decision
- NOPSEMA Guideline GL2086 – Consultation in the course of preparing an environment plan – May 2024
- NOPSEMA Guidance Note GN1847 – Responding to public comment on environment plans – July 2022
- NOPSEMA Guidance Note GN1344 – Environment plan content requirements – January 2024
- NOPSEMA Guideline GL1721 – Environment Plan Decision Making Guideline – January 2024
- NOPSEMA Guidance Note GN1488 – Oil pollution risk management – July 2021
- NOPSEMA & DNP Guidance Note GN1785 – Petroleum activities and Australian Marine Parks – January 2024
- NOPSEMA Guideline GL1887 – Consultation with Commonwealth agencies with responsibilities in the marine area – November 2024
- NOPSEMA Brochure – Consultation on offshore petroleum environmental plans – May 2023

- NOPSEMA Policy PL2098 – Engaging gender-restricted information Policy – December 2023
- NOPSEMA Policy PL1347 – Environment Plan Assessment Policy – January 2024
- Department of Climate Change, Energy, the Environment and Water (DCCEEW): Sea Countries of the North-West; Literature review on Indigenous connection to and uses of the North-West Marine Region – July 2007
- DCCEEW – Assessing and Managing Impacts to Underwater Cultural Heritage in Australian Waters: Guidelines on the application of the Underwater Cultural Heritage Act 2018 – June 2024
- DCCEEW – The Interim Engaging with First Nations People and Communities on Assessments and Approvals under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (interim guidance) – February 2023
- International Finance Corporation Performance Standard 7 – 2012
- Australian Fisheries Management Authority: Petroleum industry consultation with the commercial fishing industry – 2024
- DAFF – Guidance framework for supporting cooperative coexistence of seismic surveys and commercial fisheries in Australia's Commonwealth marine area – 2022
- DAFF – Offshore Installations Biosecurity Guide – June 2023
- Commonwealth Department of Industry, Science and Resources – Streamlining Offshore Petroleum Environmental Approvals: Program Report – February 2014
- WA Department of Primary Industries and Regional Development: Guidance statement for oil and gas industry consultation with the Department of Fisheries – 2013
- WA Department of Transport: Offshore Petroleum Industry Guidance Note, Marine Oil Pollution: Response and Consultation Arrangements – July 2020
- WA Department of Mines, Industry Regulation and Safety – Consultation Guidance Note (for the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009) – April 2012
- Northern Territory Environment Protection Authority – Stakeholder Engagement and Consultation: Environmental Impact Assessment – Guidance for Proponents – January 2021
- Western Australian Fishing Industry Council – Consultation approach for unplanned events
- IAP2 Public Participation Spectrum

Shell has consulted with relevant persons identified in accordance with the NOPSEMA decision-making guideline (N-04750-GL1721 January 2024) under the OPGGS(E) Regulations for this EP.

The term ‘relevant person’ is defined in section 25(1) of the OPGGS(E) Regulations. The methodology outlined in this EP sets out the processes that have been applied to identify and determine who are relevant persons for the purposes of section 25(1)(a) to (e) of the OPGGS(E) Regulations.

These requirements are summarised in Table 5-3.

Table 5-3: Division 3 – Section 25 of the OPGGS(E) Regulations

Legislation	Summary	Requirement
Part 4, Division 3—Consultation in preparing an environment plan. 25. Consultation with relevant authorities, persons and organisations, etc.	Relevant persons	(1) In the course of preparing an environment plan (including a revised environment plan referred to in Division 5) a titleholder must consult each of the following (*a relevant person*): (a) each Commonwealth, State or Northern Territory agency or authority to which the activities to be carried out under the environment plan may be relevant; (b) if the plan relates to activities in the offshore area of a State—the Department of the responsible State Minister; (c) if the plan relates to activities in the Principal Northern Territory offshore area—the Department of the responsible Northern Territory Minister; (d) a person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the environment plan; (e) any other person or organisation that the titleholder considers relevant.
	Sufficient Information	(2) For the purpose of the consultation, the titleholder must give each relevant person sufficient information to allow the relevant person to make an informed assessment of the possible consequences of the activity on the functions, interests, or activities of the relevant person.
	Reasonable period	(3) The titleholder must allow a relevant person a reasonable period for the consultation.
	Sensitive information	(4) The titleholder must tell each relevant person the titleholder consults that: (a) the relevant person may request that particular information the relevant person provides in the consultation not be published; and (b) information subject to such a request is not to be published under this Part.

Source: OPGGS(E) Regulations

5.4 Tipakalippa Decision

In its decision handed down on 2 December 2022, the Full Court of the Federal Court of Australia considered the meaning of 'relevant person' within section 25(1)(d) of the OPGGS(E) Regulations.

The proceedings (brought by Mr Tipakalippa) challenged NOPSEMA's decision to accept Santos' Drilling and Completions EP, submitted as part of the Barossa Project. Mr Tipakalippa alleged that Santos did not consult with him or his clan and, as a result, NOPSEMA's approval was invalid.

The OPGGS(E) Regulations do not define what is meant by 'functions, interests or activities', and the construction of the words in this phrase was clarified by the Full Court. The meaning of these words is discussed in further detail in Table 5-4 below.

The Full Court also made observations on other aspects of consultation which are set out below[5].

- Superficial or tokenistic consultation will not be enough.

[5] Since the Tipakalippa Decision was handed down, section 25 of the OPGGS(E) Regulations has been the subject of two further Federal Court decisions (Cooper v NOPSEMA [2023] FCA 1112; Cooper v NOPSEMA [2023] FCA 1158). The Federal Court's observations on the requirements of consultation in the Cooper proceedings are consistent with the Tipakalippa Decision and emphasise the importance of consultation in ensuring that titleholders provide NOPSEMA with relevant information about the environmental impacts and risks of a proposed activity.

- Where interests are held communally, or across a group, the titleholder has a degree of 'decisional choice' in identifying which persons are to be approached within the group, the manner of communication and the method of consultation.

The decision also clarifies that EPs must demonstrate that consultation has occurred as required by section 25 of the OPGGS(E) Regulations. In practice, this means that:

- Once titleholders have proactively identified and engaged in consultation with relevant persons, the titleholder must demonstrate to NOPSEMA that the requisite consultation has occurred, i.e. by ensuring that the EP sets out its understanding of who a relevant person is (with reference to the Full Court's reasons).
- If the titleholder has proceeded on an incorrect interpretation of the OPGGS(E) Regulations, it may not be possible for NOPSEMA to be satisfied that the titleholder has carried out the consultations required by the OPGGS(E) Regulations.

5.4.1 NOPSEMA Consultation Guideline

The NOPSEMA Consultation Guideline, as published on their website, clarifies the legal requirements for consultation by titleholders while preparing their EPs prior to submission to NOPSEMA.

In particular, the NOPSEMA Consultation Guideline provides guidance on the following aspects:

- the interpretation of 'relevant person' and each term in the phrase 'functions, interests or activities' as contained in section 25(1)(d) of the OPGGS(E) Regulations; and
- matters that should be considered in designing and implementing consultation processes.

5.4.2 Key Terms and Definitions

The meaning of key terms and definitions are summarised in Table 5-4 by reference to the NOPSEMA Consultation Guideline (which is informed by the Full Court's observations in the Tipakalippa Decision).

Table 5-4: List of Key Definitions

Term	Definition
Activities	In relation to section 25(1)(d) of the OPGGS(E) Regulations, activities are considered to be what other persons or organisations are already doing.
Activity Area	The Activity Area is defined as the production licence AC/L10 and pipeline licences WA-33-PL and AC/PL1 (coordinates and water depths are listed in Table 6-2 and shown in Figure 6-1 and Figure 6-5. AC/PL1 (starts at downstream flange of the Riser Emergency Shutdown Valve (RESDV) on Crux platform). WA-33-PL (ends at upstream flange of the RESDV on Prelude FLNG).
Claims	Assertion or information about the potential adverse impacts from the petroleum activities to which the EP relates.
Environment	The OPGGS(E) Regulations define this as: a) ecosystems and their constituent parts, including people and communities; and b) natural and physical resources; and c) the qualities and characteristics of locations, places and areas; and d) the heritage value of places; and includes e) the social, economic and cultural features of the matters mentioned in paragraphs (a), (b), (c) and (d).
Functions	In relation to section 25(1)(d), functions refer to a power or duty to do something.
Interests	In relation to section 25(1)(d), 'interest' includes an interest possessed by an individual, whether or not the interest amounts to a legal right or is a proprietary or financial interest or relates to reputation. However, an interest does not extend to general public interest in an activity, it must be an interest over and above a member of the public at large[6].

[6] Tipakalippa Decision, paragraph [154].

Term	Definition
Nature and scale of effect on relevant persons functions, interests or activities	This is a broad screening assessment done for some selected relevant persons where a clearer distinction is warranted between the nature of a relevant persons functions, interests or activities that may be affected. This is split into two categories: • High (nature and scale): Planned impacts which may be significant will occur to a known interest such as a cultural value or feature. Impacts are likely to be long term. • Low (nature and scale): Impacts are either from highly unlikely events, such as a major spill or planned impacts are not likely to be significant, nor long term and does not involve the direct desecration of a cultural feature.
Objection	A reason or argument about the potential adverse impacts arising from the petroleum activities to which the EP relates.
Planning Area	This is the environment that may be affected by the activity. The spatial extent of the Planning Area is determined from stochastic spill modelling or National Energy Resources Australia (NERA) reference cases using the low hydrocarbon exposure thresholds (no ecological impact) as recommended by NOPSEMA. Note, the Planning Area does not define the area of affect to a relevant person's functions, interest or activities, but instead it is used as an initial input to develop a broad list of possible relevant persons that may be affected in a geographical area for the activity. Each potentially relevant person is then further assessed in direct context of the effect the activity may have on their own specific functions, interests and activities.
Reasonable period	A reasonable time for relevant persons to identify the effect of a proposed activity on their functions, interests or activities and provide a response detailing their objections or claims. Shell generally considers a reasonable period for a relevant person to review and provide an initial response as being 30 calendar days, subject to the nature and scale of the proposed activity. However, Shell has provided Indigenous relevant persons with a minimum consultation period of three months. Where dialogue with relevant persons is ongoing after this period, Shell will continue to consult until Shell believes it has provided these persons with sufficient information and a reasonable period to respond which merits consultation to close.
Reasonable efforts	During the consultation period, Shell will make all reasonable efforts to make contact with all identified relevant persons for the EP (where a reasonable and workable avenue exists). Shell recognises that specific consultation channels to pass on information may be more appropriate for certain groups of relevant persons.
Relevant matter	The matter raised does not fit the criteria descriptions for objections or claims with/without merit. However, the matter raised is relevant to the activity, comprises a request to Shell for further relevant information, or provides information to Shell that is relevant to the activity or the EP.
Not a relevant matter to this EP	Input does not relate to the activity or the relevant person's functions, interests or activities affected by the activity. Matters that are not relevant may also be generic in nature with no specific issues raised (e.g. salutations, acknowledgements, meeting arrangements, etc.).
Relevant person	Can be a person, organisation, department agency, authority or State Minister that falls within one of the categories defined by section 25(1) of the OPGGS(E) Regulations, whose functions, interests or activities may be affected by the activities to be carried out under the environment plan.

5.5 Overview of Relevant Person Methodology Workflow

Figure 5-1 presents Shell's workflow for the identification of and consultation with relevant persons. Identifying, categorising and engaging with relevant persons is shown in Steps 1–17. Assessment of objections or claims and relevant matters are dealt with in Steps 18–25. Section 5.11 details the merit of objections or claims assessment.

5.6 Identifying Relevant Persons

The NOPSEMA Consultation Guideline provides the following key guidance as to the process for the identification of relevant persons:

- The process must provide for sufficiently broad capture of ascertainable persons and organisations whose functions, interests or activities may be affected by the activity.
- The process should include reference to multiple sources of information, such as publicly available materials, review of databases and registers, published guidance, previous history, as well as advice from authorities and other relevant persons.
- Titleholders must clearly identify in their EPs who is a relevant person and the rationale the titleholder has used to determine who they consider falls within that definition.

Relevant person identification is an inherently iterative process as Shell may become aware of relevant persons during the process of consultation or after the development and submission of an EP. Nonetheless, Shell has done extensive work to ensure it identified relevant persons in the course of preparation of this EP, for the purpose of complying with section 25 of the OPGGS(E) Regulations, outlined further in this EP.

5.6.1 Identification of Relevant Persons

At the commencement of preparation for this EP, a comprehensive assessment took place to review:

- Project activities related to this EP.
- Potential spatial extent of the Planning Area and the different zones and thresholds within those areas.
- Environmental, cultural, economic, and social attributes of the Planning Area.

This informed Shell's understanding of:

- The potential cultural and social values and sensitivities of the Planning Area.
- The potential functions, interests, or activities that may be affected by Shell's proposed activities.

Two key steps were then used to commence identification of relevant persons:

- A comprehensive research methodology to identify and assign relevant persons to a thematic group (see Section 5.7).
- Advertisements in local, regional and national print, social media and radio to allow for a broad capture of relevant persons.

Table 5-5 outlines the relevant persons identification considerations and this was supported by:

- encouragement of identified relevant persons during engagement activities, such as forums and community sessions as outlined in this EP, to share and communicate with those who they may think were relevant.
- self-identified relevant persons.
- information shared with Shell through other third parties (such as industry).

Shell was then able to identify a person or organisation's functions, interests, or activities based on the overlap with the Planning Area. This approach is outlined further in the relevant person workflow in Figure 5-1.

Table 5-5: Identification Considerations

Considerations	Justification
Planning Area	Shell used oil spill modelling to assist in the process of identifying potentially relevant persons for this EP. Shell adopted a conservative approach to this modelling, which is explained further below. If less conservative and, arguably, more appropriate oil spill modelling was used, the Planning Area would be significantly reduced and therefore fewer potentially relevant persons would have been identified.
New information	During the consultation process, new information may become available to inform the extent of effect of Shell's activity on a person's functions, interests or activities, which

Considerations	Justification
	may result in an identified relevant person being removed from the relevant persons list. For example, new information may become available which further informs/clarifies a person's actual functions, interests or activities and how they could be affected which are not to the extent as previously perceived by Shell during the initial identification process.
Lack of environmental or ecological impact	There may be persons who have functions, interests or activities within the Planning Area at the initial time of submission, but those functions, interests or activities may not be affected by Shell's activities. Where no environmental or ecological impacts are predicted within a geographical area, there can be no corresponding impacts on a person's functions, interests or activities. There may also be instances where potential environmental or ecological impacts are predicted to occur within an area; however, despite a geographical overlap this will not necessarily equate to an impact on a person's functions, interests or activities.
Contact details not ascertainable	Shell may identify a group of relevant persons that are potentially affected; however, is unable to confirm individual contact details as these are not ascertainable through normal mechanisms (e.g. associated government agencies, organisations or groups who hold these details or who can advise who these individuals are). As such, consulting with such relevant persons is not capable of being discharged within a reasonable time due to the 'opacity as to the identity of those with whom consultations are to take place' (refer Tipakalippa Decision Paragraph 136, Section 5.4). The opportunity exists for such persons to contact Shell, via Shell's publicly accessible website or through the advertising campaign.

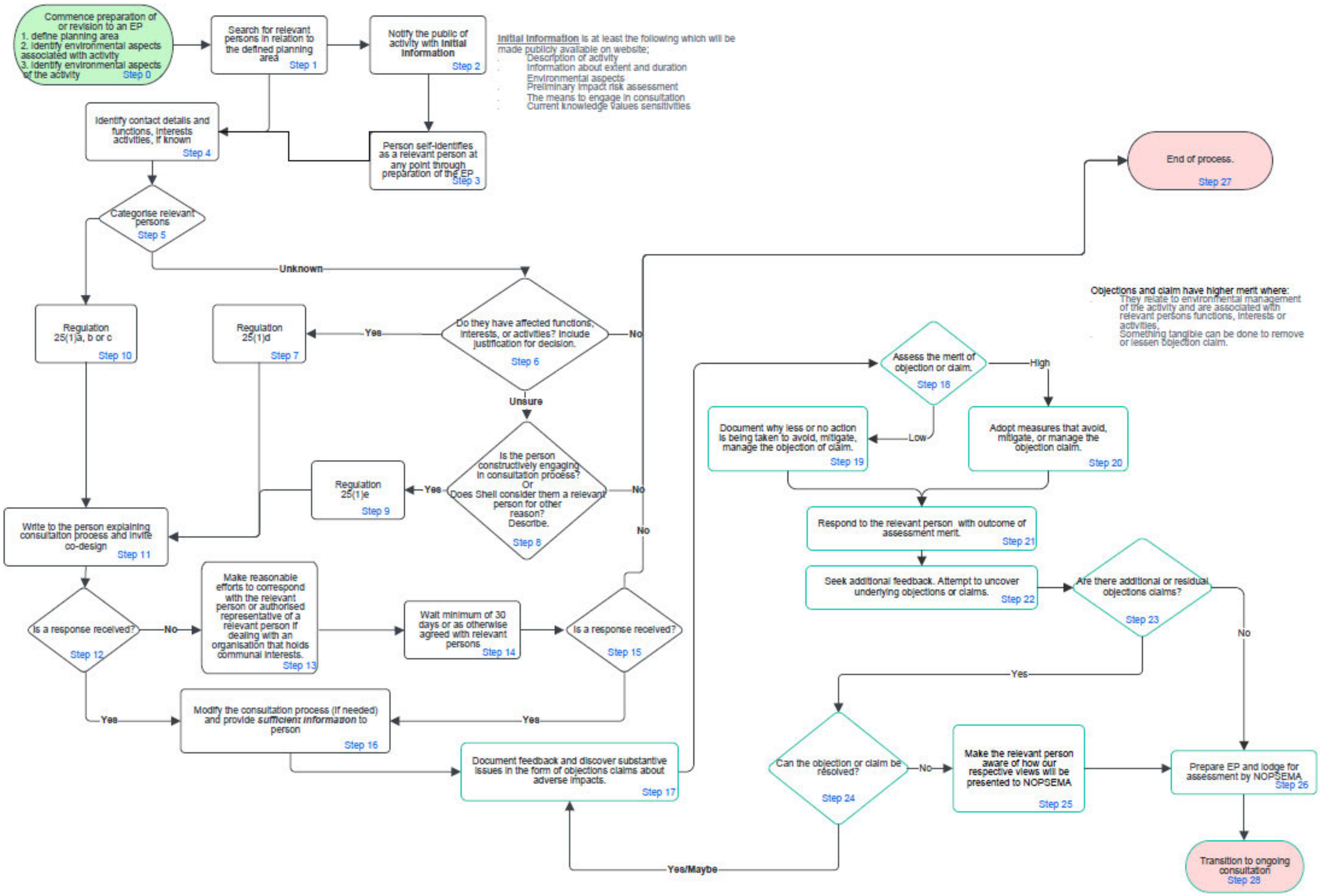


Figure 5-1: Relevant Persons Workflow

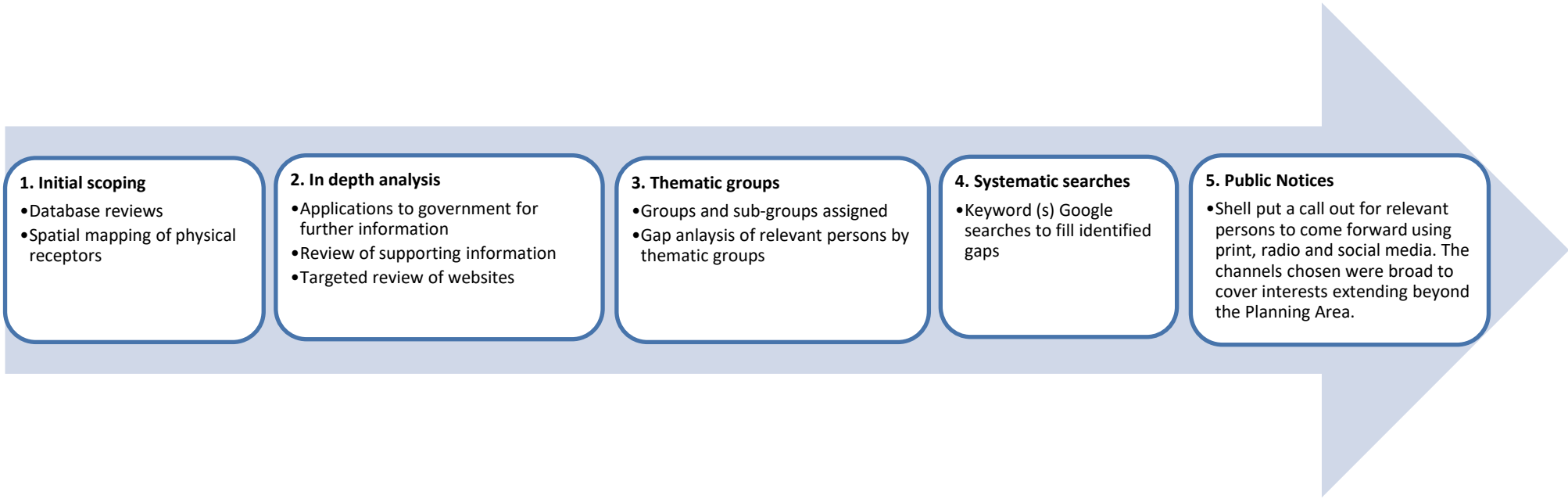


Figure 5-2: Methodology for the Identification of Relevant Persons

5.7 Description of Research Methodology

Table 5-6 presents the research methodology used for relevant persons. A comprehensive review was conducted in January – March 2023 using a range of research activities to inform the identification of relevant persons. Identification of relevant persons was reviewed prior to consultation for this EP. The details of, and methodology adopted during, each research activity is presented Table 5-6.

Table 5-6: Research Methodology

Research Activity	Detail
1. Existing Shell Australia database reviews	Shell holds an extensive database of organisations and persons identified for projects and existing operations, including from the Crux OPP and Prelude FLNG facility, located ~160 km from Crux. Existing relevant person datasets and associated recent relevant persons correspondence were reviewed in January 2023. These were merged into a register of potentially relevant persons.
2. Review of public databases and spatial mapping of datasets	A comprehensive review of publicly available databases to identify physical receptors, environmental, social and cultural values and sensitivities overlapping with the Planning Area and a further 50 km buffer was conducted. Searches of databases were also undertaken for cultural heritage (Indigenous and non-Indigenous). The 50 km buffer was introduced to go beyond the identified Planning Area in case a relevant person or social and cultural values could be identified at the edge of the Planning Area. Searches included the following: • National Native Title Tribunal (NNTT) register of Native Title Registrations, Claims, Determinations (including Prescribed Body Corporates (PBCs) and Registered Native Title Bodies Corporate (RNTBC) for the determinations), Future Acts and Indigenous Land Use Agreements. • Spatial data from the NNTT database to identify Land Councils and NT Aboriginal Trusts, and any additional Native Title material was extracted for the Planning Area. • Protected Areas including legislated lands and waters of WA and NT (e.g. Commonwealth and National Parks and Reserves), WA Lands of Interest, RAMSAR Wetlands, Australian Marine Parks, Indigenous Protected Areas (IPAs). • Heritage Areas including world and national heritage listed places, WA Heritage Council State Register, WA Heritage List, WA Heritage Council Local Heritage Survey, NT Heritage Register. • WA Aboriginal Cultural Heritage database and WA Aboriginal Cultural Heritage Survey database. (Where available information on knowledge holders was also extracted.) • Application made to the Aboriginal Areas Protection Authority (AAPA) requesting Abstract of Record for the Planning Area within Territorial waters. • Petroleum exploration and operations licence holders. • Key Ecological Features (KEFs) and Biologically Important Areas (BIAs). • Underwater Cultural Heritage (UCH) including the Australasian UCH Database. • Local Government Authorities and Town Councils. • Population centres including Indigenous communities (Indigenous, remote, town based, seasonal and permanent).

Research Activity	Detail
	• Military land. • Commonwealth fisheries, state and territory fishers, aquaculture licence holders and pearl lease holders. • Spatial mapping of datasets enabled an understanding of overlaps with the Planning Area.
3. Review of background reports and supporting information for database searches	Using the outcomes of the initial database searches (refer to research activity 2), relevant supporting information was accessed and reviewed to inform the identification of potentially relevant persons and organisations, their functions, interests, or activities. Key supporting information reviewed included: • Native Title application documents and any associated court documents, Indigenous Land Use Agreements (ILUAs) and Future Acts. This review identified potentially relevant RNTBCs, PBCs and RATSIBs organisations as well as individual Indigenous People and family groups. Saturation was reached once all identified Native Title claims, determinations etc. within the Planning Area (including the additional 50 km buffer) were exhausted. • WA Aboriginal cultural heritage survey reports overlapping with the Planning Area. Research organisations, Indigenous organisations and Indigenous Knowledge Holders were identified as potentially relevant persons. This review informed an understanding of overlapping cultural and social values in the Planning Area. • Management plans associated with identified protected areas, KEFs and BIAs, such as Australian Marine Parks. This process identified relevant persons (people and organisations) including Indigenous Groups with research interests in the marine environment. • Management plans and future application plans for all identified IPAs. • Healthy Country Plans for all Land Councils identified through database searches. • WA State of the Fisheries Report (2022/23) (Newman et al. 2023) with a focus on the WA fisheries overlapping with the Planning Area and Bio Regions. • Commonwealth Fisheries reports.
4. Review of research journals	An online search for journal articles related to Saltwater People, Totems and Indigenous use of Sea-Country was conducted to inform an understanding of cultural values potentially overlapping with the Planning Area. This process also identified potentially relevant persons (persons and organisations) (e.g. Indigenous groups who identify as Saltwater People).
5. Targeted review of websites and other sources associated with Indigenous Organisations	In addition to searches and assessments listed in research activity 2–4, representation searches were also considered: • By whom and what organisation as well as legal standing of the organisation • Parties to ILUAs that have since had a native title determination made over the Planning Area • If an Aboriginal Corporation was an appointed Local Aboriginal Cultural Heritage Services • A targeted review of all Land Council, RNTBC and PBC websites and social media platforms was undertaken to identify potentially relevant

Research Activity	Detail
	persons (persons and organisations) and their interests, functions or activities overlapping the Planning Area • Importantly this process enabled the outcomes of the KEFs and BIA database searches (refer to research activity 2) to be considered within the context of Indigenous cultural values (i.e. totems, cultural activities and Indigenous land and resource use activities). This process informed the identification of some geographically remote organisations as potentially relevant persons.
6. Targeted review of websites for peak bodies	A targeted review of the websites and social media platforms associated with a range of peak bodies, representing interests identified through database searches (e.g. recreational fishing, commercial fishing, Commonwealth fisheries) was undertaken to confirm functions, interests, or activities, and to identify additional and related potentially relevant persons (persons and organisations) and their interests, functions or activities overlapping the Planning Area. This review included recreational and commercial fisheries including aquaculture activities.
7. Targeted review of websites for Local Government Authorities	A targeted review of the websites and social media platforms associated with Local Government Authorities (LGAs) identified through the database searches and spatial mapping was undertaken to identify additional potentially relevant persons and to scope functions, interests, or activities of each relevant local government authority. This process, representing interests identified through database searches (such as recreational fishing, commercial fishing, Commonwealth fisheries), was conducted to confirm functions, interests, or activities, and to identify additional and related potentially relevant persons (persons and organisations) and their functions, interests or activities overlapping with the Planning Area.
8. Review of local community directories	Where available on the internet, a search of local community services directories for each Local Government Area with an area intersecting the Planning Area for potentially relevant persons (people and organisations) and associated functions, interests or activities was conducted. This process identified a number of interest groups, service providers, sport and recreation organisations as well as accommodation providers.
9. Targeted keyword search for Indigenous and non-Indigenous commercial operations	An online search for potentially relevant persons (persons and organisations) using key words and place-based search terms (e.g. fish + Darwin) was conducted. Table 5-7 lists the key search terms used.
10. Broad based keyword search	Online searches for potentially relevant persons (persons and organisations) were deployed systematically, with search terms such as 'Darwin + tourism'. Table 5-7 lists the key search terms used. Search results were interrogated until limitations became evident.
11. Public advertising campaign and engagement with identified relevant persons	Shell also sought to identify potentially relevant persons by placing advertisements in local, regional, and national print, social media and broadcast media. During engagement activities, such as the forums and community sessions outlined in this EP, Shell also encouraged relevant persons to share and communicate with those whom they considered may be relevant and those who self-identified.
12. Crux OPP persons or organisation who made public comment	The Crux OPP was published for public comment during the assessment process. There were no limitations on where public comments could come from.

Table 5-7: Key Internet Search Terms

Search Terms
beach accommodation + Broome /Kimberley /Dampier Peninsula
beachfront accommodation + Broome /Kimberley /Dampier Peninsula
bird watching + Broome /Kimberley /Eighty Mile Beach /Dampier Peninsula
Broome + helicopter
Broome academic + research organisation
caravan parks + Kimberley + Western Australia
coastal accommodation + Kimberley Western Australia
commercial fishing + Western Australia
conservation + Broome /Kimberley /Dampier Peninsula
cultural experiences + Broome
fishing tours + Broome
Indigenous Protected Areas + Australia
Land Council + Western Australia
[name of Local Government] + community directory
Native Title + Western Australia
ocean views hotel + Broome /Kimberley /Dampier Peninsula
Sea Country + Totems
Sea Country + Western Australia
surf + Broome /Kimberley /Dampier Peninsula
surf lifesavers + Broome /Kimberley /Dampier Peninsula
things to do + Broome /Kimberley /Dampier Peninsula
tourism + Beachfront accommodation + Broome /Kimberley /Dampier Peninsula
tours + Broome
volunteer and emergency services + Broome
water sports + Kimberley + Western Australia
watersports or water sports +Broome /Kimberley /Dampier Peninsula

During the initial scoping task, each identified potentially relevant person was assigned to a thematic group. Two thematic groupings of relevant persons were identified as having particularly defined functions, interests, and activities within the Planning Area: Indigenous People and commercial fishing operators.

Further and targeted effort was taken to identify relevant persons within each of these thematic groups. A further four thematic groups, being international persons, Indonesian traditional fishers, commercial operators and interest groups, were also identified as having potentially relevant persons (particularly organisations) with defined interests and activities within the Planning Area. Further efforts were applied to identify relevant persons in these thematic groups.

Sections 5.7.1 to 5.7.6 describe the methodology for the identification of relevant persons in the thematic groups and the relevance of these groups for this EP.

5.7.1 Indigenous People

Shell has a history of engaging with Indigenous People at various levels, including local communities, Indigenous groups (Native Title determined or otherwise), and governing bodies. Shell has a deep appreciation and respect for the Traditional Owners and Custodians of the land and seas where it operates. This extends to the Crux Project. For the purposes of reporting on consultation, people and organisations with attributes described above are captured in this thematic group (Indigenous People).

Offshore projects intersect heavily with Sea Country – a part of the landscape that is equally important to Indigenous People as Land Country. Many elements within Sea Country are deeply rooted in Indigenous cultures, including their history and creation stories. Marine life, cultural sites, and places of significance are directly connected to the wellbeing and everyday life of Indigenous Peoples. Furthermore, the health and wellbeing of Sea Country is one and the same as the health and wellbeing of the Indigenous People themselves. The approach to the identification of Indigenous People as relevant persons is guided by Indigenous relationship to Sea Country.

Additional methods (apart from those described in Figure 5-2) of identifying Indigenous People that may be relevant persons included the following activities:

- Identification and review of the total values and sensitivities of the physical environment that may be affected by the planned activities for each EP, including the spatial extent of the activities.
- Desktop research to identify any published Sea Country research (including anthropological reports where available) that could identify marine and avian species that may represent spiritual totems, relevant to the activities in the EP.
- Review of available Indigenous cultural heritage survey reports (including ethnographic reports) and supporting information for selected Indigenous cultural heritage sites identified within the Planning Area.
- Further research based around subgroupings as described below.
- Direct requests to relevant land councils or representative bodies to further identify any relevant persons.
- Any person identified by another relevant person or representative body where they consider it appropriate for cultural or other reasons (i.e. ownership of a particular site).

Shell acknowledges that existing data or information relating to Sea Country values and sensitivities in both public and from other sources is currently limited and does not exist to the same degree as research on Land Country.

5.7.1.1 Native Title Holders

Native Title recognises the traditional rights and interests to land and waters of Indigenous People. Native Title Holders are recognised by Australian legal systems as holding rights and interests (which may be exclusive or non-exclusive) in relation to land and sea within determination boundaries. For the purposes of the relevant persons identification process, all Native Title applications, determined or otherwise, were regarded as relevant. The identification process was extended beyond the western construct of mappable boundaries and approached the concept of relevance of Indigenous groups and individuals with a degree of flexibility. Where one group's Native Title boundaries may not intersect with the Planning Area, they may still hold values and interests within the Planning Area. To this end, initial searches conducted included all Native Title applications and determinations within a further 50 km buffer added to the Planning Area.

Using spatial data from the NNTT database, all relevant Native Title information (i.e. applications, registrations, determinations and ILUAs) were extracted for the Planning Area. All applications, supporting information (where available) and court outcomes (where available) were interrogated. Saturation was reached once all identified Native Title applicants and holders within the Planning Area (including the additional 50 km buffer) were exhausted.

The names of Native Title applicants and holders were identified on the extracted Native Title information. Identified relevant persons included individuals and organisations (drawing on the NOPSEMA Consultation Guidelines that relevant persons can be individuals, organisations, or groups).

5.7.1.2 Native Title and Indigenous Representative Bodies

Using the same process as described in Section 5.7.1.1, together with the strong working knowledge of Native Title and Indigenous governance structures held by Shell personnel, Native Title Representative Bodies (NTRBs), Prescribed Bodies Corporate (PBCs), Registered Native Title Bodies Corporate (RNTBCs) and Native Title Service Providers (NTSPs) were identified. NTRBs and NTSPs are funded by the National Indigenous Australians Agency to assist native title claimants and holders. NTRBs and NTSPs can also be referred to as Representative Aboriginal/Torres Strait Islander Bodies (RATSIBs).

NTRBs and NTSPs were generally identified directly from the NNTT catalogue entries and included the Northern Land Council (NTRB) within the Northern Territory RATSIB Area, Kimberley Land Council (NTRB) within the Kimberley RATSIB Area. These NTRBs have a function in relation to the administration of Native Title and may represent Native Title applicants and holders' interests in relation to existing Native Title claims and determinations that extend into Sea Country. They may also be the contact point for specific RNTBCs, PBCs or native title applicants for the purposes of consultation. Where this is the case, it is identified for the particular person or organisation in Appendix B.

5.7.1.3 Land Councils

Aboriginal Land Councils (Land Councils) assist Indigenous Peoples to negotiate with governments and private companies over projects on Aboriginal land. Land Councils also support Indigenous Peoples to manage their land and sea, including issuing permits to enter, fish, film and perform other activities on Aboriginal land. Shell carried out database searches of Land Council boundaries in WA and NT, and Land Councils with areas intersecting the Planning Area were identified as potentially relevant persons. Saturation was achieved through spatial mapping and the identification of Land Council areas with borders or overlap with the Planning Area.

Systematic searching of the websites of potentially relevant Land Councils enabled further interrogation of potential functions, interests, or activities. Land and Sea Ranger Groups and programs associated with Land Councils were identified through these searches. Healthy Country Plans were also identified and reviewed and provided vital information to understand values and sensitivities (e.g. Sea Country use and/or totems that potentially overlapped with the Planning Area).

5.7.1.4 Aboriginal Trusts

Aboriginal Trusts were established under the *Aboriginal Land Rights (Northern Territory) Act 1976* (ALRA) (Cth). The ALRA recognises the traditional ownership and occupation of the land by Indigenous People and the importance of their connection to land. In the NT, Traditional Owners can be granted Aboriginal freehold land ownership under the ALRA. The ownership of this land is held by Land Trusts, which are in turn managed by Land Councils.

Under the ALRA Traditional Owners have exclusive rights over their land and may impose conditions on how the land is used (should they agree to an organisation using it). Spatial mapping of Aboriginal freehold land across the NT, and the identification of the associated Aboriginal Trusts was undertaken as part of the search for potentially relevant persons. This included a search for any Aboriginal Trusts associated with Aboriginal freehold land that intersected with or was adjacent to the Planning Area.

5.7.1.5 Aboriginal Corporations

Aboriginal and Torres Strait Islander Corporations (Aboriginal Corporations) are registered under the *Corporations (Aboriginal and Torres Strait Islander) Act 2006* (Cth) and includes RNTBCs. The identification of Aboriginal Corporations was conducted primarily through the desktop review of Traditional Owner websites and Healthy Country Plans. When a Traditional Owner group did not have a website, searches were conducted through search engines and social media to identify Facebook accounts and/or news or media articles.

5.7.1.6 Family Groups and Individuals

Family groups and individuals were identified independently of Native Title information. The rationale for this is based on the Tipakalippa Decision; that family groups and individuals may hold different values and interests from those of the Native Title applicants and holders as a collective group. These relevant persons are difficult to identify through desktop research. Other communications channels, such as public advertisements and community consultation were also used to enable relevant persons to self-identify. The list of relevant persons was derived from a comprehensive review of Native Title information, Healthy Country Plans, Land Council websites, plans of management for protected areas including National Parks and Marine Parks, WA Aboriginal cultural heritage survey reports, government websites, media and community (drop-in centres) consultation as further described in Section 5.10.5. An abstract of records for all land intersecting with the Planning Area from NT AAPA provided further information used to identify potential sacred sites (recorded and registered) and enable sourcing of knowledge holder information.

5.7.2 Commercial Fisheries

One of the primary relevant persons with activities that may be impacted by project activities in the Planning Area is commercial fishers. Shell used a variety of resources, including data files and fishery reports, to identify relevant persons according to the criteria set out above. The method of identifying potential commercial fishers that may be relevant persons included the following activities:

- Identified and mapped designated State, Territory (where available) and Commonwealth Fisheries overlapping with the Planning Area and identified spatial overlaps with the Planning Area.
- Identified concession holders for overlapping Commonwealth Fisheries and obtained concession holder contact details from AFMA (letters were sent to all in the EP Planning Area).
- For WA Managed Fisheries:
- Identified 60 Nm fish cube areas overlapping with the Planning Area and applied to DPIRD for effort and catch data for each WA fishery for fish cubes that were within a planned impact area (e.g. noise) based on modellings.
- Obtained concession holder contact details for overlapping WA Managed fisheries within the EP Planning Area (letters were sent to all in the EP Planning Area).
- Applied to NT Fisheries for information on effort and catch data and concession holder contact details within the identified NT commercial fisheries.
- Reviewed the WA State of the Fisheries Report 2022/23 (Newman et al. 2023) to inform an understanding of effort and catch in the identified WA fisheries, including permit holders.
- Systematic online search and review for the websites of peak commercial fishing industry bodies including Western Australia Fishing Industry Council Inc (WAFIC), Northern Territory Seafood Council and the Northern Prawn Fisheries Industry.
- Engagement of WAFIC and Tuna Australia to assist in identification and consultation with relevant WA managed fisheries.

5.7.3 International Persons

According to the worst-case credible oil spill model, results predicted no shoreline contact (99% probability) with the Indonesian and Timor Leste coastlines. As the Indonesian and Timor Leste coastlines are within the Planning Area, Shell has taken a conservative approach to make reasonable efforts to identify and consult with relevant persons in Indonesia and Timor Leste. No relevant persons outside of Australia were identified during the preparation of this EP.

The purpose of oil spill modelling, consistent with the NOPSEMA procedure on oil pollution risk management guidance (GN1488), ‘is purely for the evaluation of oil pollution risks and to inform preparedness and response planning for oil spill risk management’ (NOPSEMA 2024). Although Shell chose to use the Planning Area to help

understand the geographic extent of its risks, and subsequent consultation of relevant persons in Australia, this approach is not seen as appropriate for international relevant persons for the reasons detailed below.

Low impact and low likelihood: Major vessel collision spills are very unlikely, with an oil spill frequency (per vessel per hour at sea) ranging from 1.4e−08 to 6.4e−08 depending on the vessel type (DNV 2011). The worst-case credible oil spill model results predict no shoreline contact (99% probability) with the Indonesian and Timor Leste coastlines. In addition, Shell puts a high focus on vessel collision prevention and emergency response to further reduce the likelihood and extent of potential impacts.

Spill Modelling used is highly conservative: Appendix C discusses model conservatisms and limitations.

By necessity over such a large domain, the model incorporates many simplifications that lead to over prediction of oil concentrations. The further away from the source, errors are compounded, particularly in nearshore areas where many physical processes are omitted (e.g. coastline resolution, surface waves, intertidal wetting and drying, refloating of oil, etc). Predictions of shoreline contact are therefore highly conservative. The modelling also does not take into consideration any spill prevention and mitigation that would be implemented in response to an incident discussed above.

Negligible nature and scale of the effect on functions, interests or activities of relevant persons in Indonesia or Timor Leste: The nature and scale of effects on the functions, interests or activities of persons in Indonesia and Timor Leste is predicted to be negligible. In addition, the Indonesian and Timor-Leste coastlines are over 300 km away from Crux.

Reasonable efforts to *identify* relevant persons in Indonesia and Timor Leste have occurred: Shell sought to ascertain the identities of relevant persons in Indonesia and Timor Leste through broadcast advertising, social media and the EP webpage. Shell provided sufficient information through the EP webpage, information booklets and broadcast media advertisements to enable relevant persons in Indonesia and Timor Leste to make themselves known to Shell.

Further, the Crux OPP has been publicly available since 2019. Those who made comment during the public comment period have also been carried forward as relevant persons. No one from outside of Australia was identified as a relevant person from public comments made on the Crux OPP.

Shell believes this approach to identification of relevant persons in Indonesia and Timor Leste is appropriate given the low nature and scale of potential impacts on their functions, interests or activities. Going forward, the opportunity for relevant persons outside of Australia to make themselves known to Shell will be available through the EP webpage.

Reasonable efforts to consult with relevant persons in Indonesia and Timor Leste have occurred: Shell has provided all relevant persons in Indonesia and Timor Leste with sufficient information about the proposed activities within this EP in the form of information sheets, information sheets and the draft of this EP available on the EP webpage. Relevant persons have had a reasonable opportunity to access this information by way of notifications Shell has made through broadcast media and social media.

A reasonable period for consultation has also been allowed for all relevant persons in Indonesia and Timor Leste. Shell made sufficient information available from March - April 2024 and has allowed persons in Indonesia and Timor Leste at least 30 days to consider the information and provide feedback.

Shell has received no feedback from persons outside Australia in the course of preparing this EP. Shell believes that it has made reasonable efforts to consult with relevant persons in Indonesia and Timor Leste in the preparation of this EP, having regard to the low likelihood of the possibility of negligible effects on their functions, interests or activities.

Shell does not consider it proportionate or reasonable for more specific, targeted consultation to occur, beyond what Shell has already carried out. To do so would require extensive efforts by Shell (from both a time and resourcing perspective), given the geographical area and size of the population concerned, which Shell estimates to be >100 million people. Shell's position is that further consultation efforts would be unworkable and well beyond what is considered reasonably practicable.

The opportunity for relevant persons outside of Australia to provide feedback will also be available moving forward through the EP webpage and relevant matters and other inputs can still be considered by Shell through its ongoing consultation process (see Section 5.13), including updates of the EP through the MOC process as required and outlined in Section 10.3.5.

5.7.4 Indonesian Traditional Fishers

As described in Section 7.11.2 the Activity Area and Planning Area both overlap the MoU Box. However, Indonesian traditional fishing effort is focussed on shallow waters such as those at Seringapatam Reef and the Scott Reef complex where target sedentary reef-species are generally encountered, rather than the deep waters of the Activity Area.

The MoU Box overlaps Australian waters, and the majority of traditional fishing activities occur at reefs and islands within AMPs whose values are described in Section 7.3.1.2 The AMPs are managed by the Director of National Parks with whom Shell has consulted for this activity.

During consultation with AFMA for a previous EP in September 2023, AFMA confirmed to Shell that it does not directly license or regulate the traditional fishers that may be operating in the MoU Box, nor do they maintain a register of contact details for the Indonesian traditional fishers. As there is no requirement for traditional fishers to be licensed by either the Australian or Indonesian governments, there is no publicly available information to identify these individuals.

The obligation to identify relevant persons for the purpose of consultation must be reasonably capable of discharge within a reasonable time and all relevant persons must be ascertainable. Based on the opacity as to the identity of any traditional fishers operating within the MoU Box, Shell has not been able to identify or contact them in a manner which is considered to be both reasonable and workable.

This is an example of where Shell has identified a group of relevant persons that may be potentially affected. However, Shell is unable to confirm individual contact details as these are not ascertainable through normal mechanisms (e.g. associated Australian government agencies, organisations or representative bodies who may hold these contact details). As such, consulting with such relevant persons is not capable of being discharged within a reasonable time due to the 'opacity as to the identity of those with whom consultations are to take place' (refer Tipakalippa Decision Paragraph 136 and Section 5.4).

Nevertheless, it can be inferred that the interests of traditional fishers (healthy fish communities) would be the same as those licensed commercial fishers operating in Australia that Shell has been able to contact via Commonwealth and State/Territory agencies such as AFMA, WA DPIRD, DITT and WAFIC. It is considered that feedback received by Shell, in relation to potential impacts to fish communities and harm to fish stocks, would be similar to traditional fishers in the MoU Box who share the same interests.

Consultation outcomes from Commonwealth and State/Territory agencies in relation to commercial fisheries included some aspects of Shell's preparedness in response to an unplanned oil spill event and impacts to fisheries. Shell has an operational and scientific monitoring plan (OSMP) which includes suitable monitoring programs to determine the impact of oil spill on commercial, traditional and recreational fisheries, which includes various assessments depending on type, nature and scale of the spill. In the event of an unplanned oil spill, consultation with the Indonesian government will be managed by DFAT.

5.7.5 Commercial Operators

Commercial operators form a large group of identified relevant persons for this EP and includes Indigenous and non-Indigenous tourism operators and marine transport operators. Commercial operators were primarily identified through online searches (including purposive and snowballing searching) coupled with expert and local knowledge. Online searches were deployed systematically with search terms (see Table 5-7 for a list of key search terms used). Search results were interrogated until saturation became evident.

5.7.6 Interest Groups

Interest groups form a large proportion of relevant persons who are difficult to identify through desktop research. Interest groups are defined as casual and formal collections comprised of members of the public who have an interest that lies within the Planning Area. Examples of formal interest groups include conservation and

environment focused groups as well as activity-based groups (e.g. Fishing Clubs). Examples of casual interest groups include bird watchers, wreck divers, and history enthusiasts.

Identification of these relevant persons was conducted in two ways: through local knowledge of interest groups likely to exist in the Western Australian setting, and through Google searching key terms (described elsewhere). Saturation is difficult to reach and identify in this category through desktop research alone. Therefore, community consultation and interrogating hyper-local knowledge was a critical element of the identification process.

5.8 Identification of Relevant Persons by Category

The relevant persons identified for this EP as related to the OPGSS(E) Regulations, including the rational for inclusion, are described in Table 5-8. The research methodology used by Shell to identify relevant persons is described in Table 5-6. Sections 5.8.1 and 5.8.4 detail specific categories of relevant persons referred to in section 25 of the OPGGS(E) Regulations.

5.8.1 Relevant Persons – Section 25(1)(a), (b) and (c) of the OPGGS(E) Regulations

These sub-sections of the OPGGS(E) Regulations include the following as relevant persons:

(a) each Commonwealth, State or Northern Territory agency or authority to which the activities to be carried out under the environment plan may be relevant;

(b) if the plan relates to activities in the offshore area of a State—the Department of the responsible State Minister;

(c) if the plan relates to activities in the Principal Northern Territory offshore area—the Department of the responsible Northern Territory Minister.

5.8.2 Relevant Persons – Section 25(1)(d) of the OPGGS(E) Regulations

Persons or organisations whose functions, interests or activities may be affected by the activities to be carried out under an environment plan are relevant persons under section 25(1)(d). Relevant persons considered by Shell to meet the requirements of section 25(1)(d) have been identified based on:

- An assessment of the totality of the relevant environment, values and sensitivities and potential activity impacts and risks.
- The overlap of functions, interests, or activities with the activity and Planning Areas.
- Desktop research, as summarised above.
- Advertisements and other public publications and broadcasts, described below.

Persons or organisations were contacted directly via email, telephone and/or mail. These communications provided information on consultation method and channels available for communication.

The list of relevant persons was further refined as consultation progressed, including any additional relevant persons that self-identified through the broadcast and print media advertising campaign.

5.8.3 Relevant Persons – Section 25(1)(e) of the OPGGS(E) Regulations

Relevant persons under section 25(1)(e) include any other person or organisation that the titleholder considers relevant. Shell considered whether persons or organisations who self-identified should be identified as relevant persons under this category (if they did not already come within section 25(1)(d)). This consideration is further detailed in Table 5-8.

5.8.4 Not Relevant Persons

Where Shell received feedback related to general project or business operations, these questions or comments were responded to and managed as part of Shell's standard community consultation mechanisms and processes. Most of these queries related to job opportunities or enquiries on becoming a supplier to Shell. All persons who self-identified through the public advertisement campaign, were provided an information pack, including information sheets on the EPs, to enable them to determine whether their functions, interests or activities would

be impacted. Where no further response was received, these persons were not categorised as relevant persons for the purposes of this EP.

Table 5-8: Assessment of Relevant Persons for this EP

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
Commonwealth and State Government Departments or Agencies				
Australian Border Force (Maritime Border Command)	Maritime	Responsible for maritime security. Deters and prevents illegal activities in the Australian Marine Domain.	Yes	25(1)(a)
Australian Communications and Media Authority (ACMA)	Media	Responsible for matters relating to maritime communications and licensing, as well as matters relating to telecommunications networks.	Yes	25(1)(a)
Australian Fisheries Management Authority (AFMA)	Environment	Responsible for the efficient management and sustainable use of Commonwealth fish resources. Activity is within a Commonwealth fishery area. AFMA expects petroleum operators to consult directly with fishing operators or via their fishing association body about all activities and projects which may affect day to day fishing activities.	Yes	25(1)(a)
Australian Hydrographic Office (AHO) – Department of Defence Operations Branch	Maritime	Manage the development, maintenance and disposal of the Defence estate, including unexploded ordnance. Department of Defence agency responsible for the publication and distribution of nautical charts and other information required for the safety of ships navigating in Australian waters. The AHO issues fortnightly Notices to Mariners for relevant nautical products.	Yes	25(1)(a)
Australian Maritime Safety Authority (AMSA)	Maritime	Responsible for maritime safety, adherence to advice, protocols, regulations. Issue radio-navigation warnings.	Yes	25(1)(a)
Clean Energy Regulator (CER)	Regulator	Responsible for implementing legislation to reduce carbon emissions and increase the use of clean energy.	Yes	25(1)(a)
Department of Climate Change, Energy, the Environment and Water (DCCEEW)	Commonwealth Department	Responsible for preventing, responding to and recovering pests and diseases that threaten the economy and environment. Responsible for protecting Australia's ocean systems, threatened marine species and coastal blue carbon ecosystems.	Yes	25(1)(a)

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
Department of Foreign Affairs (DFAT)	National	Facilitates international relations with governments and other organisations. Specifically, DFAT will have functions relating to oil spills in international waters or foreign countries jurisdictions.	Yes	25(1)(a)
Department of Industry, Science, and Resources (DISR); including NOPTA	Commonwealth Department	Responsible for OPGGS Act. They are the policy maker for the offshore petroleum sector.	Yes	25(1)(a)
Director of National Parks (DNP)	Environment	The Director of National Parks is a corporation established under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), the principal Commonwealth legislation for establishing and managing protected areas. The corporation is constituted by the person appointed to the office named the Director of National Parks. Assessed as relevant for this EP, but DNP advised that no further consultation is required.	Yes	25(1)(a)
Indigenous Land and Sea Corporation (ILSC)	Statutory Body (First Nations)	An Australian federal government statutory authority with national responsibilities to assist Aboriginal and Torres Strait Islander people to acquire land and to manage assets to achieve cultural, social, environmental and economic benefits for Indigenous peoples and future generations.	Yes	25(1)(a)
National Native Title Tribunal (NNTT)	Native Title	Commonwealth government authority responsible for administering the Native Title Act 1993 (Cth) across multiple functions including reviews, mediations, and determinations for: Native title applications, and ILUAs.	Yes	25(1)(a)
The Department of Agriculture Fisheries and Forestry's (DAFF)	Commonwealth Department	DAFF maintain and create agricultural export opportunities, to provide gains for Australian agriculture, fishing and forestry. They manage biosecurity risks to Australia to protect our multi-billion-dollar industries and our way of life. They engage with international counterparts to reinforce Australia's role in shaping how the global agriculture and fibre sector addresses food security, productivity, trade, sustainability and the impacts of climate change.	Yes	25(1)(a)

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
Aboriginal Areas Protection Authority NT (AAPA)	Non-Government Organisation	AAPA is an independent statutory authority established under the *Northern Territory Aboriginal Sacred Sites Act*. The Authority is responsible for overseeing the protection of Aboriginal sacred sites on land and sea across the NT.	Yes	25(1)(b)
Department of Biodiversity, Conservation and Attractions (DBCA)	WA Department	Western Australian government department responsible for managing lands and waters described in the Conservation and Land Management Act 1984, the Rottnest Island Authority Act 1987, the Swan and Canning Rivers Management Act 2006, the Botanic Gardens and Parks Authority Act 1998, and the Zoological Parks Authority Act 2001, and implementing the state's conservation and environment legislation and regulations. The Department reports to the Minister for Environment and the Minister for Tourism.	Yes	25(1)(b)
Department of Environment, Parks and Water Security (DEPWS)	NT Department	This department functions to foster and protect the environment and natural resources in the NT. This includes water, land resource management, environmental issues and the parks and wildlife functions. The Cobourg Peninsula is also managed as a national park (the Garig Gunak Barlu National Park) under a joint management arrangement between the Indigenous People and the Parks and Wildlife Commission of the Northern Territory.	Yes	25(1)(b)
Department of Jobs, Tourism, Science and Innovation (JTSI)	WA Department	Deliver initiatives on behalf of the WA Government that supports the full spectrum of economic activity in WA, including large-scale mining and industrial operations.	Yes	25(1)(b)
Department of Planning Lands and Heritage (DPLH); including Heritage Council of WA and Aboriginal Cultural Heritage Committee	WA Department	Responsible for planning and managing all land use and heritage considerations within the state.	Yes	25(1)(b)
Department of Primary Industries and Region Development (DPIRD) – Fisheries Division	WA Department	Department responsible for management of WA State fisheries – including licence holders, and maintenance of fisheries.	Yes	25(1)(b)

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
Department of Transport (DoT)	WA Department	Legislated responsibility for oil pollution response in State Waters.	Yes	25(1)(b)
Department of Water & Environmental Regulation (DWER)	WA Department	DWER is responsible for environment and water regulation, serving as a 'one stop shop' for industry and developers, with the aim of streamlining and simplifying regulation.	Yes	25(1)(b)
Environment Protection Authority (EPA)	WA Department	Primary environmental regulator for WA. They partner with business, government and the community to reduce pollution and waste, protect human health, and prevent degradation of the environment.	Yes	25(1)(b)
Federal Member for Kimberley – Melissa Price	WA Federal Member	Member for region that overlaps the Planning Area. Likely to be interested in constituent values and interests.	Yes	25(1)(b)
State Member for Kimberley – Divina Grace D'Anna	WA State Member	State Member for region very close to project area. Likely to have an interest in various aspects of the project.	Yes	25(1)(b)
Department of Industry Tourism and Trade (DITT)	NT Department	DITT supports industry development through globally competitive strategy, policy and promotion and delivers a regulatory framework that enables responsible growth, market access and stakeholder certainty.	Yes	25(1)(c)
Department of Energy, Mines, Industry Regulation and Safety (DEMIRS)	WA Department	Its mission is to support a safe, fair and responsible future for the WA community, industry, energy and resources sector.	Yes	25(1)(c)
Commercial Fisheries				
Abalone Managed Fishery Licence	WA Commercial Fishery	Commercial fishing activities and interests within the Planning Area.	Yes	25(1)(d)
Australian Northern Prawn Fishery	Commonwealth Fishery	Commercial fishing activities and interests within the Planning Area.	Yes	25(1)(d)
Australian Southern Bluefin Tuna Industry Association (ASBTIA)	Industry Representative	Industry representative for commercial fishing of Bluefin Tuna in southern waters of Australia.	Yes	25(1)(d)
Broome Prawn Managed Fishery	WA Commercial Fishery	Commercial fishing activities and interests within the Planning Area.	Yes	25(1)(d)

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
Commonwealth Fisheries Association	Industry Representative	Peak body representing the collective rights, responsibilities and interests of a diverse commercial fishing industry in Commonwealth regulated fishers. There are Commonwealth regulated fisheries in the Installation and Cold Commissioning Planning Area.	Yes	25(1)(d)
Cygnet Bay Pearl Farm	WA Commercial Fishery	Kimberley Pearl farm located on the periphery of the Planning Area.	Yes	25(1)(d)
Kimberley Crab Managed Fishery Licence	WA Commercial Fishery	Commercial fishing activities and interests within the Planning Area.	Yes	25(1)(d)
Kimberley Prawn Managed Fishery Licence	WA Commercial Fishery	Commercial fishing activities and interests within the Planning Area.	Yes	25(1)(d)
Mackerel Managed Fishery Licence	WA Commercial Fishery	Commercial fishing activities and interests in the Activity Area for the Crux project.	Yes	25(1)(d)
Marine Aquarium Fish Managed Fishery Licence	WA Commercial Fishery	Commercial fishing activities and interests within the Planning Area.	Yes	25(1)(d)
North West Slope Trawl Fishery	Commonwealth Fishery	Commercial fishing activities and interests within the Planning Area.	Yes	25(1)(d)
Northern Demersal Scalefish Managed Fishery Licence	WA Commercial Fishery	Commercial fishing activities and interests within the Planning Area.	Yes	25(1)(d)
Northern Prawn Fishery Industry Pty Ltd	Northern Prawn Fishery Industry Pty Ltd	Commercial fishing activities and interests within the Planning Area.	Yes	25(1)(d)
Pearl Oyster Fishery	WA Commercial Fishery	Commercial fishing activities and interests within the Planning Area.	Yes	25(1)(d)
Pilbara Crab Managed Fishery Licence	WA Commercial Fishery	Commercial fishing activities and interests within the Planning Area.	Yes	25(1)(d)
Seafarms Group Ltd	Aquaculture	Planning to build one of the world's largest Prawn Farms near Kununurra. Activities and Interests within the Planning Area.	Yes	25(1)(d)
Seafood Industry Association	Industry Representative	Industry representative for Seafood Industry.	Yes	25(1)(d)

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
Skipjack Tuna Fishery West	Member of Tuna Australia	Tuna Australia identified the Skipjack Tuna Fishery West and also advised that The Western sector is not currently active. There are 14 fishing permits but no total allowable commercial catch. Therefore, Shell has assessed as not relevant for this EP.	No	
South West Coast Salmon Fishery	WA Commercial Fishery	Commercial fishing activities and interests within the Planning Area.	Yes	25(1)(d)
Southern Bluefin Tuna Fishery	Commonwealth Fishery	Commercial fishing activities and interests within the Planning Area.	Yes	25(1)(d)
Southern Bluefin Tuna Management Advisory Committee (SBTMAC)	Industry Representative	Industry representative for the Southern Bluefin Tuna Fishery.	Yes	25(1)(d)
Specimen Shell Managed Fishery Licence	WA Commercial Fishery	Commercial fishing activities and interests within the Planning Area.	Yes	25(1)(d)
Small Pelagic Fishery Industry Association	Industry Representative	Industry representative for small pelagic fishery. Requested not to be contacted	No	
South East Trawl Fishery Industry Association	Industry Representative	Industry representative for South East Trawl fishery. Requested not to be contacted	No	
Tropical Tuna Management Advisory Committee	Industry Representative	Industry representative for Tropical Tuna Management.	Yes	25(1)(d)
TUNA Australia	Industry Representative	Represents statutory fishing right owners, holders, fish processors and sellers, and associate members of the Eastern and Western tuna and billfish fisheries of Australia.	Yes	25(1)(d)
West Coast Deep Sea Crustacean Managed Fishery Licence	WA Commercial Fishery	Commercial fishing activities and interests within the Planning Area.	Yes	25(1)(d)
Western Australian Fishing Industry Council (WAFIC)	Industry Representative	Industry representative for WA Fishing Industry.	Yes	25(1)(d)
Western Tuna and Billfish Fishery	Commonwealth Fishery	Concession holder with permission to fish in Commonwealth Fisheries that intersect the Planning Area.	Yes	25(1)(d)
Kimberley Gillnet and Barramundi Fishery	WA Commercial Fishery	DPIRD identified this fishery as being relevant to this EP very late in the consultation process. Upon further research, Shell has confirmed that they do	No	

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
		not operate within the Planning Area and assessed them as not relevant.		
WA Sea Cucumber Fishery	WA Commercial Fishery	DPIRD identified this fishery as being relevant to this EP very late in the consultation process. Upon further research, Shell has confirmed that they do not operate within the Planning Area and assessed them as not relevant.	No	
Aquaculture	WA Commercial Fishery	DPIRD identified this fishery as being relevant to this EP very late in the consultation process. Upon further research, Shell has confirmed that they do not operate within the Planning Area and assessed them as not relevant.	No	
Aquaculture Council of Western Australia Inc (ACWA)	Peak fishing body	DPIRD identified this peak body as being relevant to this EP very late in the consultation process. The Aquaculture Council of Western Australia Inc. (ACWA) is the incorporated peak body for the State's aquaculture industry and is an industry group member of the WA Fishing Industry Council (WAFIC) and Seafood Industry Australia (SIA). Shell has confirmed that they do not operate within the Planning Area and assessed them as not relevant.	No	
Titleholders and Operators				
Bengal Energy Ltd	Industry	Petroleum proponent holder within the Planning Area.	Yes	25(1)(d)
Carnarvon Energy Ltd	Industry	Petroleum proponent holder within the Planning Area.	Yes	25(1)(d)
Eni Australia Ltd	Industry	Petroleum proponent holder within the Planning Area.	Yes	25(1)(d)
Finder Energy	Industry	Petroleum proponent holder within the Planning Area.	Yes	25(1)(d)
INPEX	Industry	Petroleum proponent holder within the Planning Area.	Yes	25(1)(d)

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
IPB-WA	Industry	Petroleum proponent holder within the Planning Area.	Yes	25(1)(d)
Jadestone Energy	Industry	Petroleum proponent holder within the Planning Area.	Yes	25(1)(d)
Melbana Energy	Industry	Petroleum proponent holder within the Planning Area.	Yes	25(1)(d)
Pathfinder Energy	Industry	Petroleum proponent holder within the Planning Area.	Yes	25(1)(d)
Santos Ltd	Industry	Petroleum proponent holder within the Planning Area.	Yes	25(1)(d)
Timor Resources	Industry	Petroleum proponent holder within the Planning Area.	Yes	25(1)(d)
Timor Gap	Industry	Petroleum proponent holder within the Planning Area.	Yes	25(1)(d)
Vulcan Energy Resources	Industry	Petroleum proponent holder within the Planning Area.	Yes	25(1)(d)
Woodside Energy Ltd	Industry	Petroleum proponent holder within the Planning Area.	Yes	25(1)(d)
Commercial Operators				
Absolute Ocean Charters	Tourism Operators	Commercial Boat Operator with activities (including whale watching) within the Planning Area.	Yes	25(1)(d)
Auriga Marine	Transport Operators	Transport Operator conducting operations in and over the ocean in the NT.	Yes	25(1)(d)
Aurora Expeditions	Tourism Operator	Operates activity-based cruises on the northern WA Coastline and is a member of KMTA	Yes	25(1)(d)
Coral Expeditions	Tourism Operator	Operates cruises on the Kimberley coast. Member of Kimberley Marine Tourism Association (KMTA)	Yes	25(1)(d)
Eco Abrolhos	Tourism Operator	Cruise operator on the WA Kimberley coastline and Abrolhos Islands with marine based activities. Member of KMTA	Yes	25(1)(d)

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
Fly Broome	Tourism Operator	Tourism Operator with activities in or adjacent to the Planning Area.	Yes	25(1)(d)
Kimberley Air Tours	Tourism Operator	Tourism Operator with activities in or adjacent to the Planning Area.	Yes	25(1)(d)
Kimberley Boat Cruises	Tourism Operator	Tourism Operator with activities in or adjacent to the Planning Area.	Yes	25(1)(d)
Kimberley Coastal Camp	Tourism Accommodation Provider	Accommodation provider located near the ocean. Likely to have interests and potentially activities in or adjacent to the Planning Area.	Yes	25(1)(d)
Kimberley Cruise Centre	Tourism Operator	Tourism Operator with activities in or adjacent to the Planning Area. Assessed as relevant but requested not to be contacted.	No	25(1)(d)
Kimberley Ports Authority	Port Authority	Commercial operator with activities on and adjacent to the Planning Area.	Yes	25(1)(d)
Kimberley Quest – Beyond Adventure	Tourism Operator	Commercial cruise operators in the Kimberley.	Yes	25(1)(d)
Kuri Bay Sport Fishing Tours	Charter boat operator	Tourism Operator with activities in or adjacent to the Planning Area.	Yes	25(1)(d)
Lady M Cruising	Tourism Operator	Cruise company operating in Kimberley. Member of KMTA.	Yes	25(1)(d)
Odyssey Expeditions	Tourism Operator	Cruise boat located in the Kimberley's. Operates within the Planning Area, has social interests.	Yes	25(1)(d)
One Tide Charters	Tourism Operator	Kimberley cruise operator with activities in the marine environment.	Yes	25(1)(d)
Oolin Sunday Island Cultural Tours	Tourism Operator	Indigenous Tourism Operator near the Planning Area.	Yes	25(1)(d)
Reel Teaser	Charter boat operator	Tourism operator with activities in or adjacent to the Planning Area.	Yes	25(1)(d)
Slick Fishing Charters Broome	Charter boat operator	Commercial operator with activities in or adjacent to the Planning Area.	Yes	25(1)(d)

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
The Great Escape Charter Company	Tourism Operator	Tourism Operator with activities in or adjacent to the Planning Area.	Yes	25(1)(d)
The Travelling Naturalist	Tourism Operator	Tourism Operator with activities in or adjacent to the Planning Area.	Yes	25(1)(d)
True North Kimberley Cruises	Tourism Operator	Tourism Operator with activities in or adjacent to the Planning Area.	Yes	25(1)(d)
Unreel Adventure Safaris	Tourism Operator	Tourism Operator with activities in or adjacent to the Planning Area.	Yes	25(1)(d)
Interest Groups				
10,000 Birds	Environment (Birding)	Likely to have interests in project activities that may impact the health, feeding, and breeding grounds of any migratory or seabirds within the Planning Area.	Yes	25(1)(e)
Australasian Seabird Group	Environment	Established to promote seabird research and conservation in Australasia and the South Pacific.	Yes	25(1)(e)
Australasian Wader Studies Group (AWSG)	Environment	Organisation that has functions, activities, and interests in the Planning Area. Activities including monitoring shorebird populations, partnership with research institutions, formulate and promote policies for conservation of shorebirds and their habitat, promote wetland conservation and assist with nomination of sites for RAMSAR listing. Identified as relevant but AWSG requested to be removed from further consultation.	Yes	25(1)(d)
Australian Wildlife Conservancy	Environment	NFP focused on conservation of threatened wildlife and ecosystems in Australia.	Yes	25(1)(d)
Birding in Kimberley	Environment	Interest group engaging in birding activities.	Yes	25(1)(d)
Birdlife Top End	Environment	Central forum for community activities centred around the conservation of birds and their habitats. Conducts Migratory Shorebird Monitoring Program at several sites around Darwin. Monitors Key Biodiversity Areas	Yes	25(1)(d)
Broome Fishing Club	Recreational Fishing	Recreational fishing club with membership with interests in the marine environment	Yes	25(1)(d)

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
Kimberley Birdwatching	Environment	Birdwatching group with interest in animals who may be affected by Project activities.	Yes	25(1)(d)
Recfishwest	Peak Body	Peak Body for Recreational Fishing in Western Australia.	Yes	25(1)(d)
BirdLife WA	Environment	Peak Body for Birdwatching in WA. Area covers WA as well as Cocos (Keeling) Islands, Christmas Island and Ashmore Reef. 6 regional groups. Carries out research projects with DBCA e.g. Australasian Bittern Recovery Team.	Yes	25(1)(e)
Non-Government Organisations				
AIATSIS (Australian Institute of Aboriginal and Torres Strait Islander Studies)	Research Institute	AIATSIS is an Indigenous-led, national institute that celebrates, educates, and inspires people from all walks of life to connect with the knowledge, heritage and cultures of Australia's First Peoples.	Yes	25(1)(d)
Australian Conservation Foundation	Environment	Recognised conservation organisation with interests in marine environment that likely extent into the Planning Area.	Yes	25(1)(d)
Australian Marine Conservation Society	Environment	The Australian Marine Conservation Society (AMCS) is a peak conservation body with strong interest in activities in the marine environment.	Yes	25(1)(d)
Australian Marine Oil Spill Centre (AMOSC)	Industry	AMOSC has an interest and a function in relation to the management of the oil industry's response to major oil spill. AMOSC also plays a role in training and coordinating industry personnel ready to provide immediate emergency oil spill response.	Yes	25(1)(d)
Ben and Jerry's	Environment	Activist with strong interest in climate change, supporting action against sea Country petroleum and gas activities.	Yes	25(1)(d)
Conservation Council of WA	Environment	NGO in WA with an Environment focus.	Yes	25(1)(d)
Conservation Volunteers Australia	Environment	Conservation Volunteers is a non-profit organisation that operates in Australia, New Zealand, and around the world. The organisation provides opportunities for volunteers to participate in conservation projects and initiatives, including habitat restoration, wildlife monitoring, and	Yes	25(1)(d)

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
		environmental education. Has social and environmental interests.		
Environmental Defender's Office WA	Environment	The Environmental Defender's office of WA is a not-for-profit and non-Government organisation that specialises in public interest environmental law.	Yes	25(1)(d)
Environs Kimberley	Environment	As the peak environmental NGO for the Kimberley region in far north-west Australia, Environs Kimberley is dedicated to looking after the health of the land and waters of the region.	Yes	25(1)(d)
Greenpeace	Environment	Activist with strong interest in climate change, supporting action against sea Country petroleum and gas activities.	Yes	25(1)(d)
High Seas Alliance	International	The High Seas Alliance is a partnership of organisations and groups aimed at building a strong common voice and constituency for the conservation of the high seas.	Yes	25(1)(d)
Martuwarra Fitzroy River Council	Environment	NGO in WA with an Environment focus.	Yes	25(1)(d)
Save the Kimberley	Environment	NGO in WA with an Environment focus.	Yes	25(1)(d)
Sea Turtle.org	Environment	NGO in WA with an Environment focus.	Yes	25(1)(d)
Surfrider Foundation Australia	Environment	Dedicated to the protection and enjoyment of the world's ocean, waves, and beaches, for all people	Yes	25(1)(d)
Wilderness Society	Environment	NGO in WA with an Environment focus.	Yes	25(1)(d)
United Nations	International	An international organisation where all the world's nations can gather together, discuss common problems, and find shared solutions that benefit all of humanity.	Yes	25(1)(d)
WA Marine Science Institute (WAMSI)	Environment	NGO with Environment protection focus that will have interest in the Planning Area and project activities.	Yes	25(1)(d)
WA Parks Foundation	Environment	NGO in WA with an Environment focus.	Yes	25(1)(d)

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
WWF	Environment	NGO with Environment protection focus that will have interest in the Planning Area and project activities.	Yes	25(1)(d)
Regional Development Australia Kimberley	Regional Development	Regional Development Australia is an Australian Government initiative that brings together all levels of government to enhance the development of Australia's regions.	Yes	25(1)(d)
Academic and Research				
Australian National University (ANU)	Academic Project	Research institution that has been identified as possibly engaging in research located within the Planning Area, therefore having interests.	Yes	25(1)(d)
Deep History of Sea Country Research Project	Academic Project	The Deep History of Sea Country Research Project is a collaborative research initiative that aims to document and preserve the cultural and environmental heritage Indigenous Sea Countries in northern Australia. The project involves a range of Indigenous and non-Indigenous researchers, community members, and relevant persons, and focuses on using traditional knowledge, scientific research, and technological innovation to better understand and protect Australia's marine environments.	Yes	25(1)(d)
Fisheries Research and Development Corporation (FRDC)	Fisheries	Statutory corporation that manages research and development investment by the Australian Government and the Australian fishing and aquaculture commercial, recreational, and Indigenous sectors.	Yes	25(1)(d)
Kimberley Marine Research Station	Research Institute	Operational marine science hub for independent research on the coastal and marine environments of the Kimberley. Research activities and interests in marine environment.	Yes	25(1)(d)
The Ecology Centre	Environment	Potential interest in the Planning Area through research activities.	Yes	25(1)(d)

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
Industry Representative Bodies				
Australian Energy Producers (AEP)	Industry Representative	AEP is the peak national body representing Australia's upstream oil and gas sector. AEP are considered interested, rather than relevant.	No	25(1)(d)
Kimberley Marine Tourism Association	Peak Body	Tourism Peak Body with membership base across Kimberley. Members may have activities in the Planning Area.	Yes	25(1)(d)
Western Australian Game Fishing Association (WAGFA)	Game Fishing	Industry representative for Small Pelagic Fishery Industry.	Yes	25(1)(d)
Service Providers				
Broome Sea Rescue	Volunteer & Emergency Services	Emergency services located in Broome. Operates within the Planning Area and has social interests.	Yes	25(1)(d)
Territory Emergency Management Council (TEMC)	Emergency Services	NT Emergency Management arrangements.	Yes	25(1)(d)

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category	Tier
Indigenous Organisations and People					
Tier 1					
Bardi and Jawi Niimidiman Aboriginal Corporation (BJNAC)	RNTBC / Native Title Determination	Statutory function, activities and interests due to role as RNTBC/ PBC for Bardi and Jawi people. Represent native title holders. Shell received a letter on behalf of BJNAC and an individual person who is a member of BJNAC in relation to a previous EP. Shell's response offered to consult with BJNAC and the individual. The individual has not come forward to identify as relevant for this EP. Advice received from BJNAC, has directed Shell to consult through BJNAC, and follow their culturally appropriate method of consultation. Shell has respected that advice.	Yes	25(1)(d)	1
Dambimangari Aboriginal Corporation (DAC)	RNTBC	Statutory functions, interests, and activities due to role as RNTBC/ PBC. Represent native title holders. Wunambal Gaambera, Dambimangari and	Yes	25(1)(d)	1

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category	Tier
		Willinggin people make up the Wanjina Wunggurr Community and Wanjina Wunggurr (Native Title) Aboriginal Corporation, with each group managing its own Country identified through native title determination through separate Aboriginal Corporations.			
Kimberley Land Council (KLC)	Land Council	KLC is the peak Indigenous body in the Kimberley region working with Indigenous people to secure native title, conduct conservation and land management activities and develop cultural business enterprises. KLC is a Native Title Representative Body. KLC is the contact point for the following specific RNTBCs, and Indigenous organisations identified as relevant to this EP (note that where direct contact has been made Shell has not listed those RNTBCs and Indigenous organisations here): • Kimberley Ranger Network. • Nimanburr Aboriginal Corporation. • Nyul Nyul PBC Aboriginal Corporation. • Nyul Nyul Rangers.	Yes	25(1)(d)	1
Mayala Inninalang Aboriginal Corporation (incl Mayala 2)	RNTBC	Statutory functions, interests, and activities due to role as RNTBC/ PBC. Represent native title holders. KLC confirmed they are the correct contact point.	Yes	25(1)(d)	1
Northern Land Council (NLC)	Land Council	NLC is the peak Indigenous body in the north part of the Northern Territory working with Indigenous people to secure native title, conduct conservation and land management activities and develop cultural business enterprises. NLC is a Native Title Representative Body, NLC is the contact point for the following specific RNTBCs, and Indigenous organisations identified as relevant to this EP: • Top End Aboriginal Corporation RNTBC. • Arnhem Land Aboriginal Trust. • Legune Pastoral Lease.	Yes	25(1)(d)	1
Nyul Nyul PBC Corporation	RNTBC	Statutory function, activities and interests due to role as RNTBC/ PBC. Represent native title holders. This group was identified by the KLC to Shell, including that the KLC is the correct contact point.	Yes	25(1)(d)	1
Walalakoo Aboriginal Corporation	RNTBC	Statutory function, activities and interests due to role as RNTBC/ PBC. Represent native title holders.	Yes	25(1)(d)	1
Wanjina-Wunggurr (Native Title) Aboriginal Corporation	RNTBC	Statutory functions, interests, and activities due to role as RNTBC/ PBC. Represent native title holders. KLC confirmed they are the correct contact	Yes	25(1)(d)	1

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category	Tier
		point. Wunambal Gaambera, Dambimangari and Willinggin people make up the Wanjina Wunggurr Community, with each group managing its own Country under separate Aboriginal Corporations.			
Wilinggin Aboriginal Corporation	Aboriginal Corporation	Wilinggin Aboriginal Corporation is the agent of Wanjina-Wunggurr Aboriginal Corporation in relation to the interests of the Ngarinyin people and activities on Country, which includes, but is not limited to, management of Indigenous Protected Area (IPA) as well as fire and carbon projects within the Wilinggin native title determination. Wunambal Gaambera, Dambimangari and Willinggin people make up the Wanjina Wunggurr Community and Wanjina Wunggurr (Native Title) Aboriginal Corporation, with each group managing its own Country identified through native title determination through separate Aboriginal Corporations.	Yes	25(1)(d)	1
Wunambal Gaambera Aboriginal Corporation (including the Uunguu Rangers)	Aboriginal Corporation	Conduct Land business and interest transactions of the Wunambal Gaambera people, who hold Native Title over land and seas (Wanjina Wunggurr (Uunguu) NT determination. Wunambal Gaambera, Dambimangari and Willinggin people make up the Wanjina Wunggurr Community and Wanjina Wunggurr (Native Title) Aboriginal Corporation, with each group managing its own Country identified through native title determination through separate Aboriginal Corporations.	Yes	25(1)(d)	1
Tier 2					
Anindilyakwa Land Council	Aboriginal Land Council	Research undertaken identified that the Anindilyakwa Land Council have an interest in Swordfish, present within the Planning Area.	Yes	25(1)(d)	2
Balanggarra Aboriginal Corporation	Native Title Determination	Statutory function, activities and interests due to role as RNTBC/ PBC. Represent native title holders.	Yes	25(1)(d)	2
Gogolanyngor Aboriginal Corporation	RNTBC	Statutory function, activities and interests due to role as RNTBC/ PBC. Represent native title holders. KLC confirmed they are the correct contact point.	Yes	25(1)(d)	2
Kalumburu Aboriginal Corporation	Aboriginal Corporation	Local Aboriginal corporation for remote community situated on the coast. Falls within the Planning Area.	Yes	25(1)(d)	2
Wanparta Aboriginal Corporation	RNTBC	Statutory function, activities and interests due to role as RNTBC/ PBC. Represent native title holders.	Yes	25(1)(d)	2
Tier 3					
Ardyaloon Trochus Hatchery and Aquaculture Centre	Indigenous Fisheries	The peak representative body for Indigenous aquaculture activities in the Kimberley. Lead organisation with Bardi Ardyaloon Hatchery. Has functions and interests in the Planning Area.	Yes	25(1)(d)	3

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category	Tier
Arnhem Land Aboriginal Land Trust	Aboriginal Land Trust	Established under ALRA. Hold ownership of Aboriginal Land that intersects and extends within (islands) the Planning Area. Controls via Permit access the intertidal zone.	Yes	25(1)(d)	3
Cobourg Peninsula Sanctuary Land Trust	Land Trust	Represent the people of the Cobourg Peninsula under the Cobourg Peninsula Aboriginal Land, Sanctuary and Marine Park Act 1981. The Trust selects the Board who then manage the Cobourg Marine Park. Under the Act, The Northern Land Council is required to take or consent to the taking of action in relation to the Land Trust.	Yes	25(1)(d)	3
Djarindjin Aboriginal Corporation (DAC)	Aboriginal Corporation	Djarindjin Aboriginal Corporation (DAC) through entity Djarindjin Airport Pty Ltd operate airport for Prelude (and other operators).	Yes	25(1)(d)	3
Djarindjin Campgrounds	Accommodation / Tourism Operator	Indigenous Tourism Operator near the Planning Area.	Yes	25(1)(d)	3
Djuludki Consultive Committee	Consultative Committee	Represented by TEACA and relevant due to proximity to Planning Area.	Yes	25(1)(d)	3
Gambanan Wilderness Retreat	Tourism Operator	Accommodation provider located near the ocean. Likely to have interests and potentially activities in or adjacent to the Planning Area. Gambanan Wilderness Retreat has closed down, so Shell was unable to contact them.	No		
Individual Indigenous Person 1	Individual	Identified through previous EPs.	Yes	25(1)(d)	3
Joombarn-Buru Aboriginal Corporation RNTBC	Aboriginal Corporation	Self-identified through previous EPs. Statutory function, activities and interests due to role as RNTBC/ PBC.	Yes	25(1)(d)	3
Kardu Lalingkin Consultive Committee	Consultative Committee	Represented by TEACA and relevant due to proximity to Planning Area.	Yes	25(1)(d)	3
Kimberley Aboriginal Law and Cultural Centre (KALACC)	Cultural Centre	Activities, interests due to role in law and cultural business.	Yes	25(1)(d)	3
Kimberley Cultural Adventures	Indigenous Tourism Operator	Indigenous Tourism Operator near the Planning Area.	Yes	25(1)(d)	3
Kimberley Indigenous Saltwater Advisory Group (ISWAG)	Advisory Group	ISWAG is a collective of saltwater Kimberley Traditional Owner groups, recognising the enduring connection between Traditional Owners and their sea Country. Interest in sea Country. Consulted through the KLC, ISWAG is supported by KLC and Nyamba Buru Yawuru.	Yes	25(1)(d)	3

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category	Tier
Kimberley Jiyigas	Interest Group	Collective of Kimberley Indigenous women that provides a platform for facilitating the united collective voice.	Yes	25(1)(d)	3
Kimberley Ranger Network	Land and Sea Management	Indigenous Rangers have functions, interests, and activities, to maintain the health of Country and sea – linked to Native Title Determinations, IPA agreements or Federal/ State funding. The Kimberley Ranger Network is facilitated by KLC and comprises of 18 Ranger Groups. The following of which have been assessed as relevant for this EP: • Balanggarra Rangers. • Bardi Jawi Rangers. • Bardi Jawi Oorany Rangers. • Nyul Nyul Rangers.	Yes	25(1)(d)	3
KRED (Ambooriny Burru Charitable organisation)	Aboriginal Corporation	Functions, activities, interests due to role in social and economic development across the Kimberley.	Yes	25(1)(d)	3
Legune Pastoral Lease - via NLC	Native Title Determination	Statutory function, activities and interests due to role as RNTBC/ PBC.	Yes	25(1)(d)	3
Lombadina Aboriginal Corporation incl. Accommodation and Tours	Aboriginal Corporation	Tourism and commercial activities/ interests.	Yes	25(1)(d)	3
Madanaa Nada Aboriginal Corporation RNTBC	RNTBC	Statutory function, activities and interests due to role as RNTBC/ PBC. Represent native title holders. KLC confirmed they are the correct contact point.	Yes	25(1)(d)	3
Mercedes Cove Exclusive Coastal Retreat	Tourism Accommodation Provider	Indigenous Tourism Operator near the Planning Area.	Yes	25(1)(d)	3
Nimanburr Aboriginal Corporation	RNTBC	Statutory function, activities and interests due to role as RNTBC/ PBC. Represent native title holders. KLC confirmed they are the correct contact point.	Yes	25(1)(d)	3
NT Indigenous Business Network	Business Operator	The peak body representing Indigenous businesses in the Territory.	Yes	25(1)(d)	3
Nyamba Buru Yawuru Aboriginal Corporation	RNTBC	Statutory function, activities and interests due to role as RNTBC/ PBC. Represent native title holders.	Yes	25(1)(d)	3
Rak Badjalarr Consultive Committee	Consultative Committee	Represented by TEACA and relevant due to proximity to Planning Area.	Yes	25(1)(d)	3

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category	Tier
Thamarrurr Rangers	Land and Sea Management	Indigenous Rangers have functions, activities, and interests to maintain the health of Country and sea - linked to Native Title Determinations, IPA agreements or Federal/ State funding.	Yes	25(1)(d)	3
Top End Aboriginal Coastal Alliance (TEACA)	Consultative Committee	TEACA has been working to ensure that the offshore resources industry is properly consulting with First Nations persons and communities in coastal areas of the top end of the NT. TEACA represent 13 First Nations Consultative Committees. Three of those have been assessed as relevant for this EP due to their proximity to the Planning Area: • Djuludki Consultive Committee. • Kardu Lalingkin Consultive Committee. • Rak Badjalarr Consultive Committee.	Yes	25(1)(d)	3
Top End Aboriginal Corporation RNTBC	RNTBC	The Top End (Default PBC) Aboriginal Corporation is the default registered native title body corporate for a large number of native title determinations and acts as an agent for native title holders.	Yes	25(1)(d)	3
Yawoorroong Miriuwung Gajerrong Yirrgeb Noong Dawang Aboriginal Corporation (MG Corp)	Aboriginal Corporation	Statutory function, activities and interests due to role as RNTBC/ PBC. Represent native title holders. KLC confirmed they are the correct contact point.	Yes	25(1)(d)	3
Buurabalayji Thalanyji Aboriginal Corporation	RNTBC	Statutory function, activities and interests due to role as RNTBC/ PBC. Represent the Thalanyji People. Advised that they do not consider themselves relevant for this EP. Agreed Shell would keep them informed.	No		

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category	Tier
• **Nyangumarta Karajarri Aboriginal Corporation** • **Karajarri Traditional Lands Association Aboriginal Corporation** • **Yawuru Aboriginal Corporation**	RNTBC / Aboriginal Corporations	These organisations were identified by KLC for distribution of information about the broader Crux Project but have been assessed as not relevant for this EP, as they do not meet the definition of a Tier 0, Tier 1, Tier 2 or Tier 3 relevant persons as detailed in Table 5-10.	No		
• **Kenbi Rangers** • **Wudicupildiyerr Outstation Rangers** • **Garngi Land and Sea Management** • **Croker Island - Garngi Rangers** • **Malak Malak Land and Water Management Rangers** • **Bulgul Land and Sea Management Rangers** • **Numbulwar Land and Sea Management** • **Mardbalk Land and Sea Management** • **Garawa and Waanyi / Garawa** • **Timber Creek** • **Wagiman** • **Yugul Mangi Land and Sea Management** • **Yugul Mangi Rangers**	Land and sea management	NLC was identified as the contact point for these organisations for distribution of information about the broader Crux Project but have been assessed as not relevant for this EP, on the basis. they do not meet the definition of a Tier 0, Tier 1, Tier 2 or Tier 3 RP as detailed in Table 5-10.	No		

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category	Tier
Top End Aboriginal Coastal Alliance (TEACA)	Consultative Committee	TEACA represent 13 First Nations Consultative Committees. Three of those have been assessed as relevant for this EP. The following are those that are not relevant: • Larrakia Family Groups. • Jindiwi Consultative Committee. • Coburg Consultative Committee. • Mulurryud Consultative Committee. • Goulburn Islands Consultative Committee. • Maningrida Regional Consultative Committee. • Gapu Maringa Consultative Committee. • Ngoy Garmak Consultative Committee. • Miyarrka Consultative Committee. • Tiwi Clans (as of 24/10 Committee not formed).	No		

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
Self-identified via online form				
Person 1	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 2	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 3	Individual	Indicated an interest in an earlier EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 4	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 5	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
Person 6	Individual	Indicated interest in Prelude. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 7	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 8	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 9	Individual	Indicated an interest in this EP for a school project. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 10	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 11	Individual	Indicated an interest in IMS. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 12	Individual	Indicated an interest in oil and gas generally. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 13	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 14	Individual	Indicated an interest in commissioning. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 15	Individual	Indicated an interest in the Crux Project. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 16	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 17	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 18	Individual	Indicated an interest in the Crux Project. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 19	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 20	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
Person 21	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 22	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 23	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 24	Individual	Indicated an interest in commissioning. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 25	Organisation	Indicated an interest in the Crux Project. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified. Note this organisation also attended the Broome drop-in session see section below.	No	
Person 26	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 27	Individual	Indicated an interest in the Crux Project, around hookup, commissioning, start-up and turnarounds. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 28	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 29	Individual	Indicated an interest in the Crux flaring. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 30	Individual	Indicated interest in Prelude. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 31	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 32	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 33	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 34	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
Person 35	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 36	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 37	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 38	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 39	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 40	Individual	Indicated an interest in an earlier EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 41	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 42	Individual	Indicated an interest in supplier opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 43	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 44	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 45	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 46	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 47	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 48	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 49	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
Person 50	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 51	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 52	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 53	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 54	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 55	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 56	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 57	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 58	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 59	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 60	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 61	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 62	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 63	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 64	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
Person 65	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 66	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 67	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 68	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 69	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 70	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 71	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 72	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 73	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 74	Individual	Indicated an interest in an earlier EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 75	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 76	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 77	Individual	Indicated an interest in supplier opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 78	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 79	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
Person 80	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 81	Individual	Indicated an interest in the Crux Project. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 82	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 83	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 84	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 85	Individual	Indicated an interest in an earlier EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 86	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 87	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 88	Individual	Indicated an interest in how the project would affect Broome. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 89	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 90	Individual	Indicated an interest in how the project would affect Broome. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 91	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 92	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 93	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 94	Individual	Indicated an interest in the Crux Project. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
Person 95	Individual	Indicated an interest in the Crux Project. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 96	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 97	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 98	Individual	Indicated an interest in the Crux Project. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 99	Individual	Indicated an interest in an earlier EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 100	Individual	Indicated an interest in an earlier EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 101	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 102	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 103	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 104	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 105	Individual	Indicated an interest in this EP and an earlier EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 106	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 107	Individual	Indicated an interest in supplier opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 108	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 109	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
Person 110	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 111	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 112	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 113	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 114	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 115	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 116	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 117	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 118	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 119	Individual	Indicated an interest in supplier opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 120	Individual	Indicated an interest in this EP. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 121	Individual	Indicated an interest in employment opportunities. Individual was provided with sufficient information but assessed as not relevant for this EP as no functions, interests or activities were identified.	No	

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
Attended a Community Information or Drop-in Session				
Aarnja	Organisation	Attended the Broome drop-in session and also completed an online form (see above). Shell gave an overview of the Crux project and provided information sheets. Did not want Shell to contact them personally and advised that the CEO would be in touch if any further information was required. No further contact made.	No	
Environs Kimberley	Organisation	Attended the Broome drop-in session. Environs Kimberley has been assessed as relevant for this EP see RP 404.	Yes	25(1)(d)
Broome Chamber	Organisation	Attended the Broome Community Information session. Broome Chamber has been assessed as relevant for this EP see RP 439.	Yes	25(1)(d)
Rio Tinto	Organisation	Attended the Broome Community Information session. Once sufficient information was provided, this organisation was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
CHC	Organisation	Attended the Broome Community Information session. This individual works for a Shell contractor and is assessed as not relevant for this EP.,	No	
Kimberley Development Commission (KDC)	Organisation	Attended the Broome Community Information session. The Kimberley Development Commission is a statutory authority of the government of Western Australia. Their role is to promote the economic and social development of the Kimberley. KDC has been assessed as not relevant for this EP as no functions, interests or activities were identified. KDC will continue to be engaged by Shell as a general stakeholder.	No	
Kimberley Ports Authority (KPA)	Organisation	Attended the Broome Community Information session. KPA has been assessed as relevant for this EP see RP 302.	Yes	25(1)(d)
Kimberley Marine Supply Base (KMSB)	Organisation	Attended the Broome Community Information session. KMSB has been assessed as relevant for this EP see RP 302.	Yes	25(1)(d)
Department of Energy, Mines, Industry Regulation and Safety (DEMIRS)	Organisation	Attended the Broome Community Information session. DEMIRS has been assessed as relevant for this EP see RP 27.	Yes	25(1)(c)
Wyndham Port	Organisation	Attended the Wyndham drop-in session. Once sufficient information was provided, this organisation was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Dawang Council	Organisation	Attended the Kununurra drop-in session. The Dawang Council is made up of 16 MG members representing each Dawang traditional land or estate group. MG Corporation has been assessed as relevant for this EP see RP 105 and consultation should occur through them as the formal contact point.	Yes	25(1)(d)

Individual or Organisation	Group	Rationale	Relevant for this EP	Link to Section 25 of the OPGGS(E) Regulations Category
Mirima Language Centre	Organisation	Attended the Kununurra drop-in session. Mirima Council Aboriginal Corporation is about sharing and nurturing language and culture of the Miriwoong Country. The drop-in session was held at the language centre so a few people who worked there came to see Shell. Assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 1	Individual	Attended the Broome drop-in session with an interest in employment and traineeship opportunities. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	
Person 2	Individual	Attended the Wyndham drop-in session. Once sufficient information was provided, this individual was assessed as not relevant for this EP as no functions, interests or activities were identified.	No	

**Please note each person's identity is unique for each Shell EP.*

5.9 Consultation Approach

5.9.1 Providing Sufficient Information

Section 25(2) of the OPGGS(E) Regulations requires titleholders to provide relevant persons with sufficient information to allow relevant persons to make an informed assessment of the possible consequences of the proposed activities on their functions, interests, or activities. This section demonstrates that Shell has provided sufficient information to relevant persons because:

- Information provided was detailed enough to allow people to make an informed decision as to how their functions, interests or activities may be affected (Section 5.9.2).
- Information provided to relevant persons was tailored to their functions, interests, and activities with the information Shell had available at the time (Section 5.9.3).
- Further information was provided where a request was considered reasonable or related to EP content or supporting information (Section 5.9.4).
- Shell raised awareness of NOPSEMA's Guideline: Consultation in the course of preparing an environment plan for relevant persons (N-04750-GL2086) (Section 5.9.5).
- Shell published the draft EP on its website on 2 October 2024 (Section 5.9.6).

5.9.2 Information given allowed informed decisions by relevant persons

The initial call out for relevant persons, and the iterations of information provided throughout the consultation process were developed to ensure that a relevant person could make an informed decision as to how the proposed activities could affect their functions interest and activities. This included the initial broad advertisements, where links to the EP webpage allowed access to relevant EP information, so that anyone who wanted to seek further information could access the information (see Section 5.9.3).

5.9.3 Tailored information to the relevant persons functions, interests, and activities

In determining information requirements, Shell considered the functions, interests and activities of the relevant persons and the nature and scale of environmental impacts and risks that could affect them. Shell recognised that different categories of relevant persons required different levels of engagement on this basis.

Further, Shell adheres to published guidance for good practice consultation relevant to different sectors and disciplines, as described below.

Materials were developed with subject matter experts, including corporate communications professionals, to ensure the content was comprehensible and appropriate for the recipient. Instead of a 'one size fits all' approach, a suite of materials were developed to support the various communications: channels listed in Table 5-9 and Appendix B summarises the communication channels used for each relevant persons during the development of this EP.

The methodology used by Shell to provide relevant persons with sufficient information is outlined below and the evidence of the information provided can be found in Appendix A.

5.9.4 Provided further information for relevant persons on request

Shell created targeted consultation material that was appropriate to the category of persons, such as specific information sheets or presentation materials. This was prepared on Shell's own initiative or due to information requested by the relevant person. For example, commercial fishing licence holders and representative bodies received additional information relevant to their fishery, or bespoke information and materials created for Indigenous People, as appropriate (see Appendix A). To ensure information was appropriately provided to relevant persons, Shell invited feedback, sought advice, provided information and community drop-in sessions. Feedback on the clarity, relevance and usefulness of the materials was adopted from relevant persons throughout the consultations and the information provided was refined and improved because of that feedback.

5.9.5 Raise awareness of NOPSEMA's guideline for relevant persons

NOPSEMA released its Guideline: Consultation in the course of preparing an environment plan (N-04750-GL2086) on 12 May 2023 (subsequently updated on 20 May 2024), during the preparation of this EP. The Guideline encourages titleholders to provide relevant persons with a copy of the NOPSEMA Consultation on offshore environment plans Brochure as part of consultation. This Brochure is posted on Shell's public website and was included in follow-up communications in June and August 2024 with relevant persons (see Appendix A).

5.9.6 Publication of the draft EP

Shell made the draft EP publicly available on the Crux Project website on 2 October 2024. The EP was published to enable relevant persons to self-select additional information, if needed. In doing so, relevant persons were also able to see any information provided in context, and in further detail than the summaries.

5.9.7 Providing a reasonable period for consultation

Section 25(3) of the OPGGS(E) Regulations provides that titleholders must give relevant persons a reasonable period for consultation. Shell allows a minimum of 30 days from the date that sufficient information is provided to a relevant person, for the person to review the information and respond to Shell on the impact that Shell's proposed activities may have on their functions, interests, or activities. As noted below, in many cases, where no response is received within a 30-day period, Shell has sent follow-up communications to the relevant persons in question. Shell recognises that additional time may be required for relevant persons to provide feedback due to availability and accessibility issues and assesses requests for additional time on a case by-case basis. Shell also recognises that where interests are held communally, such as with Indigenous people, more than 30 days may be required. Where this occurred, it is documented in further detail in Table 5-11 and Table 5-12. Shell acknowledges that participating in consultation is voluntary for relevant persons, and that in some circumstances Shell may be limited in the form of consultation it can undertake, e.g. if a relevant person does not make contact details available. If comments are received from relevant persons after submission of the final version of the EP to NOPSEMA they will not have been considered or incorporated into the preparation of appropriate control measures included in the EP. In this event, Shell will consider comments and feedback as part of the Implementation Strategy for the EP (refer Section 10). Should the feedback or comments identify a significant measure or control that requires implementation or update to meet the intended outcome of consultation, Shell will apply its Management of Change (MOC) and Review process (noting the obligations under sections 19, 26, 38 and 39 of the OPGGS(E) Regulations).

Table 5-9: Consultation Channels

Channel	Purpose
Consultation emails	These are the initial contact made to relevant persons and contain project and EP information, including contact details with various options to obtain more information, ask questions or provide feedback. All relevant persons identified through the relevant person search were sent an initial email that advised on obligation of titleholders to undertake consultation and the role of relevant persons, including inviting feedback on how they would like to be consulted. Consultation emails also included follow-up emails to ensure potentially relevant persons were aware of where to find information to consider and assess potential impacts.
Information Sheets	Short, sharp, digestible documents that outline the key facts related to this EP including: • a description of the environment. • a summary of the environmental impacts and risks. • a summary of the risk mitigation and management control measures. The information sheet was sent directly as well as being available on the Shell website. Information sheets should never be considered the sole way to communicate and may not be appropriate for all relevant persons.
Information Booklet	An overview of the Crux Project in one booklet, outlining all the various stages of the project and relevant activities of each EP.

Channel	Purpose
Information Sessions	A means to gather together similar relevant persons and present to them the content they require from the EP submission with an opportunity to ask questions. This was held in Broome.
Drop-in Sessions	Shell spent time in each of the locations identified below which allowed relevant persons to 'drop-in'. This allowed for appropriate and adapted consultation delivered in a flexible way to offer relevant persons an opportunity to have two-way dialogue with Shell and view information on the project. These drop-in sessions were widely advertised to ensure appropriate representation and locations chosen appropriate to the Planning Area: • Derby. • Broome. • Djarindjin. • Wyndham/Kununurra.
Tailored face to face / Microsoft Teams' meetings	These were held as required with relevant persons and provided additional opportunity to discuss matters of interest to the relevant person or organisation as well as ask questions or feedback in a two-way engagement.
Online materials and information	The website allows for more information to be included than an information sheet and allows relevant persons to handpick what interests them. The website includes a form which allows relevant persons to self-identity.
Sharing the entire draft EP via Shell's website	Transparent approach to what is included in the EP for those who want more detail.
Newspaper adverts/Local radio	Adverts placed in print media or local radio where print media was not available to allow relevant persons to self-identify. These ads were placed in regional locations along the geographic spread of the Planning Area. Ads were also placed to raise awareness of local drop-in sessions.
Social media	Social media posts were placed tactically across social media to allow relevant persons to self-identify. These ads targeted regional locations across the geographic spread of the Planning Area.
Industry support	Sharing information via membership/industry groups.
WAFIC	WAFIC provided fee for service consultation to directly engage with WA managed fisheries who had activities or interests in the EP operations areas. Tailored materials were provided to relevant fisheries.
Tuna Australia	Tuna Australia provided fee for service consultation to directly engage with Tuna managed fisheries who had activities of interests in the EP operations area.
Traditional communications	Email, telephone, posted mail.
Maps	Various maps were used to outline the proposed activity and overlaps with a relevant person's area of interest, for example: • A location map with relevant exclusion zones. • fisheries maps. • community maps.
Crux animation	Outlining the Crux activities in an easy-to-follow format.

Channel	Purpose
NOPSEMA's consultation brochure	Give relevant persons a better understanding of what the regulations require when it comes to consultation including: • the obligations of titleholders in consulting on EPs. • the roles and responsibilities of relevant persons. • further information from relevant persons was sought on environment values and sensitivities such as cultural values or features.
Power point presentations	These were tailored for relevant persons depending on specific areas or issues of interest based on feedback.

5.9.8 Government Departments or Agencies

The consultation channel used for relevant Commonwealth and State Government Departments or Agencies was email. If no response was received to the initial email, at least one follow-up email was sent. If there was still no response, it was assumed that the department or agencies had no objection or comment on the proposed activity. This was considered reasonable as government departments have systems and the resources to consult on matters of relevance to their portfolio.

5.9.9 Indigenous people and organisations

Shell acknowledges that Indigenous peoples are Australia's First Peoples and the Traditional Owners of the land and waters on which we work and live. Shell has been operating in Australia for over 120 years, developing proud partnerships with more than thirty Indigenous communities. Shell is committed to building meaningful relationships with Indigenous communities based on honesty, integrity, and respect.

The Full Federal Court has held that titleholders should adopt pragmatic and practical approaches to consultation conducted in accordance with section 25 of the OPGGS(E) Regulations. Consultation may be through properly notified and conducted meetings, or other engagements that facilitate genuine two-way dialogue between the titleholder and relevant persons such as approaches suggested by NTRBs, RNTBCs or PBCs. Meetings should be widely advertised to ensure appropriate representation. However, it is recognised that meetings may not be attended by all members of a group.

When approaching consultation with Indigenous relevant persons, Shell started with a broad approach, reviewing the Planning Area, which approaches a number of Native Title determinations (Figure 7-32; Section 7.10.3.2) with a further 50 km buffer for all searches to ensure a broad capture of potentially relevant persons.

This identified >50 Aboriginal organisations as fitting the criteria of relevant persons comprising:

- Land Councils.
- Aboriginal Land Trusts – which exist in the Northern Territory and include land held in trust for use by Aboriginal people by another entity.
- Native Title Representative Bodies (NTRB).
- Registered Native Title Bodies Corporate (RNTBCs – the formal name given to a group once Native Title has been determined).
- Prescribed Bodies Corporate (PBCs – the legal entity formed by a group of Native Title Claimants during the determination process but used interchangeably with RNTBC).
- Aboriginal Corporations – Aboriginal run or managed businesses, often operating on behalf of, or under a RNTBC, but also independently, and including Aboriginal Tourism providers.
- Land and Sea Management Groups – primarily Ranger Groups, many of whom operate under a RNTBC, but some who operate independently on an IPA, or as the result of an ILUA.

- Aboriginal Arts and Cultural centres.
- Native Title Claim groups.
- Advisory Committees.
- Individuals.

Following extensive research and community consultation, it was clear that not all groups considered themselves responsible for cultural and spiritual care of land and sea to equal or similar degrees. For example:

- NTRBs, including NLC and KLC, often provide administration services such as payroll, legal and human resource services to RNTBCs or PBCs who have chosen to use the NTRB as an umbrella organisation under which to function, in addition to their primary role of assisting with matters pertaining to Native Title claims and determinations. NTRBs were used by Shell where appropriate to advise on Indigenous groups who could be relevant or have sea Country or are located on the coast, preferred consultation approaches and to distribute consultation information to RNTBCs as deemed appropriate by the NTRB. However, the NTRBs do not consider it appropriate to represent the views of the RNTBCs or other groups who use their services, although in some circumstances they operate as a conduit or formal contact point for RNTBCs.
- Where an Aboriginal corporation operates under the umbrella of a RNTBC, they tend to be focused on running a business or service, and Native Title responsibilities (land and sea care and management) falls to the RNTBC and other appropriate sub-groups. This includes most (but not all) tourism service providers.
- Advisory Committees are comprised of individual RNTBCs, ranger groups and other Land Management groups, and do not speak with one voice on land, sea, and cultural values.
- Arts and Cultural Centres tend to be focused on their business, and again, defer land and sea cultural issues to the appropriate PBC or RNTBC.

Table 7-1 establishes that planned activity impacts are not expected to extend beyond ~38 km from the substructure location (based on noise and light modelling outcomes). Shell has very conservatively considered that planned impacts to Indigenous Peoples functions, interests or activities (including cultural values or features) are unlikely to extend beyond 50 km from the Activity Area (Figure 5-3 and Figure 5-4) therefore this was considered a reasonable basis for including this distance as a criteria for Tier 1 consultation efforts on those closest to the planned activities outlined in this EP and those who could provide inputs into cultural features closest to our planned activities. As a result, Shell prioritised consultation with these tier 1 relevant person groups as described below. However, regardless of which tier a group was placed in, Shell's overarching approach was to be collaborative and responsive in consultation, taking into account Indigenous Persons' or Organisations' feedback about the method of consulting. This is further explained later in this section.

Table 5-10 identifies the key Indigenous groups who were categorised into Tiers 0–3. Figure 5-3 and Figure 5-4 show the spatial location of Tier 1 and Tier 2 groups in relation to the 50 km line and the Planning Area.

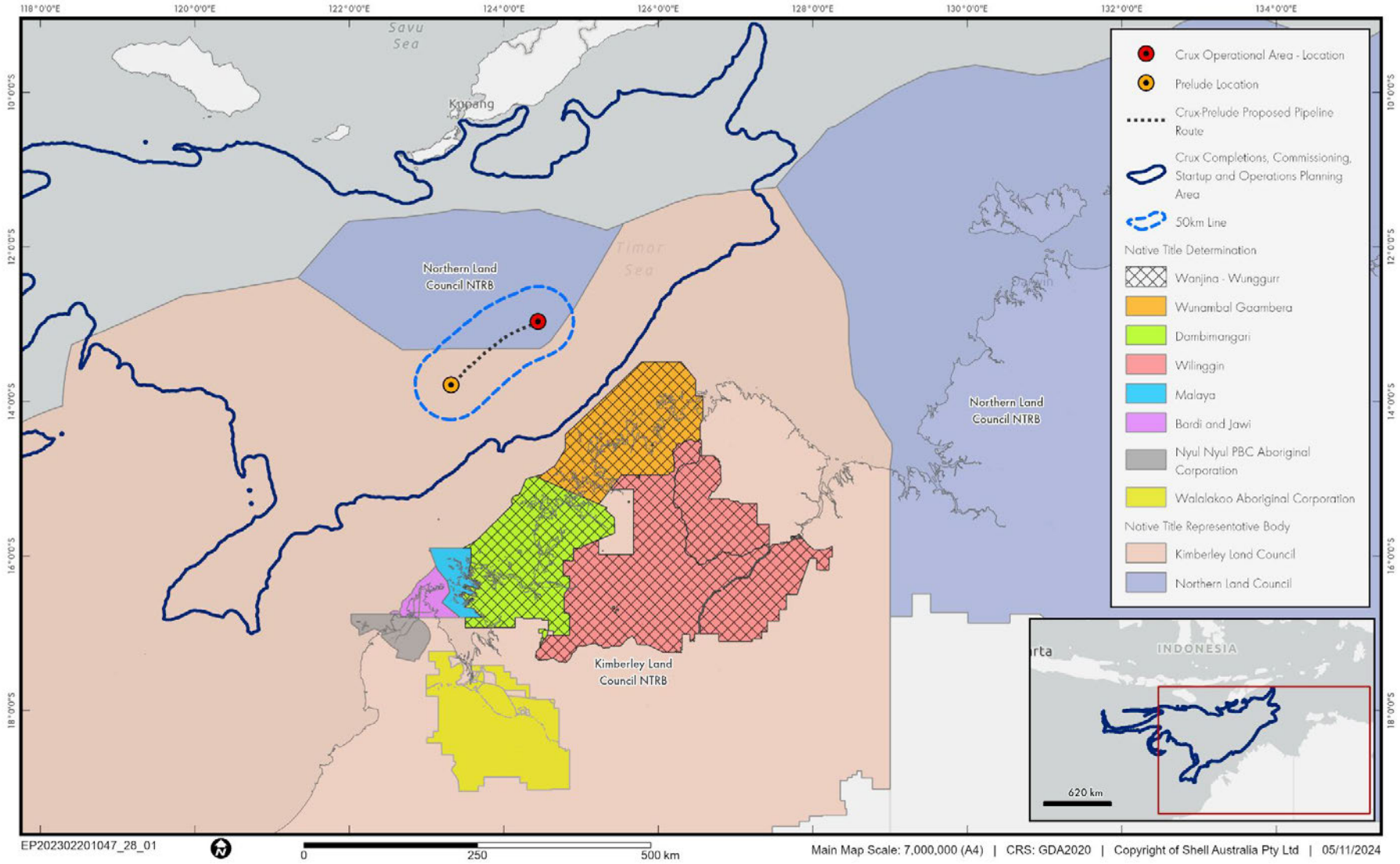


Figure 5-3: Shell Identified Tier 1 Indigenous Relevant Persons

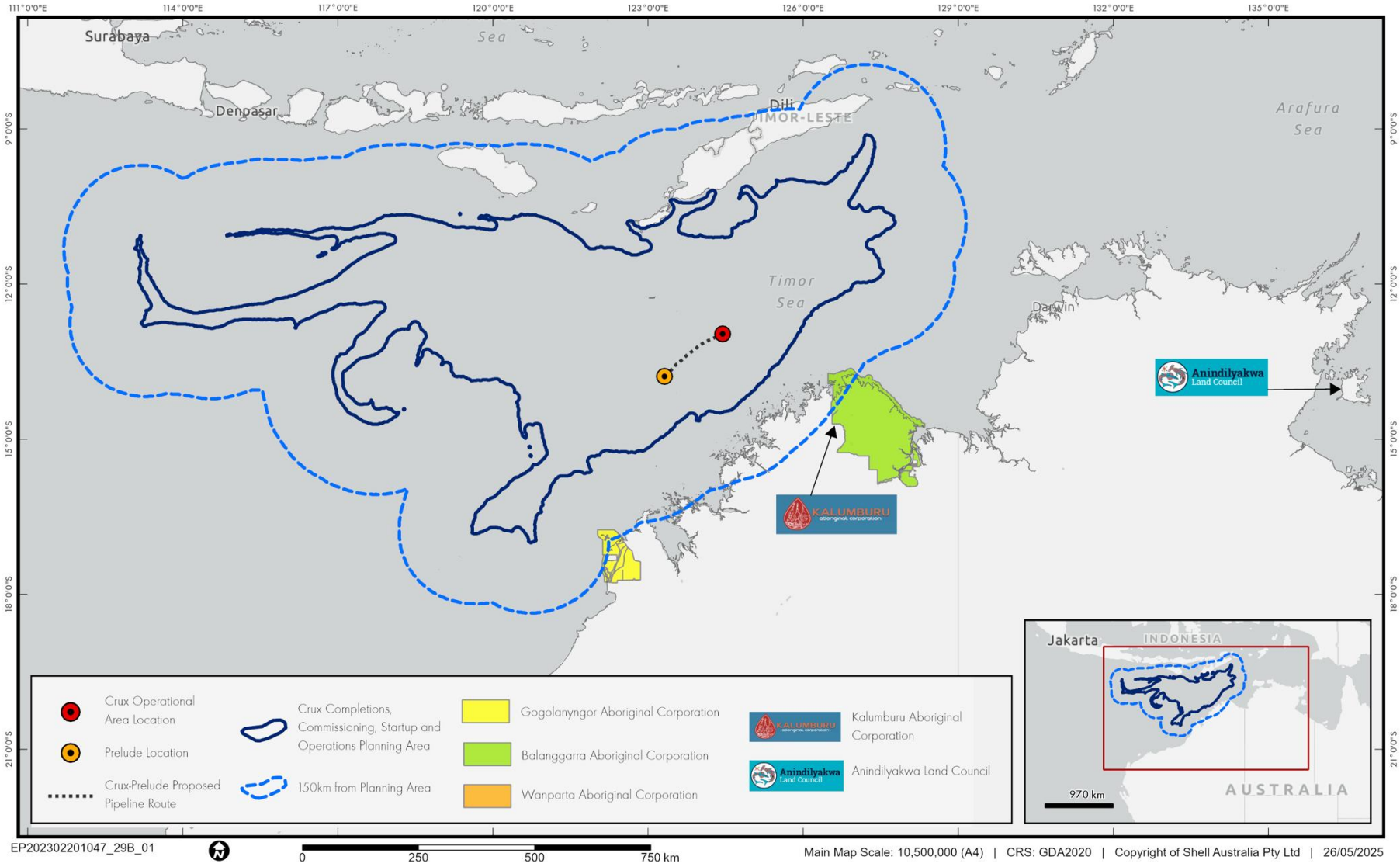


Figure 5-4: Shell Identified Tier 2 Indigenous Relevant Persons (excludes groups where spatial data was not available)

Table 5-10: Approach to Consultation with Relevant Indigenous Persons and Organisations

Shell may adjust tiering to reflect Indigenous relevant persons who identify cultural values and features throughout the consultation process for this, or previous EPs, and/or are identified as important to the broader Shell operational footprint.

Contact Methodology	Overview of Indigenous Relevant Person	Indigenous Relevant Persons	Efforts to initiate consultation
Tier 0	• Direct planned impact to functions, interests, or activities of PBC, NTRB or RNTBC or those they represent. • Includes planned desecration or potential significant impacts to known cultural values or features.	Shell has not identified any Indigenous relevant persons who have interests or activities such as cultural values or features within the Activity Area of this EP which will be impacted by the planned impacts of the activities. This is supported by an independent UCH survey by Cosmos Archaeology in 2023 which stated there are no tangible Indigenous features in the Activity Area as it is beyond the ancient coastline at 130 m below lowest astronomical tide (LAT), where there has never been any human occupation.	As a minimum, this would include genuine two-way dialogue with a representative of the communal interest affected seeking to reach agreement on the levels of proposed impacts to the cultural feature or value.
Tier 1	• Closest to planned activities – located/or with Sea Country within 50 km of the Activity Area on the Australian mainland, in the Kimberley, WA. • PBC, NTRB or RNTBC (excluding Tier 0). • Aboriginal corporation functioning under the authority of an RNTBC (excluding Tier 0).	Aligned to methodology • Kimberley Land Council (KLC). • Northern Land Council (NLC). Adjusted tiering • Bardi and Jawi Niimidiman Aboriginal Corporation RNTBC (BJNAC). • Nyul Nyul PBC Aboriginal Corporation (represented by KLC). • Mayala Inninalang Aboriginal Corporation RNTBC (incl Mayala 2). • Walalakoo Aboriginal Corporation RNTBC. • Wanjina-Wunggurr Aboriginal Corporation. • Dambimangari Aboriginal Corporation. • Wilinggin Aboriginal Corporation. • Wunambal Gaambera Aboriginal Corporation.	Precedence placed on consultation with these groups with focussed efforts, including attempting to contact by multiple forms of communication and seeking to establish long term relationships, where not already established and sought by relevant group.
Tier 2	• Those coastally adjacent to the Planning Area, defined as areas	• Anindilyakwa Land Council. • Balanggarra Aboriginal Corporation. • Gogolanyngor Aboriginal Corporation. • Kalumburu Aboriginal Corporation. • Wanparta Aboriginal Corporation.	Concerted effort to contact these groups by attempting multiple forms of communication as necessary, to gather inputs on cultural values or features and other matters to inform preparation of this EP.

Contact Methodology	Overview of Indigenous Relevant Person	Indigenous Relevant Persons	Efforts to initiate consultation
	of coastline which are within 150 km of the Planning Area[7]. • PBC, NTRB or RNTBC who are coastally adjacent to the Planning Area[7] (excluding Tier 0, Tier 1 and Tier 3). • Aboriginal corporations who are coastally adjacent to the Planning Area (excluding Tier 0, Tier 1 and Tier 3).		
Tier 3	• PBC, NTRB or RNTBC whose members are at the periphery of the Planning Area (excluding Tiers 0–2). • All other Indigenous people or organisations.	Remaining Indigenous relevant persons.	Emailed sufficient information with at least one follow-up.

[7] Beyond 150km from the planning area, there are deemed to be no 'coastally adjacent' areas to the planning area and therefore relevant persons are deemed too far away to be impacted more than an immaterial or negligible way.

When engaging with Indigenous relevant persons, Shell adopted a culturally appropriate tailored approach, in addition to the broader community engagement plan outlined in this EP. For example, where many face-to-face meetings occurred with RNTBCs and Aboriginal Corporations, Shell tailored the presentation material or verbal delivery of information to what Shell considered to be the primary ways their functions, interests or activities could be affected, or what was considered to be culturally appropriate to a particular group, such as have a local photo representing the title slide and Acknowledgement of Country. Tailoring of a verbal nature can be evidenced within meeting summaries emails or minutes within Appendix B.

At the commencement of consultation, Shell approached Indigenous relevant persons, including NTRBs, with a co-design strategy, offering various options (such as on-Country visits, meetings, yarning circles, phone calls, Indigenous Forums) to consult. This offered the opportunity for consultation to be led by Indigenous relevant persons, or the groups like NTRBs which represented them. This helped ensure that engagements could be culturally appropriate, respectful, and tailored to meet the needs of each person or group. Shell is also cognisant to varying degrees of potential communication barriers experienced by relevant persons and as such ensured information was delivered in layman's terms across several methods including verbal, visual and written.

The consultation co-design approach aimed to minimise negative impacts being experienced by relevant Indigenous persons and organisations, primarily due to consultation fatigue and ensure cultural obligations were carefully considered.

5.10 Consultation Summary

Shell explored alternative approaches to consultation to achieve an effective and culturally respectful engagement method. To implement the co-design approach, which also helps demonstrate reasonable efforts, Shell adopted specific suggestions by Indigenous people or organisations, including and in particular, NTRBs like KLC, where these occurred through the consultation period. This is because Shell relied significantly on the direction and input received from NTRBs, in the consultation approach which was used with the Indigenous people and organisations they support and represent. Shell adopted more focused consultation measures as suggested by the feedback, including but not limited to:

- Specific advice from NTRBs on consulting and obtaining appropriate contact details to consult with certain RNTBCs was received.
- Prioritising face to face meetings where possible.
- Prioritising phone call contact with known leaders of different Indigenous groups to establish rapport and relationship where contact details are freely available.
- Offering to meet at a time and location of choice with people identified by them as appropriate.
- Holding meetings that followed a format and approach determined and agreed by both parties (Indigenous person/organisation and Shell) e.g. TEACA.
- Full details on consultation co-design measures adopted during consultation with Indigenous persons and organisations is outlined in Appendix B.

5.10.1 Summary of Consultation with Tier 1 and Tier 2 Indigenous Relevant Persons

Table 5-11 provides a summary of consultation with Indigenous relevant persons who were consulted via Consultation Method – Tier 1.

Table 5-12 provides a summary of consultation with Indigenous relevant persons who were consulted via Consultation Method – Tier 2.

Table 5-11 and Table 5-12 are intended to demonstrate that consultation has been carried out for all Tier 1 and Tier 2 Indigenous relevant persons. The full summary of consultation for all relevant persons is provided in Appendix B.

Table 5-11: Tier 1 Indigenous Relevant Persons Consultation Completion Statement

Indigenous relevant person	Relevant person's Functions, Interests and Activities	Petroleum Activity Impacts and Risks which May Affect Relevant Persons Functions, Interests, or Activities	Nature and Scale of Effect on Relevant Persons Functions, Interests, or Activities	Sufficient Information Provided	Consultation Overview / Efforts to Consult For a full summary of contact, see Appendix B	Reasonable Period Provided	Appropriate Measures Adopted
29. Bardi and Jawi Niimidiman Aboriginal Corporation (BJNAC)	~340km from the Crux Activity Area to closest part of BJNAC Country. BJNAC represents the Native Title Determination on the North East of the Dampier Peninsula. BJNAC has the potential following Functions, Interests and Activities: • Represent the Bardi and Jawi Traditional Owners as the RNTBC and hold native title in trust. • Jointly manage the Bardi Jawi Gaarra Marine Park with WA DBCA. • Sea Country. • Cultural values. • Cultural features. • Indigenous traditional activities (e.g., fishing). • Have responsibility for Sea Country within the Kimberley Marine Park.	Spill risks have the potential to affect BJNAC's functions, interests, or activities.	Low, in accordance with Table 5-3: Division 3 – Section 25 of the OPGGS(E) Regulations. BJNAC's functions, interests and activities do not extend near the Activity Area. There are no planned impacts from Shell's activities predicted to occur to BJNAC functions, interests, and activities. They may be affected to a limited extent if a major spill event were to occur.	Information sheets were provided to BJNAC on 17 April 2024. Shell shared the draft EP on 16 October 2024. Shell published in social media, radio and newspapers which were targeted at groups or individuals within this region from April to June 2024 (Appendix A).	Shell has been engaging with BJNAC since March 2023 for previous Crux EPs and contact was made in August 2023 when a meeting was held with BJNAC. For the purposes of consultation on this EP, BJNAC received sufficient information on 17 April 2024. From April to October, Shell and BJNAC have exchanged many phone calls and emails regarding consultation and the terms of a consultation protocol that BJNAC provided to Shell. A meeting was held on 20 June 2024 seek to progress the consultation protocol. Following the 20 June 2024 meeting, Shell and BJNAC have continued to engage regarding organising meetings and the consultation protocol. Shell and BJNAC have been unable to reach alignment on the consultation protocol. Whilst this is not considered a relevant matter to this EP, Shell has been trying to progress a consultation protocol with BJNAC throughout the consultation period, given it was requested by BJNAC and Shell is committed to progressing genuine relationships. BJNAC and Shell have not been able to reach alignment on this as the current draft contains certain conditions that do not align with the Regulations. Shell has been clear in its explanation around why this cannot be signed at this time. From April 2024, Shell undertook a targeted media campaign in the region, using print, geotargeted social media and radio ads. The campaign urged potentially relevant persons to contact Shell and provided a link to the Crux project on the Shell website with access to draft EP s. These materials enabled relevant persons to make an informed decision about how their functions, interests, or activities may be affected, and a mechanism to consult with Shell on the EP– Appendix A. Shell's further reasonable efforts to consult with BJNAC has been demonstrated through offers to cover all reasonable costs associated with attending consultation meetings/forums (e.g., accommodation, travel and where appropriate reasonable costs of time) and also contact details for environmental consultants, some independent, paid for by Shell to support the relevant persons in assessing information and providing feedback to Shell. Shell considers that BJNAC and the community it represents have been afforded a reasonable opportunity to consult with Shell in preparing this EP. Shell notes it received a letter on behalf of BJNAC and an individual person who is a member of BJNAC in relation to a previous EP. Shell's response offered to consult with BJNAC and the individual. The individual has not come forward to identify as relevant for this EP.	Shell has been reaching out to BJNAC since April 2024. Sufficient information (such as information sheets and website links was provided to BJNAC in April 2024 A published version of the draft EP was available from October 2024. BJNAC had more than 6 months to review the information, and make an informed assessment about how their functions, interests or activities may be affected. BJNAC were also allowed reasonable time to consider the information provided and to access the offer of a consultant panel to support them in reviewing information and raising issues or input on Shell's proposed activity. Shell has also agreed to pay reasonable costs to support their participation and attendance in consultation meetings. Shell considers that BJNAC and the community it represents have been afforded a reasonable period to understand how this EP impacts their functions, interests or activities and engage with Shell to raise any claims or objections or for further discussion	No measures were adopted for this EP.

Justification that the Regulation 25 obligations and Regulation 34(g) acceptance criteria have been met.

BJNAC's functions, interests and activities are only potentially impacted by the spill risk from Shell's activities (through dissolved/entrained oil). Any impact to BJNAC's functions, interests and activities is predicted to be slight. Other than source control options which are already planned to be implemented by Shell in the event of a spill, there are no other available options to directly mitigate or reduce the impacts of dissolved/entrained oil during spills which could occur from this activity. The nature and scale of how BJNAC's functions, interests or activities is predicted to be affected is low. Therefore, further attempts to consult are unlikely to improve risk management or further reduce the environmental impacts of a spill in accordance with the objects of consultation in preparing an EP. BJNAC maintain Shell has not started consultation but Shell has (i) provided sufficient information to inform BJNAC how their functions, interests and activities may be affected,; (ii) made reasonable efforts to consult,; and (iii) provided a reasonable period for BJNAC to review information and determine if their functions, interests, and activities may be affected and to review information, and provide feedback to Shell. Given the remote likelihood and scale of potential risks to BJNAC's functions, interests and activities, that sufficient information and a reasonable period for consultation has been provided and appropriate measures adopted, the EP demonstrates that the acceptance criteria in accordance with Regulation 34(g)have been satisfied.

Indigenous relevant person	Relevant person's Functions, Interests and Activities	Petroleum Activity Impacts and Risks which May Affect Relevant Persons Functions, Interests, or Activities	Nature and Scale of Effect on Relevant Persons Functions, Interests, or Activities	Sufficient Information Provided	Consultation Overview / Efforts to Consult For a full summary of contact, see Appendix B	Reasonable Period Provided	Appropriate Measures Adopted
44. Mayala Inninalang Aboriginal Corporation (MIAC) (incl Mayala 2)	Approx 350km from the Crux Activity Area to closest part of MIAC Country. Represent Indigenous people located in the North Kimberley region of Australia. KLC is the NTRB for MIAC. MIAC has the potential following Functions, Interests and Activities: • Sea Country. • Cultural values. • Cultural features. • Indigenous traditional activities (e.g., fishing). • Have responsibility for Sea Country within the Kimberley Marine Park.	Spill risks have the potential to affect MIAC's functions, interests, or activities.	Low, in accordance with Table 5 3: Division 3 – Section 25 of the OPGGS(E) Regulations MIAC's functions, interests and activities do not extend near the Activity Area for this activity. There are no planned impacts predicted to MIAC's functions, interests, and activities. They may be affected to a limited extent if a major spill event were to occur.	Information sheets were provided to MIAC on 08 April 2024. A further email was sent on 08 August 2024 with the information sheets attached again. Shell shared the draft EP on 16 October 2024. Shell published in social media, radio and newspapers which were targeted at groups or individuals within this region from April to June 2024 (Appendix A).	Shell has been engaging with MIAC since March 2023 for previous Crux EPs and contact was made in August 2023 when a meeting was held with MIAC. For the purposes of consultation on this EP, MIAC received sufficient information on 08 April 2024. Shell tried to call MIAC on 19 April 2024 with no response, and a further reminder was sent on 8 August 2024. Shell spoke with MIAC on 22 August 2024 with Shell offering to meet at MIACs convenience. Shell provided a further opportunity on the 16 October 2024 for MIAC to provide input to Shell for EP preparation, sharing the draft EP, clearly restating the purpose of consultation, the request for their input on matters we may not be aware of, such as cultural values or features, or objections or claims they may have about the activity. From April 2024, Shell undertook a targeted media campaign in the region, using print, geotargeted social media and radio ads. The campaign urged potentially relevant persons to contact Shell and provided a link to the Crux project on the Shell website with access to draft EP s. These materials enabled relevant persons to make an informed decision about how their functions, interests, or activities may be affected, and a mechanism to consult with Shell on the EP– Appendix A. Shell's further reasonable efforts to consult with MIAC has been demonstrated through offers to cover all reasonable costs associated with attending consultation meetings/forums (e.g., accommodation, travel and where appropriate reasonable costs of time) and also contact details for environmental consultants, some independent, paid for by Shell to support the relevant persons in assessing information and providing feedback to Shell. Shell considers that MIAC and the community it represents have been afforded a reasonable opportunity to consult with Shell in preparing this EP.	Shell has been reaching out to MIAC since April 2024 when sufficient information (such as information sheets and website) was provided to them. MIAC had more than 6 months to review the information, and make an informed assessment about how their functions, interests or activities may be affected. Shell also shared the draft EP in October 2024, giving an additional one month with the full EP. It also allowed reasonable time to digest information provided and to access the offer of a consultant panel to support them in reviewing information and raising issues or input on Shell's proposed activity. Shell considers that MIAC and the community it represents have been afforded a reasonable period to understand how this EP impacts their functions, interests or activities and engage with Shell for further discussion.	No measures adopted.
Justification that the Regulation 25 obligations and Regulation 34(g) acceptance criteria have been met. MIAC's functions, interests and activities are only potentially impacted by the spill risk from Shell's activities (through dissolved/entrained oil). Any impact to MIAC's functions, interests and activities is predicted to be slight. Other than source control options which are already planned to be implemented by Shell in the event of a spill, there are no other available options to directly mitigate or reduce the impacts of dissolved/entrained oil during spills which could occur from this activity. Therefore, further consultation is unlikely to improve risk management or further reduce the environmental impacts of a spill in accordance with the objects of consultation in preparing an EP. Shell has provided sufficient information to inform MIAC how their functions, interests and activities may be affected, made reasonable efforts to consult, having met in a face-to-face meeting, and provided further opportunity for follow-up meeting if they wanted. Shell has also provided a reasonable period for MIAC to determine if their functions, interest and activities may be affected and to review information, with support offered by Shell through providing options for environmental consultants to support MIAC and provide feedback to Shell. Given the remote likelihood and scale of potential risks to MIAC's functions, interests and activities, MIAC has been provided sufficient information, a reasonable period to consult, having been sufficiently informed of the purpose of consultation and their rights in the process. Therefore, consultation has been carried out in accordance with Regulation 34(g).							

Indigenous relevant person	Relevant person's Functions, Interests and Activities	Petroleum Activity Impacts and Risks which May Affect Relevant Persons Functions, Interests, or Activities	Nature and Scale of Effect on Relevant Persons Functions, Interests, or Activities	Sufficient Information Provided	Consultation Overview / Efforts to Consult For a full summary of contact, see Appendix B	Reasonable Period Provided	Appropriate Measures Adopted
114. Northern Land Council (NLC)	NLC represents Indigenous people located in the Top End of the Northern Territory of Australia. NLC has a function as the NTRB in relation to the Ashmore and Cartier Islands area. NLC are also the contact point for the following specific RNTBCs, PBCs or native title applicants identified as relevant persons for the purposes of this EP: • Top End Aboriginal Corporation • Arnhem Land Aboriginal Land Trust	Spill risks have the potential to affect NLC's, functions, interests, or activities.	Low, in accordance with Table 5 3: Division 3 – Section 25 of the OPGGS(E) Regulations NLC's area of responsibility as an NTRB overlaps with the Activity Area and Planning Area. There are no planned impacts predicted to NLC's functions, interests, and activities. They may be affected to a limited extent if a major spill event were to occur.	Information sheets were provided to NLC on 10 April 2024. Shell shared the draft EP in October 2024. Shell published in social media, radio and newspapers which were targeted at groups or individuals within this region from April to June 2024 (Appendix A).	Shell has been consulting with NLC since March 2023 for previous Crux EPs and Shell met face to face with NLC in May 2023. For the purposes of consultation on this EP, NLC received sufficient information on 10 April 2024. As the peak Indigenous body in the Northern Territory and Ashmore and Cartier Island territories, NLC were requested by Shell to forward information to NLC members outlined in the second column of this table. Shell spoke to NLC on 13 May 2024 and requested a call back to confirm receipt of emails and to arrange a meeting. Shell then reached out to NLC again on 27 May 2024 to request assistance with sharing information with Top End Aboriginal Corporation and Arnhem Land Aboriginal Land Trust. Shell tried calling NLC again on 15 July 2024 which was passed to voicemail. Several further emails were sent to NLC from 15 July through to September, when Shell reached out with the possibility to meet while in Darwin in September. Shell provided a further opportunity on the 15 October 2024 for NLC to provide input to Shell for EP preparation, sharing the draft EP, clearly restating the purpose of consultation, the request for their input on matters we may not be aware of, such as cultural values or features, or objections or claims they may have about the activity. From April 2024, Shell undertook a targeted media campaign in the region, using print, geotargeted social media and radio ads. The campaign urged potentially relevant persons to contact Shell and provided a link to the Crux project on the Shell website with access to draft Environment Plans. These materials enabled relevant persons to make an informed decision about how their functions, interests, or activities may be affected, and a mechanism to consult with Shell on the EP (Appendix A). Shell's further reasonable efforts to consult with NLC has been demonstrated through offers to cover all reasonable costs associated with attending consultation meetings/forums (e.g., accommodation, travel and where appropriate reasonable costs of time) and contact details for environmental consultants, some independent, paid for by Shell to support the relevant persons in assessing information and providing feedback to Shell. Shell considers that NLC have been afforded a reasonable opportunity to consult with Shell in preparing this EP.	Shell has been reaching out to NLC since April 2024 when sufficient information (such as information sheets and website) was provided to them. NLC had more than 6 months to review the information, and make an informed assessment about how their functions, interests or activities may be affected. Shell also shared the draft EP in October, giving an additional one month with the full EP. It also allowed reasonable time to digest information provided and to access the offer of a consultant panel to support them in reviewing information and raising issues or input on Shell's proposed activity. Shell considers that NLC and the community it represents have been afforded a reasonable period to understand how this EP impacts their functions, interests or activities and engage with Shell for further discussion.	No measures were adopted for this EP.
Justification that the Regulation 25 obligations and Regulation 34(g) acceptance criteria have been met. NLC is the peak Indigenous body and NTRB in the north part of the Northern Territory and Ashmore and Cartier Island Territories. Shell has provided sufficient information and a reasonable period for consultation with the NLC as demonstrated by the provision of information. Therefore, consultation has been completed in accordance with section 34(g) of the OPGGS(E) Regulations.							

Indigenous relevant person	Relevant person's Functions, Interests and Activities	Petroleum Activity Impacts and Risks which May Affect Relevant Persons Functions, Interests, or Activities	Nature and Scale of Effect on Relevant Persons Functions, Interests, or Activities	Sufficient Information Provided	Consultation Overview / Efforts to Consult For a full summary of contact, see Appendix B	Reasonable Period Provided	Appropriate Measures Adopted
125. Wunambal Gaambera Aboriginal Corporation (WGAC) Wanjina-Wunggurr Aboriginal Corporation is the formal RNTBC for the Dambimangari, Uunguu Part A, Uunguu - Area B, Wanjina - Wunggurr Wilinggin Native Title claim, determined between 2004 and 2012. However, day to day management of the Determined area is in the hands of three separate Aboriginal Corporations: • Dambimangari Aboriginal Corporation • Wunambal Gaambera Aboriginal Corporation and • Wilinggin Aboriginal Corporation.	~140 km from the Activity Area to closest part of WGAC Country. WGAC represents the northern part of the Wanjina Wunggurr Native Title Determination and the interests of the Uunguu People. WGAC has the potential following Functions, Interests or Activities: • Cultural values • Cultural features • Indigenous traditional activities (e.g., fishing) • Have responsibility for Sea Country within the Kimberley Marine Park.	Spill risks have the potential to affect WGAC's functions, interests, or activities.	Low, in accordance with Table 5 3: Division 3 – Section 25 of the OPGGS(E) Regulations, WGAC's functions, interests and activities do not extend near the Activity Area. There are no planned impacts from Shell's activities predicted to occur to WGAC's functions, interests, and activities. They may be affected to a limited extent if a major spill event were to occur.	Information sheets were provided to WGAC on 08 April 2024. A face to face meeting occurred on 23 August WGAC with a tailored presentation pack (Appendix A). Shell shared the draft EP in October 2024. Shell published in social media, radio and newspapers which were targeted at groups or individuals within this region from April to June 2024 (Appendix A).	Shell has been engaging WGAC since March 2023 for previous Crux EPs and contact was made in September 2023 when a meeting was held with WGAC. For the purposes of consultation on this EP, WGAC received sufficient information on 08 April 2024. Multiple follow up calls were made in April and May with no response. Shell also attempted to contact WGAC via the North Kimberley Airport in May, with no response. On 20 August 2024, WGAC contacted Shell related to a different matter which resulted in a meeting on 23 August 2024. The Crux Project and underwater cultural heritage work were discussed. WGAC provided a copy of their Wunambal Gaambera Healthy Country Plan – Looking after Wunambul Gaambera Country 2021-2030 (WGAC, 2021) and Uunguu Inddigenous Protected Area: Wundaagu (Saltwater) Country, Plan of Management 2021-2030 (WGAC, 2023). Shell offered an opportunity to meet on-Country, and WGAC said they would consider and respond. A follow up attempt was made but no further meeting has been scheduled. Shell provided a further opportunity on the 16 October 2024 for WGAC to provide input to Shell for EP preparation, sharing the draft EP, clearly restating the purpose of consultation, the request for their input on matters we may not be aware of, such as cultural values or features, or objections or claims they may have about the activity. From April 2024, Shell undertook a targeted media campaign in the region, using print, geotargeted social media and radio ads. The campaign urged potentially relevant persons to contact Shell and provided a link to the Crux project on the Shell website with access to draft EP s. These materials enabled relevant persons to make an informed decision about how their functions, interests, or activities may be affected, and a mechanism to consult with Shell on the EP– Appendix A. Shell's further reasonable efforts to consult with WGAC has been demonstrated through offers to cover all reasonable costs associated with attending consultation meetings/forums (e.g., accommodation, travel and where appropriate reasonable costs of time) and also contact details for environmental consultants, some independent, paid for by Shell to support the relevant persons in assessing information and providing feedback to Shell. Shell considers that WGAC and the community it represents have been afforded a reasonable opportunity to consult with Shell in preparing this EP.	Shell has been reaching out to WGAC since April 2024 when sufficient information (such as information sheets and website) was provided to them. WGAC had more than 6 months to review the information, and make an informed assessment about how their functions, interests or activities may be affected. Shell also shared the draft EP in October, giving an additional one month with the full EP. It also allowed reasonable time to digest information provided and to access the offer of a consultant panel to support them in reviewing information and raising issues or input on Shell's proposed activity. Shell considers that WGAC and the community it represents have been afforded a reasonable period to understand how this EP impacts their functions, interests or activities and engage with Shell for further discussion.	WGAC provided a current copy of Healthy Country Plan and IPA Management Plan to Shell. The Healthy Country Plan and IPA Management Plan has been reviewed against the previous version which was considered in the initial research work undertaken which supports this EP. No further measures adopted.
Justification that the Regulation 25 obligations and Regulation 34(g) acceptance criteria have been met. WGAC's functions, interests and activities are only potentially impacted by the spill risk from Shell's activities (through dissolved/entrained oil). Any impact to WGAC's functions, interests and activities is predicted to be slight. Other than source control options which are already planned to be implemented by Shell in the event of a spill, there are no other available options to directly mitigate or reduce the impacts of dissolved/entrained oil during spills which could occur from this activity. Therefore, further consultation is unlikely to improve risk management or further reduce the environmental impacts of a spill in accordance with the objects of consultation in preparing an EP. Given the remote likelihood and scale of potential risks to WGAC's functions, interests and activities, Shell provided sufficient information to inform WGAC how their functions, interests and activities may be affected, provided information to make WGAC sufficiently informed of their rights and their opportunity to be consulted, made reasonable efforts to consult WGAC. Shell also provided a reasonable period for WGAC to determine if their functions, interests, and activities may be affected and to review information and provide feedback to Shell. Shell supported WGAC in this process by providing access to reasonable support in the form of environmental consultants to support advising WGAC and offers of reasonable financial support to attend forums. Shell has also adopted appropriate measures as a result of consultation carried out with WGAC. Since Shell has provided WGAC sufficient information, a reasonable period to consider the information and be able to respond and appropriate measures have been adopted, consultation has been carried out in accordance with section 34(g) of the OPGGS(E) Regulations.							

Indigenous relevant person	Relevant person's Functions, Interests and Activities	Petroleum Activity Impacts and Risks which May Affect Relevant Persons Functions, Interests, or Activities	Nature and Scale of Effect on Relevant Persons Functions, Interests, or Activities	Sufficient Information Provided	Consultation Overview / Efforts to Consult For a full summary of contact, see Appendix B	Reasonable Period Provided	Appropriate Measures Adopted
31. Dambimangari Aboriginal Corporation (DAC) Wanjina-Wunggurr Aboriginal Corporation is the formal RNTBC for the Dambimangari, Uunguu Part A, Uunguu - Area B, Wanjina - Wunggurr Wilinggin Native Title claim, determined between 2004 and 2012. However, day to day management of the Determined area is in the hands of three separate Aboriginal Corporations: • Dambimangari Aboriginal Corporation. • Wunambal Gaambera Aboriginal Corporation. • Wilinggin Aboriginal Corporation.	Approx 230 km from the Crux field to closest part of DAC Country Represents Indigenous people located in the North Kimberley region of Australia. KLC is the NTRB for DAC, via WWAC. DAC have the following potential Functions, Interests and Activities: • Sea Country. • • Cultural values. • Cultural features. • Indigenous traditional activities (e.g., fishing). • Have responsibility for Sea Country within the Kimberley Marine Park.	Spill risks have the potential to affect DAC's functions, interests, or activities.	Low, in accordance with Table 5 3: Division 3 – Section 25 of the OPGGS(E) Regulations. DAC's functions, interests and activities do not extend near the Activity Area. There are no planned impacts predicted to DAC's functions, interests, and activities. They may be affected to a limited extent if a major spill event were to occur.	Information sheets were provided to DAC on 8 April. Face to face meeting held with DAC on 10 April 2024, with a tailored presentation pack (Appendix A). Shell shared the draft EP in October 2024. Shell published in social media, radio and newspapers which were targeted at groups or individuals within this region from April to June 2024 (Appendix A).	Shell has been consulting with DAC since March 2023 for previous Crux EPs and Shell met face to face with DAC in September 2023. Specific to this EP, sufficient information was shared with DAC on 8 April 2024, followed by a face to face meeting shortly afterwards on 10 April. No objections or claims were raised regarding environmental management of impacts/risks of the activities. Shell liaised with DAC throughout April to August to schedule an additional meeting. The meetings were scheduled in August then October, due to leadership changes DAC requested to postpone these dates, which Shell respected. This resulted in a meeting with DAC on 4 December 2024 with a focus on social performance and Crux operations. From April 2024, Shell undertook a targeted media campaign in the region, using print, geotargeted social media and radio ads. The campaign urged potentially relevant persons to contact Shell and provided a link to the Crux project on the Shell website with access to draft EP s. These materials enabled relevant persons to make an informed decision about how their functions, interests, or activities may be affected, and a mechanism to consult with Shell on the EP– Appendix A. Shell's further reasonable efforts to consult with DAC has been demonstrated through offers to cover all reasonable costs associated with attending consultation meetings/forums (e.g., accommodation, travel and where appropriate reasonable costs of time) and also contact details for environmental consultants, some independent, paid for by Shell to support the relevant persons in assessing information and providing feedback to Shell. Shell considers that DAC and the community it represents have been afforded a reasonable opportunity to consult with Shell in preparing this EP.	Shell has been reaching out to DAC since April 2024. Sufficient information (such as information sheets and website) was provided to DAC in April 2024. This allowed DAC more than 6 months to review the information, and make an informed assessment about how their functions, interests or activities may be affected. Shell also shared the draft EP with DAC in October 2024, giving an additional one month with the full EP. It also allowed reasonable time to digest information provided and to access the offer of a consultant panel to support them in reviewing information and raising issues or input on Shell's proposed activity. Shell agreed to pay reasonable costs to support their participation and attendance in consultation meetings. Shell considers that DAC and the community it represents have been afforded a reasonable period to understand how this EP impacts their functions, interests or activities and engage with Shell for further discussion.	Shell confirmed that we have been consulting with ISWAG as a relevant person for this EP, following feedback from Dambimangari.
Justification that the Regulation 25 obligations and Regulation 34(g) acceptance criteria have been met. DACs functions, interests and activities are only potentially impacted by the spill risk from Shell's activities (through dissolved/entrained oil). Any impact to DAC functions, interests and activities is predicted to be slight. Other than source control options which are already planned to be implemented by Shell in the event of a spill, there are no other available options to directly mitigate or reduce the impacts of dissolved/entrained oil during spills which could occur from this activity. Shell has had multiple, meaningful two-way dialogues with DAC representatives, and they have provided input which led to measures being adopted in the EP. Therefore, further consultation is unlikely to further improve risk management or further reduce the environmental impacts of a spill in accordance with the objects of consultation in preparing an EP. Shell has provided sufficient information to inform DAC how their functions, interests and activities may be affected, made reasonable efforts to consult, provided a reasonable period for DAC to determine if their functions, interests, and activities may be affected and to review information and provide feedback to Shell. Given the remote likelihood and scale of potential risks to DAC's functions, interests, and activities, that sufficient information and a reasonable period for consultation has been provided and appropriate measures adopted, consultation has been carried out in accordance with section 34(g) of the OPGGS(E) Regulations.							

Indigenous relevant person	Relevant person's Functions, Interests and Activities	Petroleum Activity Impacts and Risks which May Affect Relevant Persons Functions, Interests, or Activities	Nature and Scale of Effect on Relevant Persons Functions, Interests, or Activities	Sufficient Information Provided	Consultation Overview / Efforts to Consult For a full summary of contact, see Appendix B	Reasonable Period Provided	Appropriate Measures Adopted
38. Kimberley Land Council (KLC)	KLC has a function as the NTRB in relation to the administration of Native Title and may represent Native Title applicants and holders' interests in relation to existing Native Title claims and determinations that extend into Sea Country. They are also the contact point for the following specific RNTBCs, PBCs or native title applicants identified as relevant persons for the purposes of this EP. • Kimberley Ranger Network • Nimanburr Aboriginal Corporation • Nyul Nyul PBC Aboriginal Corporation • Nyul Nyul Rangers. KLCs have the potential Functions, Interests and Activities: • Sea Country. • Cultural values. • Cultural features. • Indigenous traditional activities (e.g., fishing). • Responsible for Sea Country within the Kimberley Marine Park.	Spill risks have the potential to affect KLC's, functions, interests, or activities or the RNTBCs, PBCs or Aboriginal Corporations they represent.	Low, in accordance with Table 5 3: Division 3 – Section 25 of the OPGGS(E) Regulations.KLC's area of responsibility as an NTRB overlaps with the Planning Area. KLC's interests and activities do not extend near the Activity Area. There are no planned impacts predicted to KLC's functions, interests, and activities. They may be affected to a limited extent if a major spill event were to occur.	Information sheets were provided to KLC on 8 April 2024. Shell shared the draft EP in October 2024. Shell published in social media, radio and newspapers which were targeted at groups or individuals within this region from April to June 2024 (Appendix A).	Shell has been attempting to meet face to face with KLC since March 2023 for previous Crux EPs. For the purposes of consultation for this EP, KLC received sufficient information on 8 April 2024. As the peak Indigenous body in the Kimberley, KLC were also used to make contact with the RNTBCs, PBCs and Aboriginal Corporations they represent. The KLC is the formal contact point for the groups outlined in the second column of this table. Shell therefore determined that the appropriate way to consult with these organisations was through their formal contact point, KLC. While KLC is the formal contact point, Shell has also made direct contact with groups that KLC represents. Shell requested a meeting with KLC on 17 April, KLC were unavailable to meet. Throughout all consultation with KLC, and the groups it is the formal contact point for, no objections or claims have been raised. From April 2024, Shell undertook a targeted media campaign in the region, using print, geotargeted social media and radio ads. The campaign urged potentially relevant persons to contact Shell and provided a link to the Crux project on the Shell website with access to draft EP s. These materials enabled relevant persons to make an informed decision about how their functions, interests, or activities may be affected, and a mechanism to consult with Shell on the EP (Appendix A). Shell's further reasonable efforts to consult KLC has been demonstrated through offers to cover all reasonable costs associated with attending consultation meetings/forums (e.g., accommodation, travel and where appropriate reasonable costs of time) and also contact details for environmental consultants, some independent, paid for by Shell to support the relevant persons in assessing information and providing feedback to Shell. Shell considers that KLC and the organisations it is the formal contact point for have been afforded a reasonable opportunity to consult with Shell in preparing this EP.	Shell has been reaching out to KLC since April 2024. Sufficient information (such as information sheets and website) were provided to KLC in April 2024. The KLC was also requested to forward it on to other RNTBCs, PBCs and Aboriginal Corporations. KLC had more than 6 months to review the information, and make an informed assessment about how their functions, interests or activities may be affected. Shell also shared the draft EP with KLC in October 2024, giving an additional one month with the full EP. It also allowed reasonable time to digest information provided and to access the offer of a consultant panel to support them in reviewing information and raising issues or input on Shell's proposed activity. Shell considers that KLC and the community it represents have been afforded a reasonable period to understand how this EP impacts their functions, interests or activities and engage with Shell for further discussion.	No measures were adopted for this EP.

Justification that the Regulation 25 obligations and Regulation 34(g) acceptance criteria have been met.

KLC is the peak Indigenous body and NTRB in the Kimberley region working with Indigenous people to secure native title, conduct conservation and land management activities and develop cultural business enterprises. Shell has provided sufficient information and a reasonable period for consultation with the KLC as demonstrated by the provision of information. Shell also requested that KLC share the information provided with the groups they represent to ensure they also get sufficient information and a reasonable period to provide input, claims or objections. Shell has adopted appropriate measures related to all relevant matters raised by KLC during consultation where suggestions were made on how to better reach members they support which may be affected by the activities of this EP. Therefore, consultation has been completed in accordance with section 34(g) of the OPGGS(E) Regulations.

Indigenous relevant person	Relevant person's Functions, Interests and Activities	Petroleum Activity Impacts and Risks which May Affect Relevant Persons Functions, Interests, or Activities	Nature and Scale of Effect on Relevant Persons Functions, Interests, or Activities	Sufficient Information Provided	Consultation Overview / Efforts to Consult For a full summary of contact, see Appendix B	Reasonable Period Provided	Appropriate Measures Adopted
54. Walalakoo Aboriginal Corporation (WAC)	Approx 470 km from the Crux field to closest part of WAC Country. Represent the Nyikina Mangala people of the Kimberley region in Western Australia, based in Derby. WAC has the potential following Functions, Interests or Activities: • WAC identified a culturally sensitive reef in the region. Cultural values. • Cultural features.	Spill risks have the potential to affect WAC's functions, interests, or activities.	Low, in accordance with Table 5 3: Division 3 – Section 25 of the OPGGS(E) Regulations. WAC's functions, interests and activities do not extend near the Activity Area. There are no planned impacts from Shell's activities predicted to occur to Walalakoo's functions, interests, and activities. They may be affected to a limited extent if a major spill event were to occur.	Information sheets were provided to WAC on 06 June 2024. Prior to this, attempts were made to call WAC first to discuss. Over the course of July and August Shell made attempts to call WAC but there was no answer. A further email was sent on 22 August 2024 with the information sheets attached again. Shell shared the draft EP in October 2024. Shell published in social media, radio and newspapers which were targeted at groups or individuals within this region from April to June 2024 (Appendix A).	Shell has been engaging with WAC since March 2023 for previous Crux EPs and contact was made in August 2023. For the purposes of consultation on this EP, Shell called WAC on 5 June prior to sending them sufficient information on 6 June 2024. Shell attempted to call WAC several times and made contact on 22 August who provided a contact number. Shell tried that number which was not answered and following up these attempts with an email. Shell provided a further opportunity on the 16 October 2024 for WAC to provide input to Shell for EP preparation, including the draft EP, clearly restating the purpose of consultation, the request for their input on matters we may not be aware of, such as cultural values or features, or objections or claims they may have about the activity. Shell received an email from WAC on 25 October 2024 providing Shell with a draft resourcing protocol. Shell responded to this email on 12 November 2024. From April 2024, Shell undertook a targeted media campaign in the region, using print, geotargeted social media and radio ads. The campaign urged potentially relevant persons to contact Shell and provided a link to the Crux project on the Shell website with access to draft EPs. These materials enabled relevant persons to make an informed decision about how their functions, interests, or activities may be affected, and a mechanism to consult with Shell on the EP (Appendix A). Shell's further reasonable efforts to consult with WAC has been demonstrated through offers to cover all reasonable costs associated with attending consultation meetings/forums (e.g., accommodation, travel and where appropriate reasonable costs of time) and also contact details for environmental consultants, some independent, paid for by Shell to support the relevant persons in assessing information and providing feedback to Shell.	Shell has been reaching out to WAC since June 2024 when sufficient information (such as information sheets and website) was provided to them. WAC had more than 5 months to review the information, and make an informed assessment about how their functions, interests or activities may be affected. Shell also shared the draft EP in October 2024, giving an additional one month with the full EP. WAC were allowed reasonable time to digest information provided and to access the offer of a consultant panel to support them in reviewing information and raising issues or input on Shell's proposed activity. Shell considers that WAC and the community it represents have been afforded a reasonable period to understand how this EP impacts their functions, interests or activities and engage with Shell for further discussion.	No measures were required to be adopted as a result of consultation with WAC for this EP.

Justification that the Regulation 25 obligations and Regulation 34(g) acceptance criteria have been met.

WAC's functions, interests and activities are only potentially impacted by the spill risk from Shell's activities (through dissolved/entrained oil). Any impact to WAC's functions, interests and activities is predicted to be slight. Other than source control options which are already planned to be implemented by Shell in the event of a spill, there are no other available options to directly mitigate or reduce the impacts of dissolved/entrained oil during spills which could occur from this activity. Therefore, further consultation is unlikely to improve risk management or further reduce the environmental impacts of a spill in accordance with the objects of consultation in preparing an EP. Given the remote likelihood and scale of potential risks to WAC's functions, interests and activities, Shell provided sufficient information to inform WAC how their functions, interests and activities may be affected, provided information to make WAC sufficiently informed of their rights and their opportunity to be consulted, made reasonable efforts to consult WAC. Shell also provided a reasonable period for WAC to determine if their functions, interests, and activities may be affected and to review information and provide feedback to Shell. Shell supported WAC in this process by providing access to reasonable support in the form of environmental consultants to support advising WAC and offers of reasonable financial support to attend forums. Shell has also adopted appropriate measures as a result of consultation carried out with WAC. Since Shell has provided WAC sufficient information, a reasonable period to consider the information and be able to respond and appropriate measures have been adopted, consultation has been carried out in accordance with section 34(g) of the OPGGS(E) Regulations.

Whilst this is not considered a relevant matter to this EP, Shell has provided feedback to WAC on the consultation protocol provided, with further discussion required. This will be progressed outside of this EP.

Shell has offered to cover all reasonable costs related to consultation, to meet on country with appropriate representatives, as advised by Walalakoo as well as offering access to the Environment Panel for which Shell will cover the costs.

Indigenous relevant person	Relevant person's Functions, Interests and Activities	Petroleum Activity Impacts and Risks which May Affect Relevant Persons Functions, Interests, or Activities	Nature and Scale of Effect on Relevant Persons Functions, Interests, or Activities	Sufficient Information Provided	Consultation Overview / Efforts to Consult For a full summary of contact, see Appendix B	Reasonable Period Provided	Appropriate Measures Adopted
55. Wanjina-Wunggurr (Native Title) Aboriginal Corporation (WWAC) Wanjina-Wunggurr Aboriginal Corporation is the formal RNTBC for the Dambimangari, Uunguu Part A, Uunguu - Area B, Wanjina - Wunggurr Wilinggin Native Title claim, determined between 2004 and 2012. However, day to day management of the Determined area is in the hands of three separate Aboriginal Corporations: Dambimangari Aboriginal Corporation (DAC). Wunambal Gaambera Aboriginal Corporation (WGAC). Wilinggin Aboriginal Corporation (WAC). The KLC is the formal contact point for WWAC as listed on the NNTT website.	Approx 140 km from the Activity Area to closest part of WWAC Country.	Spill risks have the potential to affect WWAC functions, interests, or activities.	Low, in accordance with Table 5 3: Division 3 – Section 25 of the OPGGS(E) Regulations. WWAC's functions, interests and activities do not extend near the Activity Area. There are no planned impacts predicted to WWAC's functions, interests, and activities. They may be affected to a limited extent if a major spill event were to occur.	Information sheets were provided to WWAC on 8 April 2024. Shell shared the draft EP in 16 October 2024. Shell published in social media, radio and newspapers which were targeted at groups or individuals within this region from April to June 2024 (Appendix A).	WWAC is the RNTBC for the Dambimangari, Wanjina Wunggurr Wilinggin and Uunguu Part A and Part B Native Title Determination. KLC is the administrative contact point for WWAC, as WWAC has no employees or income as listed on the ORIC website. Further, DAC, WGAC and WAC together represent the Wanjina Wunggurr community. They are all active Aboriginal Corporations who manage their own Country, culture, and business. Shell consulted with these three groups separately, see relevant persons numbers 31, 57 and 125. Shell has been attempting to meet face to face with WWAC since March 2023 for previous Crux EPs. Prior to August, Shell used KLC for the purposes of consultation on this EP, WWAC received sufficient information on 8 April 2024. On 20 August 2024, Shell emailed the contact person listed on ORIC, who responded on 21 August 2024. Shell offered an opportunity to meet. 30 September, Shell followed up again regarding the offer to meet. Shell provided a further opportunity on the 16 October 2024 for WWAC to provide input to Shell for EP preparation, including the draft EP, clearly restating the purpose of consultation, the request for their input on matters we may not be aware of, such as cultural values or features, or objections or claims they may have about the activity. From April 2024, Shell undertook a targeted media campaign in the region, using print, geotargeted social media and radio ads. The campaign urged potentially relevant persons to contact Shell and provided a link to the Crux project on the Shell website with access to draft EPs. These materials enabled relevant persons to make an informed decision about how their functions, interests, or activities may be affected, and a mechanism to consult with Shell on the EP (Appendix A). Shell's further reasonable efforts to consult with WWAC has been demonstrated through offers to cover all reasonable costs associated with attending consultation meetings/forums (e.g., accommodation, travel and where appropriate reasonable costs of time) and also contact details for environmental consultants, some independent, paid for by Shell to support the relevant persons in assessing information and providing feedback to Shell.	Shell has been reaching out to WWAC since April 2024 when sufficient information (such as information sheets and website) was provided to them. WWAC had more than 6 months to review the information, and make an informed assessment about how their functions, interests or activities may be affected. Shell also shared the draft EP with KLC in September, giving an additional one month with the full EP. It also allowed reasonable time to digest information provided and to access the offer of a consultant panel to support them in reviewing information and raising issues or input on Shell's proposed activity. Shell considers that WWAC and the community it represents have been afforded a reasonable period to understand how this EP impacts their functions, interests or activities and engage with Shell for further discussion.	No measures were adopted for this EP.

Justification that the Regulation 25 obligations and Regulation 34(g) acceptance criteria have been met.

WWAC's functions, interests and activities are only potentially impacted by the spill risk from Shell's activities (through dissolved/entrained oil). Any impact to WWAC's functions, interests and activities is predicted to be Low. Other than source control options which are already planned to be implemented by Shell in the event of a spill, there are no other available options to directly mitigate or reduce the impacts of dissolved/entrained oil during spills which could occur from this activity. Therefore, further consultation is unlikely to improve risk management or further reduce the environmental impacts of a spill in accordance with the objects of consultation in preparing an EP. Given the remote likelihood and scale of potential risks to WWAC's functions, interests and activities, Shell provided sufficient information to inform WWAC how their functions, interests and activities may be affected, provided information to make WWAC sufficiently informed of their rights and their opportunity to be consulted, made reasonable efforts to consult WWAC. Shell also provided a reasonable period for WWAC to determine if their functions, interests, and activities may be affected and to review information and provide feedback to Shell. Shell supported WWAC in this process by providing access to reasonable support in the form of environmental consultants to support advising WWAC and offers of reasonable financial support to attend forums. Since Shell has provided WWAC sufficient information and a reasonable period to consider the information and be able to respond, consultation has been carried out in accordance with section 34(g) of the OPGGS(E) Regulations.

Indigenous relevant person	Relevant person's Functions, Interests and Activities	Petroleum Activity Impacts and Risks which May Affect Relevant Persons Functions, Interests, or Activities	Nature and Scale of Effect on Relevant Persons Functions, Interests, or Activities	Sufficient Information Provided	Consultation Overview / Efforts to Consult For a full summary of contact, see Appendix B	Reasonable Period Provided	Appropriate Measures Adopted
57. Wilinggin Aboriginal Corporation (Wilinggin) Wanjina-Wunggurr Aboriginal Corporation is the formal RNTBC for the Dambimangari, Uunguu Part A, Uunguu - Area B, Wanjina - Wunggurr Wilinggin Native Title claim, determined between 2004 and 2012. However, day to day management of the Determined area is in the hands of three separate Aboriginal Corporations: Dambimangari Aboriginal Corporation Wunambal Gaambera Aboriginal Corporation Wilinggin Aboriginal Corporation.	~260 km from Activity Area to closest part of Wilinggin Country. Wilinggin represents the eastern part of the Wanjina Wunggurr Native Title Determination and the interests of the Ngarinyin People and their Country. Wilinggin has the potential following Functions, Interests and Activities: Only a very small part of Wilinggin area is Sea Country.	Spill risks have the potential to affect Wilinggin functions, interests, or activities.	Low, in accordance with Table 5 3: Division 3 – Section 25 of the OPGGS(E) Regulations. Wilinggin's functions, interests and activities do not extend near the Activity Area. There are no planned impacts from Shell's activities predicted to occur to Wilinggin's functions, interests and activities. They may be affected to a limited extent if a major spill event were to occur.	Information sheets were provided to Wilinggin on 8 April 2024. Shell shared the draft EP on 15 October 2024. Shell published in social media, radio and newspapers which were targeted at groups or individuals within this region from April to June 2024 (Appendix A).	Shell has been attempting to meet face to face with Wilinggin since March 2023 for previous Crux EPs and contact was made in June 2023. For the purposes of consultation on this EP, Wilinggin received sufficient information on 8 April 2024. To enable members of the Derby community and TO's in the area to have an opportunity to engage with Shell directly, Shell held a drop-in session in Derby on 9 April 2024. Shell attempted to call Wilinggin in May with no answer and received a text message reply requesting a text back. The text was responded to, confirming Wilinggin had received information sent through by email and attempting to arrange a meeting with the Wilinggin Board. Shell called again on 15 July 2024 to follow up. Feedback was that Wilinggin did not think they needed to be consulted given the project does not overlap with native title and the distance to Crux but they would be referring the matter to their legal representative. Shell emailed the legal representative the following day, attaching sufficient information on this EP and offered an opportunity to meet. The legal representative responded on 6 August 2024, enquiring into Crux covering costs and impact on a site of interest to the group. Shell responded in support of meeting with the Board. Multiple emails were sent to the native title lawyer but this did not result in a meeting. Shell provided a further opportunity on the 15 October 2024 for Wilinggin to provide input to Shell for EP preparation, including the draft EP, clearly restating the purpose of consultation, the request for their input on matters we may not be aware of, such as cultural values or features, or objections or claims they may have about the activity. From April 2024, Shell undertook a targeted media campaign in the region in which Wilinggin are located, using newspaper ads, geotargeted social media and radio. The campaign urged potential RPs to contact Shell and provided a link to the Shell website with details about the Crux project and the Environment Plan. These materials enabled RPs to make an informed decision about how their functions, interest or activities may be affected, and a mechanism to consult with Shell on the EP (Appendix A). Shell's further reasonable efforts to consult with Wilinggin has been demonstrated through offers to cover all reasonable costs associated with attending consultation meetings/forums (e.g., accommodation, travel and where appropriate reasonable costs of time) and contact details for environmental consultants, some independent, paid for by Shell to support the relevant persons in assessing information and providing feedback to Shell.	Shell has been reaching out to Wilinggin since April 2024 when sufficient information (such as information sheets and website) was provided to them. WAC had more than 6 months to review the information, and make an informed assessment about how their functions, interests or activities may be affected. Shell also shared the draft EP with Wilinggin in September 2024, giving an additional one month with the full EP. It also allowed reasonable time to digest information provided and to access the offer of a consultant panel to support them in reviewing information and raising issues or input on Shell's proposed activity. Shell considers that Wilinggin and the community it represents have been afforded a reasonable period to understand how this EP impacts their functions, interests or activities and engage with Shell for further discussion. Shell considers that Wilinggin and the community it represents have been afforded a reasonable opportunity to consult with Shell in preparing this EP.	No measures were adopted for this EP.
Justification that the Regulation 25 obligations and Regulation 34(g) acceptance criteria have been met. Wilinggin's functions, interests and activities are only potentially impacted by the spill risk from Shell's activities (through dissolved/entrained oil). Any impact to Wilinggin's functions, interests and activities is predicted to be slight. Other than source control options which are already planned to be implemented by Shell in the event of a spill, there are no other available options to directly mitigate or reduce the impacts of dissolved/entrained oil during spills which could occur from this activity. Therefore, further consultation is unlikely to improve risk management or further reduce the environmental impacts of a spill in accordance with the objects of consultation in preparing an EP. Given the remote likelihood and scale of potential risks to Wilinggin's functions, interests and activities, Shell provided sufficient information to inform Wilinggin how their functions, interests and activities may be affected, provided information to make Wilinggin sufficiently informed of their rights and their opportunity to be consulted, made reasonable efforts to consult Wilinggin. Shell also provided a reasonable period for Wilinggin to determine if their functions, interests, and activities may be affected and to review information and provide feedback to Shell. Shell supported Wilinggin in this process by providing access to reasonable support in the form of environmental consultants to support advising Wilinggin and offers of reasonable financial support to attend forums. Since Shell has provided Wilinggin sufficient information and a reasonable period to consider the information and be able to respond, consultation has been carried out in accordance with section 34(g) of the OPGGS(E) Regulations. Wilinggin have also confirmed that the project doesn't overlap with native title.							

Indigenous relevant person	Relevant person's Functions, Interests and Activities	Petroleum Activity Impacts and Risks which May Affect Relevant Persons Functions, Interests, or Activities	Nature and Scale of Effect on Relevant Persons Functions, Interests, or Activities	Sufficient Information Provided	Consultation Overview / Efforts to Consult For a full summary of contact, see Appendix B	Reasonable Period Provided	Appropriate Measures Adopted
51. Nyul Nyul Aboriginal Corporation (Nyul Nyul)	~488 km from Activity Area to closest part of Nyul Nyul Aboriginal Corporation Country, Nyul Nyul represents the Native Title Determination on the Western side of the Dampier Peninsula. KLC is the NTRB for Nyul Nyul Aboriginal Corporation. Nyul Nyul has the potential following Functions, Interests and Activities: • Only a very small part of Nyul Nyul area is Sea Country. • Cultural values. • Cultural features. • Indigenous traditional activities (e.g., fishing).	Spill risks have the potential to affect Nyul Nyul Aboriginal Corporation's functions, interests, or activities.	Low, in accordance with Table 5 3: Division 3 – Section 25 of the OPGGS(E) Regulations. Nyul Nyul Aboriginal Corporation's functions, interests and activities do not extend near the Activity Area. There are no planned impacts from Shell's activities predicted to occur to Nyul Nyul Aboriginal Corporations functions, interests and activities. They may be affected to a limited extent if a major spill event were to occur.	Information sheets were provided to Nyul Nyul Aboriginal Corporation on 8 April 2024. Shell met face to face with Nyul Nyul PBC on 22 February and 2 May 2024. Shell shared the draft EP on 15 October 2024. Shell published in social media, radio and newspapers which were targeted at groups or individuals within this region from April to June 2024 (Appendix A).	Shell has been consulting with Nyul Nyul since March 2023 for previous Crux EPs and contact was made in October 2023. Specific to this EP, sufficient information was shared with Nyul Nyul Aboriginal Corporation on 22 February at a face to face meeting, followed by an email on 8 April 2024 with information sheets attached. This was followed by a face to face meeting on 02 May 2024. No objections or claims were raised regarding environmental management of impacts/risks of the activities. From April 2024, Shell undertook a targeted media campaign in the region, using print, geotargeted social media and radio ads. The campaign urged potentially relevant persons to contact Shell and provided a link to the Crux project on the Shell website with access to draft Environment Plans. These materials enabled relevant persons to make an informed decision about how their functions, interests, or activities may be affected, and a mechanism to consult with Shell on the EP– Appendix A. Shell's further reasonable efforts to consult Nyul Nyul has been demonstrated through offers to cover all reasonable costs associated with attending consultation meetings/forums (e.g., accommodation, travel and where appropriate reasonable costs of time) and also contact details for environmental consultants, some independent, paid for by Shell to support the relevant persons in assessing information and providing feedback to Shell. Shell considers that Nyul Nyul Aboriginal Corporation and the community it represents have been afforded a reasonable opportunity to consult with Shell in preparing this EP.	Shell has been reaching out to Nyul Nyul since February 2024. Sufficient information (such as information sheets and website) was provided in April 2024. This allowed Nyul Nyul more than 6 months to review the information, and make an informed assessment about how their functions, interests or activities may be affected. Shell also shared the draft EP with Nyul Nyul in October 2024, giving an additional one month with the full EP. It also allowed reasonable time to digest information provided and to access the offer of a consultant panel to support them in reviewing information and raising issues or input on Shell's proposed activity. Shell agreed to pay reasonable costs to support their participation and attendance in consultation meetings. Shell considers that Nyul Nyul and the community it represents have been afforded a reasonable period to understand how this EP impacts their functions, interests or activities and engage with Shell for further discussion.	No measures were adopted for this EP.

Justification that the Regulation 25 obligations and Regulation 34(g) acceptance criteria have been met.

Nyul Nyul's functions, interests and activities are only potentially impacted by the spill risk from Shell's activities (through dissolved/entrained oil). Any impact to Nyul Nyul's functions, interests and activities is predicted to be slight. Other than source control options which are already planned to be implemented by Shell in the event of a spill, there are no other available options to directly mitigate or reduce the impacts of dissolved/entrained oil during spills which could occur from this activity. Therefore, further consultation is unlikely to improve risk management or further reduce the environmental impacts of a spill in accordance with the objects of consultation in preparing an EP. Given the remote likelihood and scale of potential risks to Nyul Nyul's functions, interests and activities, Shell provided sufficient information to inform Nyul Nyul how their functions, interests and activities may be affected, provided information to make Nyul Nyul sufficiently informed of their rights and their opportunity to be consulted, made reasonable efforts to consult Nyul Nyul. Shell also provided a reasonable period for Nyul Nyul to determine if their functions, interests, and activities may be affected and to review information and provide feedback to Shell. Shell supported Nyul Nyul in this process by providing access to reasonable support in the form of environmental consultants to support advising Nyul Nyul and offers of reasonable financial support to attend forums. Since Shell has provided Nyul Nyul sufficient information and a reasonable period to consider the information and be able to respond, consultation has been carried out in accordance with section 34(g) of the OPGGS(E) Regulations.

Table 5-12: Tier 2 Indigenous Relevant Persons Consultation Completion Statement

Indigenous relevant person	Relevant person's Functions, Interests and Activities	Petroleum activity impacts and risks which may affect relevant persons Functions, Interests, or Activities	Nature and scale of effect on relevant persons Functions, Interests, or Activities	Sufficient Information provided	Consultation overview	Reasonable period provided	Appropriate measures adopted
72. Anindilyakwa Land Council **122. Balanggarra Aboriginal Corporation** **33.Gogolanyngor Aboriginal Corporation** **93.Kalumburu Aboriginal Corporation** **123. Wanparta Aboriginal Corporation**	All more than 200km from the Activity Area to the closest part of native title interest and other known potential interests or activities. The NRTB's and Aboriginal Corporations represent the interests of the groups they represent and their Country, located coastally adjacent to the Planning Area. Cultural heritage values. Cultural heritage features. Indigenous traditional activities (e.g., fishing).	Spill risks have the potential to affect the relevant persons functions, interests, or activities.	Low, in accordance with Table 5 3: Division 3 – Section 25 of the OPGGS(E) RegulationsThere are no planned impacts from the Shell's activities predicted to occur to these relevant persons functions, interests, and activities. Their functions, interests and activities do not extend near the Activity Area. They may be affected if a major spill event were to occur.	Information sheets and the draft EP were provided to relevant persons between April and May 2024. Follow up emails and phone calls were sent between April and October 2024. Shell published in social media, radio and newspapers which were targeted at groups or individuals within this region from April to June 2024 (Appendix A).	All relevant persons have been provided with an EP information sheet in April 2024 and the draft EP in October 2024. Shell's further reasonable efforts to consult with all these relevant persons has been demonstrated through offers to all relevant persons to cover all reasonable costs associated with attending consultation meetings/forums (e.g., accommodation, travel and where appropriate reasonable costs of time) and also contact details for environmental consultants, some independent, paid for by Shell to support the relevant persons in assessing information and providing feedback to Shell. From April 2024, Shell undertook a targeted media campaign in the region in which the relevant persons are located, using newspaper ads, geotargeted social media and radio. The campaign urged potential RPs to contact Shell and provided a link to the Shell website with details about the Crux project and the Environment Plan. These materials enabled RPs to make an informed decision about how their functions, interest or activities may be affected, and a mechanism to consult with Shell on the EP (Appendix A). More detailed consultation summaries and full text record for these relevant persons can be found in Appendix B. Shell considers that all these relevant persons and the communities they represent have been afforded a reasonable opportunity to consult with Shell in preparing this EP. A short overview of the consultation approach for each of the tier 2 relevant persons is as follows: **72. Anindilyakwa Land Council** Shell has consulted with Anindilyakwa Land Council since May 2024 when an initial email was sent on this EP. Several further attempts through phone calls and emails were made throughout August and September. Shell provided a final opportunity on the 17 October 2024 for Anindilyakwa Land Council to provide input to Shell for EP preparation, clearly restating the purpose of consultation, the request for their input on matters we may not be aware of, such as cultural values or features, or objections or claims they may have about the	Shell has been reaching out to these relevant persons since April-June 2024 when sufficient information was provided by email with information sheets and a website link. The draft EP was made available from October 2024. Reasonable period has also been allowed to disseminate and digest information provided and to access the offer of the independent consultant panel to support them in reviewing information and raising issues or input with Shell's proposed activity. Shell has also provided offers of financial support to help participate in the consultation process (e.g., forum attendance costs).	Shell to continue to consult with Wanparta on an annual basis. No other measures were adopted for this EP.

Indigenous relevant person	Relevant person's Functions, Interests and Activities	Petroleum activity impacts and risks which may affect relevant persons Functions, Interests, or Activities	Nature and scale of effect on relevant persons Functions, Interests, or Activities	Sufficient Information provided	Consultation overview	Reasonable period provided	Appropriate measures adopted
					activity. Anindilyakwa Land Council did not respond to the offer. **122. Balanggarra Aboriginal Corporation (BAC)** Shell has consulted with BAC since April 2024 when an initial email was sent on this EP. Multiple emails were sent throughout May to October including information sheets and the draft EP. Multiple further attempts through phone calls and emails were made throughout May to August with no response. Shell provided a final opportunity on the 16 October 2024 for BAC to provide input to Shell for EP preparation, clearly restating the purpose of consultation, the request for their input on matters we may not be aware of, such as cultural values or features, or objections or claims they may have about the activity. BAC did not respond to the offer. Shell held a community session in Kununurra and Wyndham in November 2024 and shared the invite with BAC. **33.Gogolanyngor Aboriginal Corporation (GAC)** Shell has consulted with GAC since April 2024 when an initial email was sent on this EP. Several attempts to contact GAC through emails and phone calls were made throughout May to August. Shell provided a final opportunity on the 16 October 2024 for GAC to provide input to Shell for EP preparation, clearly restating the purpose of consultation, the request for their input on matters we may not be aware of, such as cultural values or features, or objections or claims they may have about the activity. GAC did not respond to the offer. **93.Kalumburu Aboriginal Corporation (KAC)** Shell has consulted with KAC since April 2024 when an initial email was sent on this EP. Several attempts to contact KAC through emails and phone calls were made throughout May to August. Shell spoke with KAC on 01 November 2024 who would like to meet in 2025 alongside Wunambal Gambera. Shell will continue to offer to meet with KAC and Wunambal Gambera.		

Indigenous relevant person	Relevant person's Functions, Interests and Activities	Petroleum activity impacts and risks which may affect relevant persons Functions, Interests, or Activities	Nature and scale of effect on relevant persons Functions, Interests, or Activities	Sufficient Information provided	Consultation overview	Reasonable period provided	Appropriate measures adopted
					Shell provided a final opportunity on the 16 October 2024 for KAC to provide input to Shell for EP preparation, clearly restating the purpose of consultation, the request for their input on matters we may not be aware of, such as cultural values or features, or objections or claims they may have about the activity. KAC did not respond to the offer. Shell held a community session in Kununurra and Wyndham in November 2024 and shared the invite with KAC. **123. Wanparta Aboriginal Corporation (WAC)** Shell has consulted with WAC since June 2024 when an initial email was sent on this EP. An in person meeting took place with WAC on 28 August 2024. Shell provided a final opportunity on the 16 October 2024 for WAC to provide input to Shell for EP preparation, clearly restating the purpose of consultation, the request for their input on matters we may not be aware of, such as cultural values or features, or objections or claims they may have about the activity.		

Justification that the Regulation 25 obligations and Regulation 34(g) acceptance criteria have been met.

All Tier 2 relevant persons functions, interests and activities are only potentially impacted by the spill risk from Shell's activities (through dissolved/entrained oil). Any impact to their functions, interests and activities is predicted to be slight. Other than source control options which are already planned to be implemented by Shell in the event of a spill, there are no other available options to directly mitigate or reduce the impacts of dissolved/entrained oil during spills which could occur from this activity. Therefore, further consultation is unlikely to improve risk management or further reduce the environmental impacts of a spill in accordance with the objects of consultation in preparing an EP. For relevant persons who did not respond to requests to provide feedback, Shell then made further attempts by alternate available means to elicit a response up until October 2024. Shell has provided sufficient information to inform these relevant persons how their functions, interests and activities may be affected, made reasonable efforts to consult with all of the relevant persons, provided a reasonable period for them to determine if their functions, interests, and activities may be affected, and to review information and provide feedback to Shell. Shell also adopted appropriate measures based on input from the relevant persons that did respond during consultation. Given the remote likelihood and scale of potential risks to their functions, interests and activities, consultation has been completed in accordance with section 34(g) of the OPGGS(E) Regulations.

5.10.2 Consultation with Commercial Fisheries

Based on the nature of Commercial Fisheries and their interests, Shell approached consultation with these relevant persons separately to broader community consultation.

In addition to the processes outlined above for general community and industry consultation, Shell employed a variety of resources to identify and classify relevant commercial fisheries. This included fisheries that overlap the Planning Area, as well as fisheries whose interests or activities overlap the Planning Area but not the location of Shell's planned activities. Shell also determined that where licence holders are active or potentially active within the Planning Area, the licence holder should be engaged as a potentially relevant person to provide them with sufficient information to assess whether they have any interest in or may be impacted by Shell's proposed activities.

In summary, identification and consultation with commercial fisheries was conducted as follows:

- Government authorities (AFMA, DCCEEW, DPIRD, and NT DITT) were engaged regarding the proposed activity and engagement with relevant persons from commercial fisheries groups. Materials were made available by government authorities, including WA FishCube (fishing effort) data files and fishing reports.
- Fishing industry associations that represent fisheries with licence areas that overlapped the Planning Area, such as WAFIC and Commonwealth Fisheries Association, were consulted with regarding the proposed activity and engagement with their members.
- WAFIC and Tuna Australia were engaged on a fee-for-service basis to engage with their members with regards the proposed activities and this EP.
- Shell consulted directly with licence holders to provide an additional means of assurance that all relevant persons had received sufficient information to assess the proposed activities in terms of their own interests and any potential impacts. WAFIC advised Shell to only contact fisheries in the activity area, as the activities outlined in this EP are routine for the industry. Shell also sent letters to the WA commercial fishers identified outside of the Activity Area but within the Planning Area as an additional courtesy.

Licence holders in commercial fisheries were consulted using the following methodology:

- Consultation via WAFIC.
- Consultation via Tuna Australia.
- Letters to WA fishers of managed fisheries within the Planning Area.
- Email to Commonwealth registered fishers.
- Tailored information sheets and information describing the proposed activity, including relevant location coordinates.

Appendix B summarises the fisheries related feedback.

5.10.3 Titleholders and Operators

Email was used to consult with petroleum titleholders and operators. If there was no response it was assumed, they had no objection or comment on the proposed activity. This was considered reasonable effort as titleholders and operators have systems and the resources to consult on matters of interest to them.

5.10.4 Community and Other

This encompasses the groups identified in the relevant person search under Commercial Operators, Interest Groups, NGOs, Community Groups, academic research or persons or organisations outside of Australia. Consultation undertaken was a combination of targeted emails containing information sheets and links to the Crux website, community drop-in sessions, targeted information sessions and a media campaign. This was considered a suitable approach to consult with this group given the low nature and scale of potential affects to a relevant person's functions, interests, or activities.

5.10.5 Community Drop-in Sessions

These sessions were held in accessible public locations in relevant communities and attended by Subject Matter Experts (SMEs) from relevant Shell disciplines.

Criteria for selection of locations for drop-in sessions was based on:

- whether there is a community located within or immediately adjacent to the coastal boundary of the Planning Area; and
- where there are several small communities in close proximity, the most populated community in these areas was selected as the representative location.

Awareness was generated via appropriate targeted public advertisements (both print and social media) for each session and information was also provided to local government, local business chambers and community organisations for dissemination to amplify awareness. Sessions were supported with consultation materials for the Planning Area. Materials appropriate to the audience were used to maximise their understanding of the purpose and subject of consultation, including the EP process and relevant elements of the EP such as the location and nature of activities, associated environmental aspects and management, including proposed controls. The materials encouraged high-level two-way discussions between SMEs and attendees to ensure adequate consultation and opportunity for relevant persons to provide feedback and inform the EP. Materials included videos, information sheets and maps.

Community drop-in sessions were held in these locations:

- Broome.
- Derby.
- Wyndham.
- Kununurra.

To complement these sessions, proactive visits to local organisations, such as local Shires, chambers of commerce, local port authorities, Police, and tourism offices, at each of the above locations were completed to provide further opportunity for consultation. Shell also offered community sessions in the various locations above in order to provide an opportunity for relevant persons who may be interested in the activity set out in this EP but may be geographically located outside of the Planning Area to provide comments or feedback.

5.10.6 Targeted Information Sessions

In addition to community drop-in session consultation, targeted information sessions were held with relevant persons from the community, including the business community (via chambers of commerce). A formal presentation on the EP was completed followed by an open forum discussion where attendees were provided with an opportunity to ask questions. These sessions also acted as an awareness amplification method for community drop-in sessions and the broader EP consultation process with potentially relevant persons. Information sessions were held in Broome.

5.11 Assessment of Merit of Objections and Claims

Shell's assessment of relevance and assessment of merit considers four broad categories:

- objection or claim has merit – the objection or claim raised is relevant to both the planned activity and the relevant person's or organisation's functions, interests, and activities. The objection or claim has merit if there is a reasonable / scientific basis for related effects or impacts to occur and/or there is a reasonable basis for the objection or claim to be addressed in the EP.
- objection or claim does not have merit – the objection or claim raised may be relevant to the planned activity or the relevant person's or organisation's functions, interests, and activities however, the objection or claim raised has no credible or scientific basis.
- relevant matter – the matter raised does not fit the criteria descriptions for objections or claims with/without merit. However, the matter raised is relevant to the planned activity, comprises a request to Shell for further relevant information, or provides information to Shell that is relevant to the activity or the EP.
- not a relevant matter – correspondence does not relate to the planned activity or the relevant person's, or organisation's functions, interests or activities being affected by the activity. Non relevant matters may also be generic in nature with no specific issues raised (e.g. salutations, acknowledgements, meeting arrangements, etc.).

Appendix B contains Shell's assessment of the feedback received from relevant persons during consultation, the merits of objections or claims, measures adopted, and any changes incorporated into the EP as a result of the feedback.

In compliance with section 26(8) of the OPGGS(E) Regulations, sensitive information (if any) contained in an EP, as well as the full text of any response by a relevant individual to consultation under section 25 of the OPGGS(E) Regulations during the preparation of the EP, must be included in the sensitive information section of the EP and not elsewhere.

5.12 Summary of Consultation for the Environment Plan

Shell considers that consultation will be complete when:

- each relevant person has received sufficient information and reasonable time to assess the impacts of the activity on their functions, interests, or activities.
- all objections or claims have been discussed and, where reasonably practicable, resolved by Shell.

Appendix B summarises all consultation carried out with relevant persons during the preparation of this EP in accordance with section 25 of the OPGGS(E) Regulations.

5.13 Ongoing Consultation as Part of EP Implementation Strategy

Consistent with section 22(15) of the OPGGS(E) Regulations, Shell will undertake consultation as part of the EP Implementation Strategy (see Section 10), with the intent to acquire and preserve an up-to-date understanding of relevant persons' functions, interests, and activities during the execution of Shell's proposed activities. Specific ongoing consultation activities Shell has undertaken to carry out are set out in Table 5-13. It should be noted that this is not an exhaustive list of all ongoing consultation activities Shell may undertake in the future.

Ongoing consultation under the Implementation Strategy will enable Shell to maintain relationships with relevant persons and foster a continued improvement in Shell's understanding of the features and values of the existing environment, and where new risks or impacts are identified, the establishment of appropriate controls to reduce risks and/or impacts to ALARP.

Matters raised post-acceptance of the EP will be assessed as detailed in Section 5, to confirm if the matter raised is a relevant matter or if objections and claims have merit. Any new risks or impacts that are discovered through ongoing consultation will be subject to Shell's Environment MOC process, which considers the requirements of sections 26, 38 and 39 of the OPGGS(E) Regulations and establishes the mechanisms to assess change to the EP. Section 10.3.5 describes this MOC process in detail. Further ongoing consultation requirements, in the form of notifications of various kinds, are outlined within Sections 10.11.4.2 and 10.11.4.3.

Table 5-13: Ongoing Consultation Program for the Crux Project

Ongoing Consultation Topic	Relevant Persons	Timing	Nature of Ongoing Consultation
The previously completed Underwater Cultural Heritage report will undertake an independent peer review. Once completed, Shell will use findings as part of Shell's ongoing consultations with Indigenous relevant persons to better understand tangible and intangible Cultural Values and Features within the Activity Area and Planning Area.	Consultation with relevant persons (including Indigenous relevant persons and other organisations) on this topic will occur where they choose to voluntarily participate.	The underwater cultural heritage report has been completed and a peer review is underway. It is anticipated that it will be shared in 2025 with relevant Indigenous groups who showed interest.	This ongoing consultation will occur at the express preference of the Indigenous relevant persons concerned. It is anticipated this could be on-country of the relevant Indigenous persons however other methods of ongoing consultation will be offered.
Industry collaboration on Indigenous People involvement in oil spill preparedness. Given the program is a novel approach, the activity is planned to be a pilot project initially. Shell believes an industry collaboration with involvement from AMOSC (or similar organisation) is the best vehicle to progress this request in a mutually beneficial manner. Shell will seek to work with AMOSC in establishing an industry collaboration and if successful, progress ongoing consultation with traditional owners in the codesign of a suitable training program, with input from WA DoT, as the control agency for oil spill response within WA state waters.	It is not reasonably practicable to implement a pilot such as this with many Indigenous People. However, Shell acknowledges the importance of ongoing consultation in relation to this matter with Indigenous people. Initially this pilot was offered to Bardi-Jawi people however due to competing priorities it has been discussed with other Indigenous people including Nyul Nyul people.	This is a long-term commitment, which is subject to the success of a pilot program. The establishment of this program commenced in 2023. Due to a number of influencing factors which are outside of Shells control such as appetite for industry collaboration, DoT's acceptance of the program (given they are the control agency) a more specific timeframe cannot be committed to. Shell has commenced planning, with initial Indigenous group engagement, industry engagement and DoT engagement (outside of EP section 25 of the OPGGS(E) Regulations consultation requirements) have started.	This ongoing consultation will occur through co-design, at the express preference of the specific Indigenous people.
Local Content and supply opportunities were a topic of interest for numerous relevant persons during the community and Traditional Owner consultations. Shell is committed to giving Australian suppliers, local, regional, and Indigenous businesses genuine opportunities to participate in our supply chain. It uses a supplier portal to publish work packages and has dedicated staff resources to support Indigenous business to enter and then remain in Shell's supply chain.	• Bardi Jawi Aboriginal Corporation. • Joombarn-Buru Aboriginal Corporation. • Dambimangari Aboriginal Corporation. • Broome Shire (including Djarindjin community). • Nyamba Buru Yawuru.	Two full time Shell resources are responsible for this remit and will communicate relevant opportunities to the relevant persons as they arise and continue to raise awareness of potential opportunities via emails and phone calls.	Shell will continue to raise awareness of its supplier portal at all consultations. Supplier Information sessions will be held as required in the project support bases based on upcoming project and business demands to encourage local content via discussion of procurement categories and upcoming work tenders.

Ongoing Consultation Topic	Relevant Persons	Timing	Nature of Ongoing Consultation
Shell will carry out ongoing consultations with Indigenous people in the Kimberley, adjacent to the Planning Area for the Crux Project, outside of this activity scope, to better understand cultural features and values of the environment to better inform current and future impact and risk assessments on the Crux Project.		Subject to preferences of each specific group, Shell is aiming to set-up regular meetings with these Indigenous groups.	This consultation will be driven by the preferences of the Indigenous people e.g. cadence and on Country meetings.
Where Indigenous people have identified cultural features and values which may be affected by major spills, Shell has committed to further ongoing consultation with them to better inform an effective response to mitigate the effects of a major spill, inclusive of potential impact to identified cultural features or values.	• Bardi Jawi Aboriginal Corporation. • Walalakoo Aboriginal Corporation. • Mayala Inninalang Aboriginal Corporation. • Wanparta Aboriginal Corporation.	Further consultation will occur in the event of a major spill which threatens the area where identified significant song lines and ceremonial sites occur.	This consultation will be driven by the preferences of the Indigenous people e.g. on Country meetings.
In preparation of this EP, DCCEEW requested that ongoing consultation with the Department's UCH Team occur in relation to activities that have the potential to impact UCH.	DCCEEW UCH Team.	During the execution of the activity, where potential impacts to UCH are established.	This consultation will be driven by the discovery of potential impacts to UCH. To date, through relevant person consultation and the execution of a First Nations UCH Impact Assessment (Cosmos Archaeology 2023) and subsequent peer review, no planned impacts to UCH have been identified. Shell has a chance find process as detailed in Table 9-34, which may trigger this ongoing consultation requirement, should a discovery be made. Additionally, through ongoing consultation with Indigenous persons, if an impact to UCH is established, Shell will consult the DCCEEW UCH Team.

6 Description of the Activity

6.1 Scope of the EP

This Section describes the petroleum activity (or petroleum activities) in accordance with subsection 21(1) of the OPGGS(E) Regulations, also referred to as 'activity' or 'activities' throughout the EP.

For the avoidance of doubt the activity types, as detailed in subsection 59B(1) of the *Offshore Petroleum and Greenhouse Gas Storage (Regulatory Levies) Regulations 2022* (Cth), addressed within this EP as required by subsection 21(1) of the OPGGS(E) Regulations include:

- Operation of a facility that is used for the recovery or processing of petroleum.
- Operation of a pipeline subject to a pipeline licence.
- Significant modification of a facility.
- Drilling.

These activities are broadly summarised as the completion, hot commissioning, start-up, and operation of the Crux facility (or 'facilities'), which comprise the infrastructure, equipment and physical descriptions listed in Table 6-1. The physical delineation of the activities is detailed in Figure 6-1.

- Facilities summarised in Table 6-1 and described in Sections 6.1, 6.2, 6.5, 6.6 and 6.7.
- Activities summarised in Table 6-1 and described in Sections 6.8, 6.9, 6.10, 6.11 and 6.12.

Table 6-1: Summary of Facilities Associated with the Activities

Facility/Activity	Summary Description
Pipeline and subsea infrastructure facilities	The pipeline and subsea infrastructure are part of the hydrocarbon system that enables the import of gas from Prelude FLNG to the Crux platform (backflow gas) for use during hot commissioning and start-ups on the Crux platform; and for the export of gas and condensate (and associated constituents) from Crux topsides to Prelude FLNG (for subsequent processing on Prelude FLNG, which is not in scope for this EP). The infrastructure includes: • 26″ Corrosion Resistant Alloy (CRA) cladded carbon steel rigid riser from the RESDV on the Crux platform to the base of the jacket structure. • 26″ CRA cladded carbon steel tie-in spool connecting the Crux riser and pipeline end termination (PLET). • PLET on foundation which includes a subsea isolation valve (SSIV) located near the Crux platform. • Welded 26″ outside diameter (OD) concrete coated carbon steel export pipeline of ~155 km length. The pipeline crosses the Offshore Area of the Territory of Ashmore & Cartier Island and the Offshore Area of Western Australia. • Second PLET on foundation inside the Prelude FLNG 1,500 m Petroleum Safety Zone, which also includes a SSIV and a 26″ to 18″ OD reducer. • 16″ internal diameter (ID) flexible riser terminates the pipeline facility at the upstream flange of the RESDV in the Prelude FLNG turret. • The pipeline design includes provisions of scour protection and span rectification structures (e.g. mattresses, skirts, mud mats and grout bags). • Other subsea infrastructure including fibre optic flying lead, electrical flying leads, hydraulic flying leads, static and dynamic umbilicals, and umbilical termination heads; in addition to, ancillary permanent equipment and structures including foundation, bracelet anodes, continuity cables, buoyancy modules, clamps, bend restrictors, clump weight clamps, collars, buoyancy devices and related piping components. • Fibre optic communications system connected from the Crux platform umbilical to a cable termination assembly (CTA) via a fibre optic flying lead and subsequently via a ~55 km cable to the existing Crux branching unit on the North-West Cable System (NWCS), a subsea fibre network owned and

Facility/Activity	Summary Description
	operated by regional network telecommunication service provider (outside of the Petroleum Safety Zone (PSZ), this infrastructure is not deemed a petroleum activity). Maintenance, replacements, overhauls and equipment modifications of pipeline and subsea infrastructure are included activities.
Wells facilities	Five dry christmas ('xmas') tree wells are part of the hydrocarbon system which are tied back to the platform, and each has a design production capability of 200 MMscfd. Three spare slots are available for potential well re-spudding and contingency. The platform is positioned above the five production wells (currently designated C1, C3, C4, C5 and C7 – pending possible name changes from any sidetracks or respuds that occur during the drilling campaign). Each well has a dry tree at surface, a surface wellhead, rigid tieback risers and a subsea wellhead. All well functions can be controlled remotely from Prelude FLNG or the Integrated Operations Centre (IOC). A drill deck is incorporated into the platform design to support well service activities, interventions, workovers, and the eventual plugging and abandonment of the wells; the deck has been designed to support temporary well equipment up to and including a small Modular Platform Rig (MPR).
Platform substructure facilities	The Crux platform is composed of a jacket substructure which supports the topsides. The substructure (~190 m high and gross weight of ~24,000 t) is fixed to the seabed with piled foundations (weight ~18,000 t) which penetrate ~155 m into the seabed. Refer Figure 6-2 for a digital visualisation of the substructure and Figure 6-3 for a digital visualisation of the topsides, and Figure 6-4 for the combined facility with wells (at the Crux platform end). The substructure primarily consists of a steel lattice type jacket structure which is positioned on top of a drilling template and is fixed to the seabed with piled foundations (weight ~18,000 t) which penetrate ~155 m into the seabed. The Crux platform substructure includes but is not limited to the following main components: • Jacket structure. • Pile sleeves. • Cathodic protection and coatings. • Skirt piles comprising of driven primary and drilled and grouted insert piles. • Mudmats. • Docking piles. • Subsea interfaces including riser subsea diverless connector hub, riser hang-off flange and guides, umbilical j-tube(s) and supports. • Installation, pile drilling appurtenances and drilling template left in-situ. The subsea wellheads are positioned above the drilling template with the tie-back risers connecting the wells to the dry trees on the platform supported and protected by the substructure. The substructure also supports the pipeline rigid riser and has J-tubes for the umbilical cable and sewage disposal caisson. The design of the substructure allows for additional weights of temporary equipment such as required for completions, workovers, well interventions, and maintenance (etc) and future topsides or subsea equipment such as deck expansions and extensions (e.g. subsea compression, or processing modules), processing equipment, utilities equipment and offshore hook-ups. All approximated weights may change during the fabrication process.

Facility/Activity	Summary Description
Platform topsides facilities	The platform topsides are part of the hydrocarbon system and will have a total capacity of ~550 MMscfd of combined gas and condensate exported to Prelude FLNG. Production rates will vary from the commencement of export to Prelude FLNG from ~100 to 550 MMscfd of gas and condensate and may be subject to continuous improvement and optimisation to enable production performance to technical maximum. There will be no export from Crux to Prelude FLNG until the Prelude FLNG Environment Plan (2000-010-G000-GE00-G00000-HE-5880-00002) addresses the processing of Crux gas and condensate and has been accepted by NOPSEMA. See Figure 6-2 for digital representation of Crux topsides. The topsides support all processing equipment (length ~106 m, width ~45 m, and gross weight ~12,000 t) and consists of the following key components: • Inlet cooling and liquids and gas separation. • Gas dehydration using tri-ethylene glycol (TEG). • Condensate bulk water removal. • Chemical injection. • Export system and pig launcher. • Low-pressure and high-pressure flare system. • Produced water treatment system. • Gas Turbine Generators (GTG) for power generation. • Black start diesel generator. The platform topsides support the use of well clean-up equipment (such as water handling, flare booms, and de-sanding equipment), hydraulic workover equipment, well intervention equipment and related infrastructure (etc). Maintenance, replacements, overhauls, and equipment modifications of topsides facilities and connected facilities are included activities. The primary communication from Crux to Prelude is via subsea fibre optic link provided over the NWCS. Backup communication is via a very small aperture terminal (VSAT) satellite system. These will be used to enable continued monitoring and control of Crux from the Prelude FLNG Control Room or IOC. A Closed-Circuit Television (CCTV) system provides visual feedback to the Prelude FLNG Control Room or IOC. The design of the platform allows for additional weights of temporary equipment such as required for completions, workovers, well interventions, and maintenance (etc) and future topsides or enabling subsea equipment such as deck expansions and extensions (e.g. for future topsides compression, subsea compression, or processing modules), processing equipment, utilities equipment and offshore hook-ups. The operating gross weight of the platform topsides may be up to ~16,000 t (when well workover units are in operation). All approximated weights may change during the fabrication process.
Well completions activities	These activities commence after demobilisation of the Hydraulic Workover Unit (HWU) is underway or completed (i.e. after all dry trees have been installed). The well completions activities include well perforation and two stages of well clean-up to prepare the wells for producing hydrocarbons to the platform. Well perforation and retrieval of the deepset plug will be completed using a temporary wireline or coiled tubing unit (CTU). Well clean-up will be undertaken in two stages, with only the first stage taking place during well completions activities. The first stage well clean-up will be performed on all five wells at a rate of ~60-90 MMscfd per well, with well fluids directed through a temporary well test package to separate and dispose of gun debris and liquid contaminants that remain from drilling activities. The well clean-up sequence may overlap with hot commissioning activities.
Hot commissioning activities	Hot commissioning of the Crux platform topsides requires hydrocarbon gas to enable the required activities to be carried out. This will be provided via the export pipeline being pressurised by backflowing (importing to the Crux facilities)

Facility/Activity	Summary Description
	vaporised LNG from Prelude FLNG, or by the production from a Crux well (whilst remaining wells are cleaned-up) as a contingency option. With an available hydrocarbon gas source from either pressurised pipeline gas or a non-deviated well, pressurisation and hot commissioning of the platform can commence. Activities focus on the fuel gas system and three GTGs. There may be some overlap in timing and sequence between activities and responsibilities associated with well completions and hot commissioning to ensure safe preparation and execution.
Start-up activities	Start-up activities in the EP typically refer to initial start-up, as opposed to re-starts which will occur throughout operations activities addressed below. Start-up activities include the progressive start-up and ramp-up (SURU) of the five wells producing hydrocarbons for export to Prelude FLNG (forward flow of hydrocarbons through export pipeline). The two non-deviated wells that only require a first stage clean-up will be preferentially started to commence safe production. One or two of these wells may already be in production to support the hot commissioning of the GTGs (i.e. to enable start-up of the facility). During this period, all remaining topsides equipment and systems will be systematically energised, started up, tested and brought into operation. During start-up inspections, checks and tests are undertaken to assure the system performance. Start-up activities include increasing the facility production rate to ~550 MMscfd and conclude with the completion of the facility performance test, checks and tests. It is expected during the start-up activities that the remaining three 'deviated' wells will require a second stage clean-up over several days to remove any residual gun debris before they can produce at higher rates. The second stage clean-up (which is a well completions activity) will be performed at rates up to 200 MMscfd per well using the permanent topsides separation, produced water handling and flare systems, with the addition of a temporary desander package. There is likely to be some overlap in timing between activities and responsibilities associated with well completions, hot commissioning, and start-up to ensure safe preparation and execution.
Operations activities	Operations activities commence after satisfactory completion of the inspections, checks and tests during start-up phase demonstrating safe and reliable production. The five wells will continue to produce hydrocarbons for export (forward flow of hydrocarbons through export pipeline) to Prelude FLNG in accordance with the Operating Plan. The first Operations activity phase will be referred to as not normally manned (NNM) phase 1. Subject to detailed planning at the time, manned campaigns at the platform may be reduced to ~80% of the time (outside of turnarounds, or any other activities that warrant higher POB). The remaining periods will be classified as 'unmanned', and the platform will be remotely operated from Prelude FLNG or IOC. Crux operations will move into NNM phase 2 when it is decided that the platform can safely and reliably switch to periods of unmanned, remote operation with intermittent planned minimally manned campaigns, and therefore achieve NNM operation to optimise production from the platform (stable, routine operation). Subject to detailed planning at the time, manned campaigns at the platform may be reduced to ~30–50% of the time (outside of turnarounds, or any other activities that warrant higher POB). The remaining periods will be classified as 'unmanned', and the platform will be remotely operated. The longest unmanned periods are expected to be up to 12 weeks, subject to schedule variation dictated by any future uncertainty, such as logistics schedules, maintenance schedules, availability of vessels and equipment, bad weather and so forth. Any activities that are linked to scheduled commitments based on the 12-week longest unmanned period (e.g., such as 12 weekly or quarterly sampling) are subject to the same schedule variability and uncertainty, are not exact, and may have minor changes (several weeks) based on these factors. Inspection of the facilities (subsea and pipeline, wells, substructure, topsides) will be conducted in accordance with a risk-based inspection schedule and may occur throughout all activity phases to preserve the safety, reliability, and

Facility/Activity	Summary Description
	integrity of the facilities. Planned maintenance is scheduled in the Computerised Maintenance Management System (CMMS). Whilst forecast to be implemented during Operations Activities, it may also be required at any activity phase documented in this EP (i.e. well completions, hot commissioning, start-up, and operations).
Logistics and manning activities (all activity phases)	Facilities are designed for minimal manning with no living quarter accommodation (other than temporary beds in the temporary refuge which may allow for up to 80 POB). Manning requirements will vary depending on activities and stage of operation and will be supplemented as required by an accommodation vessel (ASV) and a walk to work (W2W) vessel. The platform has a helideck and multiple access points for accommodation and vessels, including specific landing areas on the western side and north-east corner for motion compensated gangways. Activities will be 24 hours per day, 365 days per year. Vessel-related activities within the Activity Area as defined in Section 6.2, will comply with this EP. Vessels supporting the activities when outside the Activity Area (e.g. transiting to and from port) are outside the scope of this EP (except where EP requirements or commitments explicitly apply outside the Activity Area) and must adhere to applicable maritime regulations and other relevant requirements which are not managed under this EP. Simultaneous operations (SIMOPS) may occur between any activities. Timing, duration, and vessel selection for all activities is subject to change due to project schedule requirements, vessel availability, unforeseen circumstances, and weather. During all activities routine and non-route lifting (e.g. heavy lifting, engineered lifts) and handling of materials and equipment on the topsides will occur (including to, from, and between vessels) using equipment such as the pedestal crane, underhung gantry crane, monorails or davit along with materials handling equipment on the vessels. **Well completions** In well completions activity phase, the workforce will be accommodated on an ASV with a workforce of ~400 POB (subject to further planning, ASV capacity may be up to ~500 POB) accessing the platform using a motion compensated gangway. Additional personnel may arrive by helicopter on the ASV helipad or platform helipad. During well completions, the platform will be manned 100% of the time by personnel residing on the ASV vessel. **Hot commissioning and start-up / ramp-up** The ASV may remain on station during the hot commissioning activities and start-up activities. In this phase, a W2W vessel may also be stationed at the platform with up to an additional ~80 POB accessing the platform using a motion compensated gangway and additional personnel may arrive by helicopter (W2W maximum POB will be ~106, including marine crew). The ASV may depart before or during this phase when start-up and ramp-up activities have completed. During hot commissioning and start-up, the platform will be manned up to 100% of the time by personnel residing on either the ASV or W2W vessel. There may be simultaneous operations between ASV and W2W. The ASV is assumed to be on station for ~12 months across the well completions, hot commissioning and start-up activity periods, Shell may take an option to extend the duration if required to support project activities. **NNM operations – phase 1** Minimal manning operations will commence once remote operation, safety and reliability is deemed to be suitably demonstrated. NNM phase 1 operations will commence reducing personnel occupancy at the platform to ~80% of the time (outside of turnarounds, or any other activities that warrant additional people). The longest unmanned periods are expected to be ~3 weeks. **NNM operations – phase 2** NNM phase 2 operations will commence once remote operation, safety and reliability is deemed to be suitably demonstrated for unmanned operation (stable operation). This will reduce personnel occupancy at the platform to ~30–50% of the time (outside of turnarounds, or any other activities that warrant additional people). The longest unmanned periods are expected to be up to 12 weeks.

Facility/Activity	Summary Description
	NNM manning levels and W2W vessel When manned for planned campaigns during NNM phase 1 and phase 2, personnel will reside on the W2W vessel and any additional personnel that may arrive by helicopter. During unmanned periods, the W2W vessel will depart the platform. **Planned campaigns** Planned campaigns on the platform will include all inspections, testing, and maintenance activities required to operate the platform. **Remote operations** During unmanned operation, the Crux platform is designed to be operated remotely from Prelude FLNG or IOC. The platform will be operated according to the Integrated Control and Safeguarding System (ICSS) (manned or unmanned). **Unplanned events (when unmanned)** During unmanned periods, unplanned events may require personnel to re-attend the platform by helicopter or vessel (e.g. unplanned interventions, testing, inspection, maintenance, analysis, or repair). This may also require the mobilisation of W2W, or subsequently ASV. **Planned turnarounds and maintenance campaigns** Any turnarounds or unplanned interventions/workover activities that occur during NNM phase 1 or 2 are likely to require the mobilisation of an ASV or W2W vessel. **Transportation** Throughout all activity phases helicopters and vessels (such as the W2W vessel, ASV, supply vessels, support vessels, project vessels, fast rescue, inspection maintenance and repair (IMR) vessels, installation vessels, and construction vessels) will service the platform for activities such as crew, materials, and equipment transportation (e.g. fuel, supplies, chemicals, parts, waste logistics) in addition to survey, inspection, maintenance, and repair vessels. Remotely operated vehicles, drones and autonomous surface vessels may also be used to perform activities. Personnel access to the platform, ASV or W2W vessel will be by mobilisation at port, helicopter (via Prelude FLNG or Western Australia) or vessel motion compensated gangway.

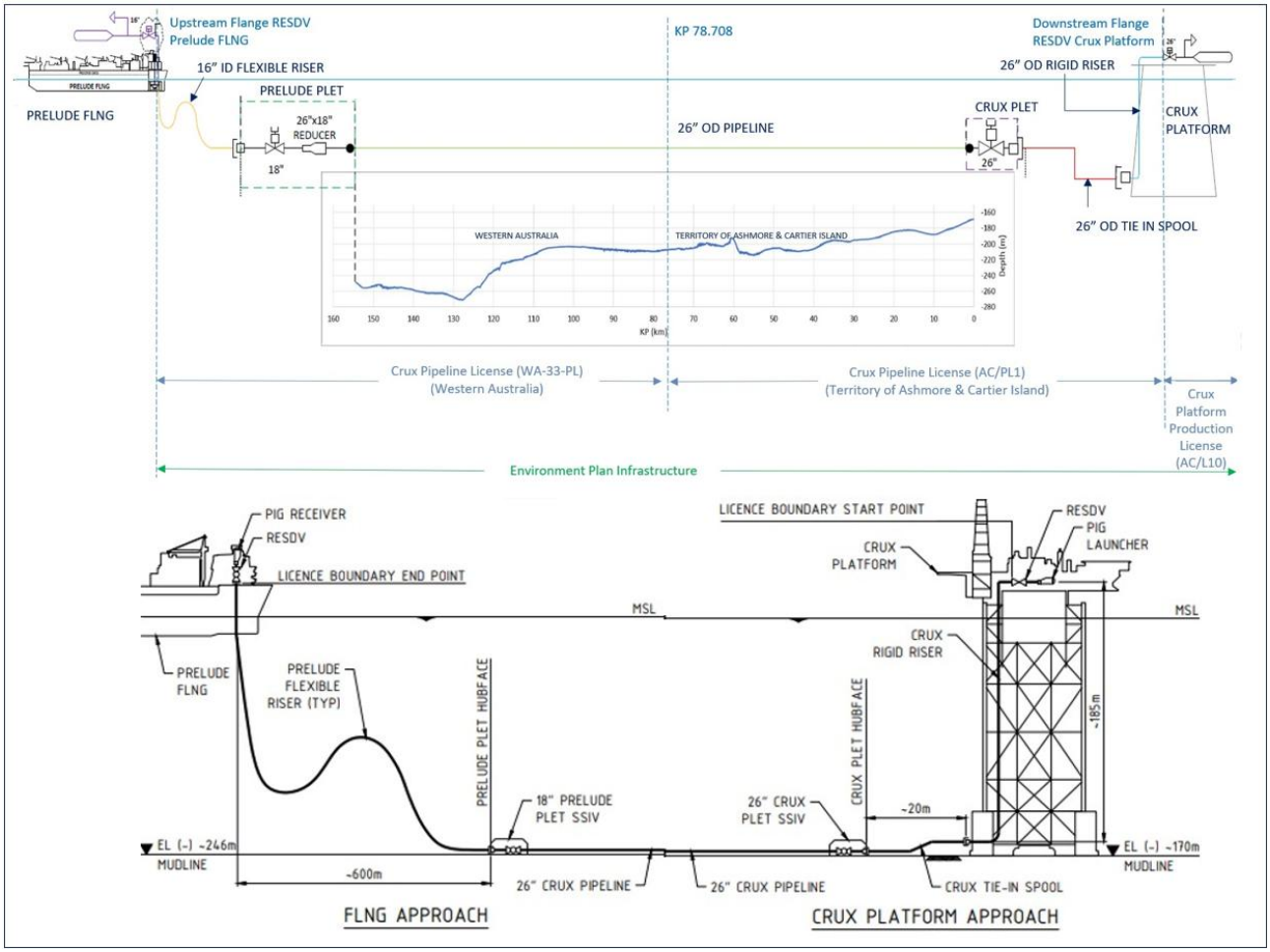


Figure 6-1: Export Pipeline Route Profile, Infrastructure Schematic (Indicative) and Applicable Production and Pipeline Licences)

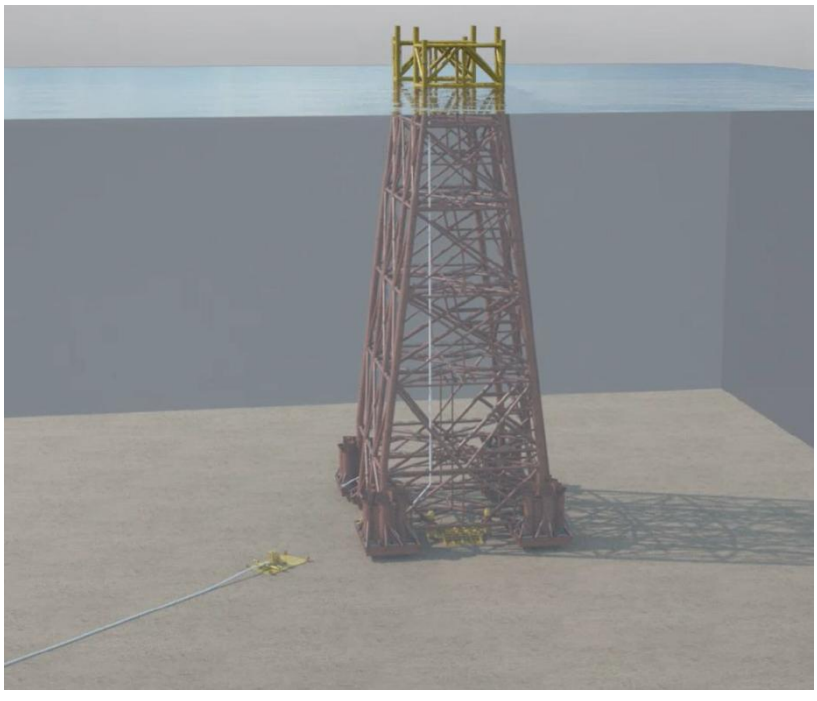


Figure 6-2: Digital Representation of Crux Platform Substructure (PLET and Pipeline also shown)

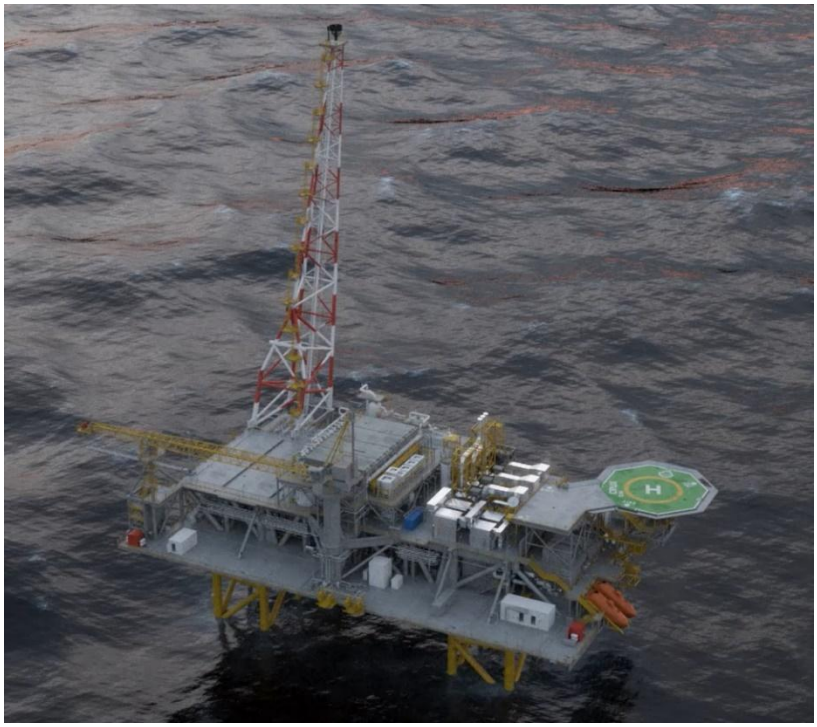


Figure 6-3: Digital Representation of Crux Platform Topsides

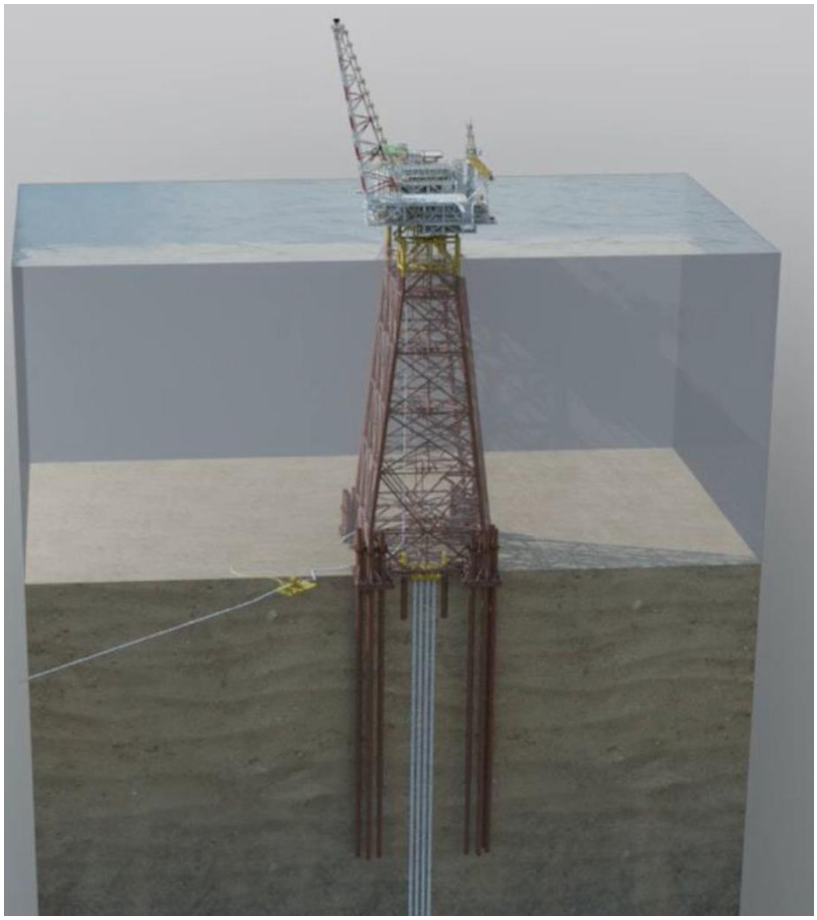


Figure 6-4: Digital Representation of Crux Platform Topsides, Substructure, Piled Footings, Wells, Export Pipeline and PLET

All numbers and data in this EP are approximate and confirmed only by as built drawings or other reports or calculations, as relevant. Digital image representation is indicative only. Numbers throughout this EP indicated by the prefix '~' or terminology such as 'approximate' or 'approximately' (or similar) are estimates and mostly based on engineering calculations or other reference point. These numbers are intended as approximate numbers and should not be considered precise values.

6.2 Location and Tenure

The Activity Area is defined as the production licence AC/L10 and pipeline licences WA-33-PL and AC/PL1 (coordinates and water depths are listed in Table 6-2 and shown in Figure 6-1 and Figure 6-5. AC/PL1 (starts at the downstream flange of the Riser Emergency Shutdown Valve (RESDV) on Crux platform). WA-33-PL (ends at the upstream flange of the RESDV on Prelude FLNG).

The Activity Area is within Commonwealth waters, 200 km offshore north-western Australia and 460 km north-north-east of Broome, WA. The physical limit of the Activity Area on Prelude FLNG is the upstream flange on the RESDV (Figure 6-1). Water depths within the Activity Area range from ~95 m (within title area), ~160 m at platform, ~237 m mean sea level at Prelude FLNG, and up to ~280 m along the pipeline route.

The Activity Area is ~80 km from Cartier Marine Park, ~128 km from Ashmore Marine Park and ~80 km from Kimberley Marine Park (see Figure 2-1) and does not contain any emergent reefs/islands. The nearest island is Browse Island, which is ~42 km south-south-east of the Activity Area. The nearest shoals or banks are ~8 km from the Activity Area—Goeree Shoal north-north-west and Eugene McDermott Shoal east-south-east.

The Activity Area includes the 500 m Petroleum Safety Zones (PSZ) which are in existence for the Crux platform, as well as the Prelude FLNG turret, its mooring chain touch down locations and the drill centre (DC-1P) (Commonwealth of Australia Gazette Notices A1046481 and A441884); and 500 m either side of the pipeline centreline subject to as-built drawings after pipelay scope completed under a separate Environment Plan. This EP includes Activities within the Prelude FLNG PSZ only when being conducted for the purposes of Crux infrastructure or activities stated in this EP.

Table 6-2: Coordinates and Water Depths

Location		Tenure	Water Depth (~m)	Longitude	Latitude
Crux Production Licence		AC/L10	160	12°54′55″S	124°25′04″E
			95	12°54′55″S	124°35′04″E
			125	12°59′55″S	124°35′04″E
			180	12°59′55″S	124°25′04″E
Export pipeline	Start KP0 – ~KP78	AC/PL1	168	12°57′55″S	124°26′31″E
	End ~KP78 – ~KP154	WA-33-PL	250	13°46′52″S	123°18′59″E
Prelude flexible riser	Prelude-end PLET	WA-33-PL	250	13°46′52″S	123°18′59″E
	Prelude FLNG	WA-33-PL	250	13°47′11″S	123°19′03″E
Upstream flange (RESDV) on Prelude FLNG		WA-33-PL	N/A	13°47′11″S	123°19′03″E

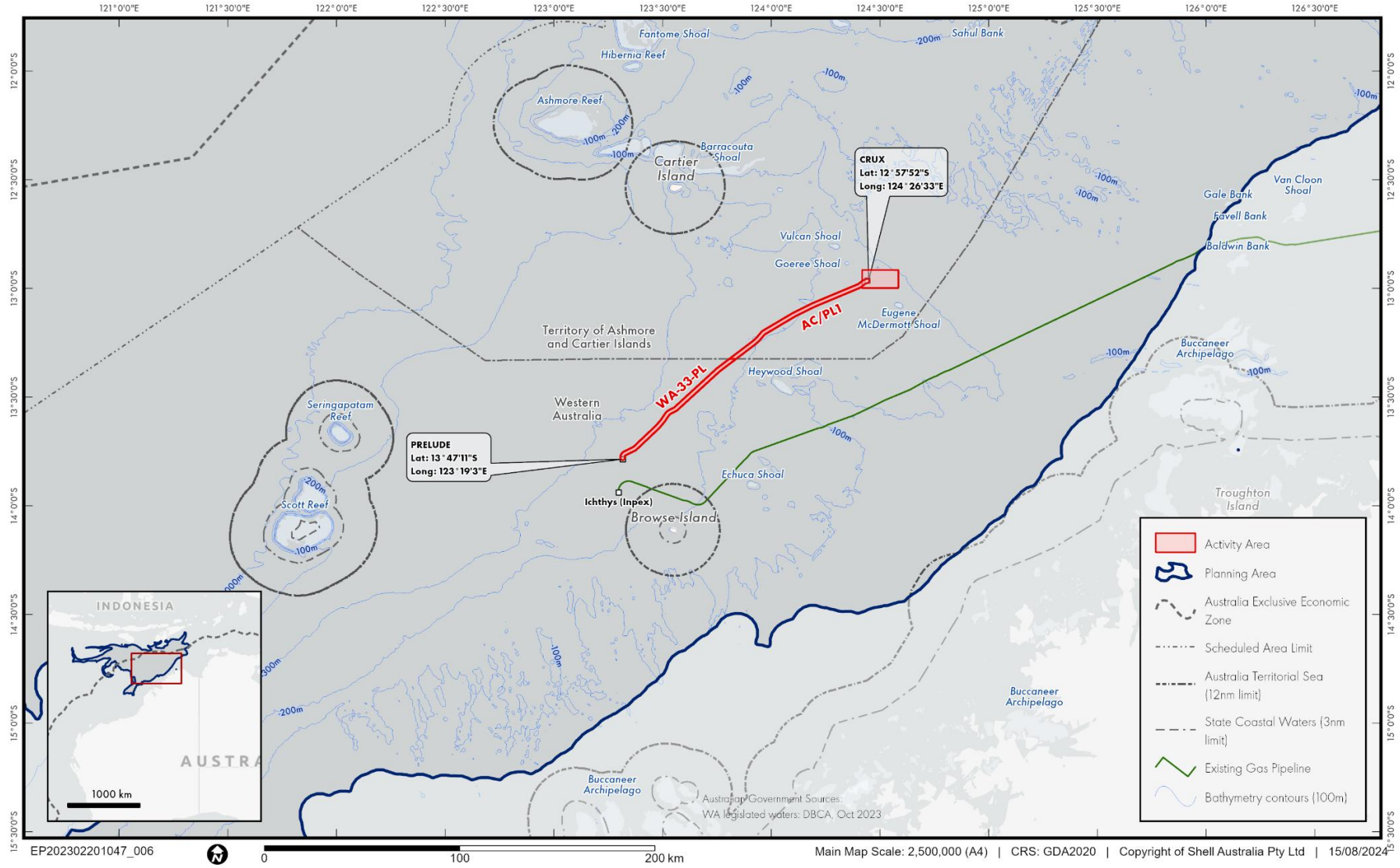


Figure 6-5: Location of the Activity Area (Indicative)

6.3 Timing

The well completion activities are likely to commence in 2026, however the dates may change depending on the execution schedule.

6.3.1 EP Sequence

The commencement of this EP is at the completion of well tie-back, upper completions and dry christmas ('xmas') tree installation which was performed under the Crux Installation and Cold Commissioning EP (2200-010-HE-5880-00002) (Figure 6-6). The EP then proceeds to cover all activities associated with well completions, hot commissioning, start-up, and operation of the facilities as described in this EP. The Prelude FLNG Environment Plan (2000-010-G000-GE00-G00000-HE-5880-00002) will be revised to manage the processing and export of gas and condensate from Crux facility to Prelude FLNG facility after the initial start-up of Crux wells (Figure 6-6).

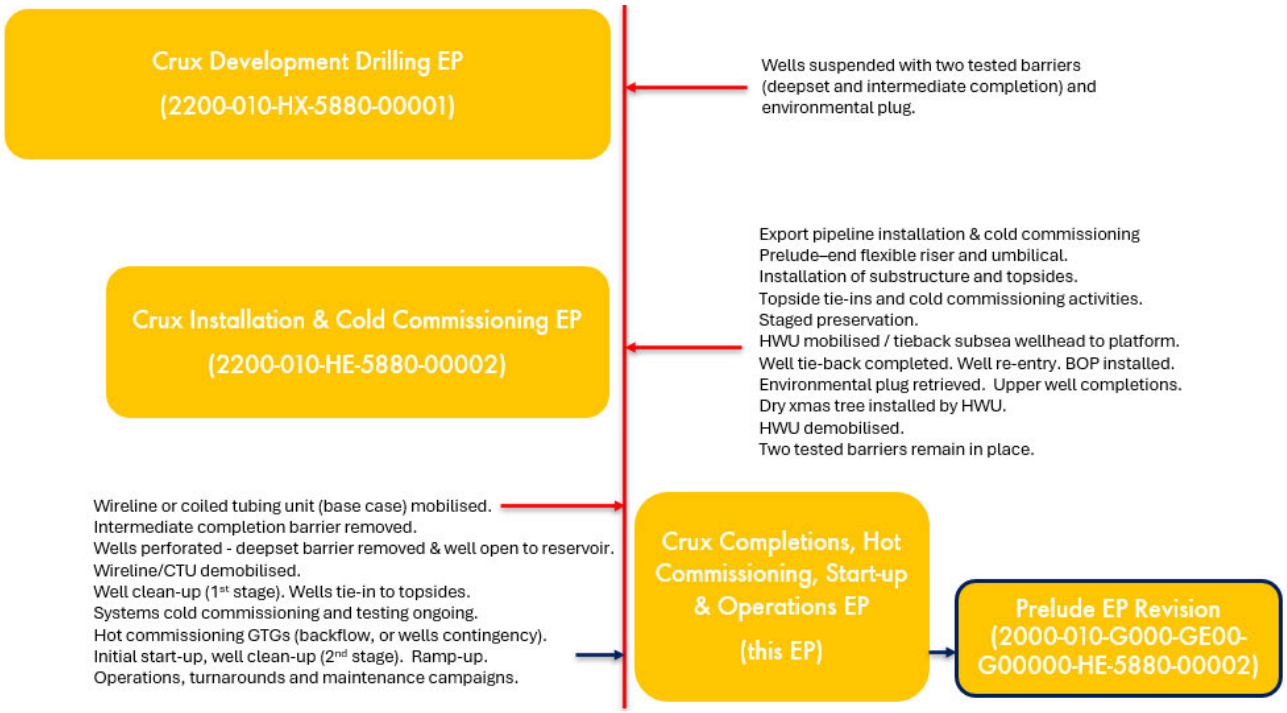


Figure 6-6: Crux EP Interfaces

6.3.2 Duration of Activities

The estimated duration of activities is summarised in Table 6-3. Factors which may change the duration and timing of activities depend on various project schedules, risks, and uncertainties. The duration ranges are indicative and include an allowance for schedule contingencies. Activities will be 24 hours a day, 7 days a week subject to operational and safety considerations. The production planning ('Operating Plan') for the export of hydrocarbons from the Crux platform is currently planned for 15 years, however, this is subject to change based on actual reservoir reserves, efficiencies in the recovery of hydrocarbons and the potential for future developments and subsea tiebacks to extend the operating life. The design life of facilities is 20 years. This EP was developed based on activities occurring any time during the year to ensure all project planning scenarios were assessed.

Table 6-3: Indicative Duration of Activities

Key Activities	Duration	Activity Summary	Duration Month (Approximate)																
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18+
Well completions *(Sections 6.8, 6.12)* *(Table 6.1)*	3 to 10 months	- Wireline/coiled tubing unit mobilised. - Well perforation. - First stage clean-up. - Tie-in/hookup xmas trees to topsides. - Logistics and manning. - Ongoing cold commissioning activities*	Perforation, first stage clean-up							Second stage clean-up + contingency									
Hot commissioning *(Sections 6.9, 6.12)* *(Table 6.1)*	1 to 5 months	- Export pipeline pressurization. - Pressurisation of topsides and fuel gas commissioning. - Backflow of gas to hot commission GTGs. - Pressurisation of the topsides with hydrocarbon gas. - Final checks, inspections, and sampling prior to start-up. - Logistics and manning. - Ongoing cold commissioning activities* - Contingency: Early opportunity for backflow - Contingency: Replace backflow gas with well gas.	Potential early backflow opportunity or hot commissioning on non-deviated well(s)						GTG	Contingency									
Start-up *(Sections 6.10, 6.12)* *(Table 6.1)*	9 to 24 months	- Systematic energisation, start-up of facilities. - Production from Crux wells with forward flow to Prelude. - Systems testing. - Early operations (some stability starting to reduce personnel). - Logistics and manning. - Ongoing cold commissioning activities*								Start-up									Contingency (+15 months)
Operations *(Sections 6.11, 6.12)* *(Table 6.1)*	Life of field	- NNM phase 1. - NNM phase 2. - Planned and unplanned platform visits. - Maintenance campaigns / turnarounds. - Well interventions/workovers (intermittent). - Logistics and manning. - Shutdowns and restarts.																	Operations (ongoing)

* Ongoing cold commissioning activities include activities such as pipe spool tie-ins, leak testing, pressure testing, flushing, cleaning, filling, and systems performance and functionality testing.

6.4 Titleholder and Liaison Person

Table 6-4 lists details of the titleholder, liaison person and arrangements for notifying of changes, in accordance with section 23 of the OPGGS(E) Regulations.

Table 6-4: Titleholder and Liaison Person Details

Titleholder Details	Liaison Person Details
Company Name: Shell Australia Pty Ltd	Name: Brendan Herbst, Vice President Prelude/Crux
Business address: 562 Wellington St, Perth WA 6000	
Phone: (08) 9338 6600	Phone: (08) 9338 6600
ACN: 14 009 663 576	Email: SDA-crux-project@shell.com

If the titleholder, titleholder's nominated liaison person or the contact details change, Shell will notify NOPSEMA (in writing) of the change within two weeks or as soon as practicable.

6.5 Subsea and Wells Facilities

6.5.1 Pipeline and Subsea Infrastructure

The Crux pipeline is laid between the Prelude and Crux pipeline end terminations (PLETs) and the pipe sections are welded together. This pipeline is comprised of the following components:

- A 26″ outside diameter corrosion resistant alloy (CRA) cladded carbon steel rigid riser from the riser emergency shutdown valve (RESDV) on the Crux platform topsides to the base of the jacket structure.
- A 26″ outside diameter CRA cladded carbon steel tie-in spool connecting the Crux riser and PLET.
- A PLET which includes a subsea isolation valve SSIV located near the Crux platform.
- A welded 26″ outside diameter concrete coated carbon steel export pipeline of ~155 km length. The pipeline crosses the Offshore Area of the Territory of Ashmore & Cartier Island and the Offshore Area of Western Australia. The pipeline may include a series of scour protection and span rectification structures (including mattresses, skirts, mud mats and grout bags).
- A second PLET inside the Prelude 1500 m petroleum safety zone, which also includes a SSIV.
- A 16″ inside diameter flexible riser that transports fluids from the pipeline on the seabed to Prelude topsides and terminates the pipeline facility at the upstream flange of the RESDV in the Prelude turret.
- Other subsea infrastructure including fibre optic flying lead, electrical flying leads, hydraulic flying leads, static and dynamic umbilicals, and umbilical termination heads; in addition to, ancillary permanent equipment and structures including bracelet anodes, continuity cables, buoyancy modules, clamps, bend restrictors, clump weight clamps, collars, buoyancy devices, spools, hydraulic lines, umbilicals, centralisers, and related piping components. Small, localised discharges of fluids may occur during operation of subsea valves.

6.5.2 Wells

The wells subsea infrastructure includes five production wells with steel drilling template supported by mud mats installed on the seabed (originally to enable correct positioning of the wells under a separate EP, however, also to provide alignment for any future tiebacks to platform infrastructure). The template includes eight well bays to support a five well development drilling campaign, with the spare slots potentially used for well re-spudding (i.e. contingency events). The wells and reservoir are managed in accordance with the Crux Development Well Operation Management Plan (WOMP) which is delivered in phases through drilling, completion to production and eventually abandonment under Part 5 of the Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011 (Cth). The Activities will be undertaken under separate WOMPs for Well Completion and Production (and in future a Crux Abandonment WOMP is likely to be produced). The WOMP will describe control measures in place to ensure the risks to the well integrity are reduced to ALARP, including during periods of non-operation, before permanent abandonment.

Permanent downhole equipment includes hydraulically operated surface-controlled subsurface safety valve (SCSSV), production packers, well casing, tubing, and cement. A SCSSV is installed in each well and designed to reliably shut-in well production (fail safe, below the mud line) if a catastrophic event occurs, allowing operators to maintain safe operations and reduce potential for hydrocarbons loss of containment.

6.6 Platform Substructure Facilities

The Crux platform substructure is part of the hydrocarbon system and consists of a jacket substructure (~190 m high and gross weight of ~24,000 t) fixed to the seabed with piled foundations (weight ~18,000 t) which penetrate ~155 m in the seabed.

The substructure is positioned above the wellheads on the seabed, the tie-back risers connecting the wells to the dry trees on the topsides are supported and protected by the substructure. The substructure also supports the rigid riser from the export pipeline. The five production wells are contained within the footprint of the steel jacket substructure and connected to the topsides.

6.7 Platform Topsides Facilities

The topsides are fixed to the substructure and supports all processing equipment (length ~106 m, width ~45 m, and gross weight ~12,000 t).

6.7.1 Hydrocarbon Process Description

The platform topsides have been designed to export ~550 MMscf of hydrocarbons per day to Prelude FLNG primarily in the form of multiphase dehydrated gas and condensate, consisting of the following key functional components (also refer Figure 6-7: Simplified Topsides Process Flow):

- Five dry tree wells producing gas, condensate and associated well fluids.
- Bulk liquids and gas separation to divert each phase off for separate processing.
- Gas dehydration using triethylene glycol (TEG) to dehydrate the gas component.
- Condensate coalescer to remove water from hydrocarbon condensates.

The separated and dehydrated gas is commingled with the condensate prior to exporting to Prelude FLNG as a multiphase hydrocarbon stream. The export stream may contain residual free water and chemicals injected in the process and associated hydrocarbon components. Some of the key functional components of the topsides that support the hydrocarbon process include:

- GTG for power generation for all topsides electricity users.
- Fuel gas package for conditioning, scrubbing, and heating fuel gas for fuelling the GTGs and distributing blanket, purge, pilot, stripping and flotation gas.
- Black start diesel generator to provide power to start-up the topsides following the loss of main power generation.
- Low-pressure and high-pressure flare system to safely dispose of hydrocarbons that cannot be exported.
- Produced water treatment system to remove dispersed oil from separated condensed and formation water.
- Segregated drains system and open drain separator to remove dispersed oil for drain water emanating from potentially hydrocarbon contaminated areas.
- Chemical injection system to manage materials integrity, flow assurance and oil in water separation, as required.
- Diesel, service water, nitrogen, and propane utility systems.

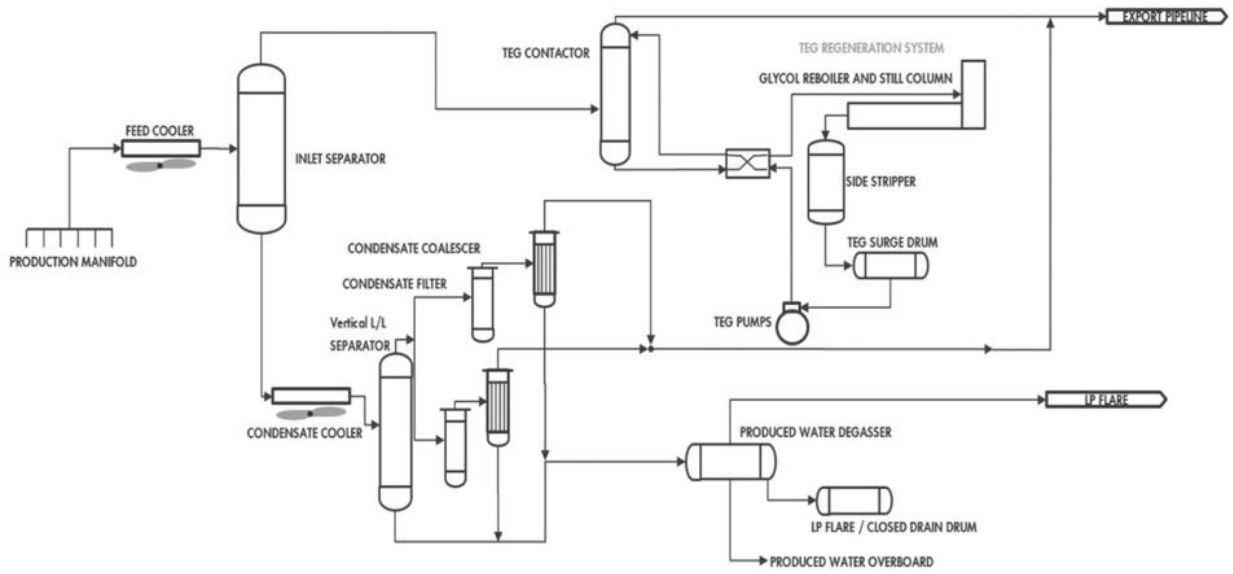


Figure 6-7: Simplified Topsides Process Flow

6.7.2 Layout

The Crux platform topsides consist of a sub-cellar deck, cellar deck with mezzanine floor, main deck, and an upper main deck with use of plated and grated decking depending on environmental and safety drivers. A helideck is installed for campaign visits, unplanned visits, and medical evacuation purposes, and will be in use through all activity phases. The platform is designed with capability for future deck installation to enable development of additional process or utilities equipment. Laydown areas are provided on the upper main deck, main deck, and on the cellar deck including additional crane and wells laydown areas. An electrical equipment and battery room is located on the cellar deck along with an electrical transformer area, temporary refuge equipped with telecoms and instrumentation. Equipment and workshop buildings, temporary laboratory and drone launchers are also located on the main deck. The cellar deck includes bunkering hoses for TEG, service water and diesel, and spare J-tubes and spare topside umbilical termination assemblies for future subsea tiebacks or subsea developments, and provisions for future produced water treatment hydrocyclone system, export pipeline pig launchers, and produced water pumps. Future development to the Crux platform may require subsea wells and subsea tieback to the platform.

6.7.3 Wells, Chokes and Production Manifold

The five production wells are contained within the footprint of the steel jacket substructure. Each well is connected to a dry xmas tree on the topsides (i.e. ‘dry tree’). The fluid flow from the wells is controlled via motor actuated choke valves and flow controllers that can be remotely controlled. These controllers take their measured variables from individual wet gas venturi flowmeters on each flowline and include a water cut meter to detect formation water breakthrough. The flow from the five wells is commingled in the production manifold prior to being routed to the inlet cooler and inlet separator. A surface-controlled subsurface safety valve (SCSSV) is installed in each well and is designed to reliably shut-in well production (fail safe, below the mud line) if a catastrophic event occurs, allowing operators to maintain safe operations and reduce potential for hydrocarbons loss of containment. During initial start-up, the inlet system is designed to enable well clean-up directly from the wellheads to temporary chokes, piping, and equipment, with the produced fluids disposed of via a temporary flare system. A Hydraulic Well Control Unit provides the hydraulic power for opening of the well valves.

The flow of gas from each of the five wells is controlled via dedicated electrically operated production choke valves. The choke valves also control the pressure to the inlet facilities by reducing the well fluids arrival pressure to the processing system operating pressure. The flow from the five production wells is commingled in the production manifold prior to being routed to the inlet cooler. The choke valves are controlled from the Distributed Control System (DCS).

During normal operation, the choke flow controllers receive a setpoint from the main production controller. The setpoint received is determined from various inputs, which include a Prelude demand calculation, Crux GTG

fuel gas supply flow calculation and the Crux export flow measurement. A series of calculation blocks then provide the setpoint sent to the choke flow controllers so that wells flow is increased/decreased to satisfy any change in demand from Prelude, Crux GTGs or Crux Export.

Monoethylene glycol (MEG) injection is required during well start-up for hydrate inhibition and for pressure equalisation for opening the wellhead production wing valves, and the export header valve. A wet gas venturi meter is installed to provide continuous gas flow measurements and includes a water cut meter to detect formation water breakthrough.

6.7.4 Inlet Cooling and Gas Separation System

The well fluids are cooled in the inlet air cooler downstream of the production manifold to cool production fluid thereby reducing gas water content and water load on the TEG contactor. The cooled gas, condensate and water mixture enters the vertical inlet separator for gas and liquid separation to remove liquid from the gas. Following reservoir fluids gas/liquid separation in the inlet separator, gas is sent to the dehydration system, and the fluids to the liquid separator. Air cooling was designed to avoid the need for seawater cooling (and subsequent treatment and discharge) with lower maintenance requirements for minimally manned operation.

6.7.5 Gas Dehydration System

Dehydration is required to prevent water condensation (which can cause corrosion) or hydrate formation in the export pipeline and at the Prelude FLNG facility. Gas from the inlet separator is routed to the TEG contactor vessel where it is dehydrated to the export specification by counter-current contact with lean TEG glycol (wet gas flows upward through a structured packing section which provides a large surface area where it contacts the descending lean TEG). The water-laden rich TEG is collected from the TEG contactor and regenerated for reuse in the TEG regeneration system. Fuel gas is also taken off the gas outlet of the TEG contactor, passed through a scrubber, coalescer and superheater, then distributed to the gas turbine generator for power generation and other fuel gas users on the topsides.

6.7.6 TEG Regeneration System

The TEG regeneration system provides facilities to remove water from the rich glycol (the key dehydration component of the TEG) and to supply lean glycol back to the TEG contactor (therefore, a regeneration and recycling system for the TEG chemical). Rich glycol from the TEG contactor flows to the TEG still reflux condenser (where is provides reflux cooling for the TEG still column) and then to the rich TEG flash drum where dissolved and entrained gases in the rich glycol are flashed off to the low pressure (LP) flare header.

Hydrocarbon liquids, if present, are separated and skimmed off the glycol. Rich glycol flows from the rich TEG flash drum to the rich TEG filter to remove solid particles to prevent fouling and plugging. The glycol then partially flows through an activated charcoal filter to remove any hydrocarbon liquids, degradation products, and most foam-promoting compounds such as chemicals and oils. After filtration, the rich glycol flows to the lean/rich TEG heat exchangers, where the glycol is heated prior to routing to the TEG reboiler and still column. Heat is provided at the bottom of the TEG reboiler to boil-off water from the glycol (which will include volatile components). Reflux cooling is provided to reduce glycol losses. Uncondensed water (steam) and hydrocarbon vapour will exit the TEG still reflux condenser prior to routing to the LP flare system (Section 6.7.10).

The remaining glycol from the still column is regenerated into lean glycol in the TEG reboiler and then flows to the lean TEG stripping column. Dry fuel gas from the fuel gas system is used as stripping gas to remove the remaining water in lean glycol. From the lean TEG surge drum, the lean glycol flows to the TEG recirculation pump where it recycled through the system. During this process there are expected to be TEG losses, and so a TEG storage vessel is provided and sized to cover ~13 weeks of operation. The TEG storage vessel will require periodic replenishment with new supply of TEG delivered to the topsides.

6.7.7 Condensate Dehydration System

The liquids from the inlet separator are sub cooled by the air-cooled liquid cooler with fans driven by energy efficient variable speed drives. The liquid cooler is provided to sub-cool the condensate to prevent vapour break out which can affect coalescer performance adversely leading to water carry over in the condensate. After the cooler, the liquids are routed to the liquid separator to separate the produced water from the condensate (bulk water removal), with the condensate then routed to the condensate filters and coalescers to appropriately dehydrate the condensate prior to being sent to the export pipeline. The condensate filters remove solids and protects the subsequent condensate coalescers and therefore may accumulate environmental hazardous contaminants for consideration during disposal. The coalescers are horizontal cartridge type coalescers and are designed to reduce the free water in the condensate stream to meet the

water specification of the export pipeline. The dehydrated condensate is sent to the export pipeline and the produced water to the produced water treatment system. A water-in-oil analyser is provided on the line to the export riser and pipeline to monitor the quality of the condensate, and a flowmeter and flow totaliser are installed in the line to the export riser to measure the total condensate production.

6.7.8 Produced Water Treatment System

The produced water treatment system is designed to remove dispersed hydrocarbons from the produced water to a concentration of ≤ 30 mg/L dispersed oil-in-water and to dispose of the treated produced water overboard. The system is designed for the full range of flows and conditions expected during field life from zero flow to ~19,020 b/d (~3,029 m3/d). The predicted flow is from ~403 to 1,447 b/d (~65 to 235 m^3/d) expected in early to mid-field life (comprised mainly of condensed water), up to ~19,020 b/d (~3,029 m^3/d) (comprising condensed and formation water) that may be experienced later in field life, in a 'high water case' (in the event there is breakthrough of formation water). Process chemicals that may partition into the degasser and water discharge stream primarily include residual MEG during well start-up for hydrate inhibition and well valve pressure equalisation; clarifier or demulsifier if injected into the degasser to aid OIW separation, TEG, and scale inhibitor if injected into the wellhead at any stage in the future (refer 6.7.14).

The system includes a produced water degasser with additional treatment by a dissolved gas flotation (DGF) system which consists of two dissolved gas tubes connect to the degasser. Oil removal in the degasser is accomplished by DGF where a portion of the treated water from the degasser (performing as a flotation vessel) is being recirculated externally. The pressure of the recirculation stream is increased and brought into contact with the flotation gas stream. The gas saturated stream is then re-introduced into the flotation vessel where the dissolved gas breaks out in a fine dispersion of bubbles giving a 'whitewater' appearance. The oil droplets attach to the rising gas bubbles and float upwards to the gas-liquid interface where they form a thin oil layer that is collected into the oil compartment and subsequently sent to LP Flare Knockout (KO) Drum.

Once the oil water separation has been enhanced, the off gas from the degasser is routed to the LP flare which consists of off gas generated in the degasser plus fuel gas remaining after passing through the gas dissolving tubes. The oil separated and recovered in the degasser is routed to the LP flare liquid header and therefore the LP flare knockout drum. The degasser vessel is provided with nozzles to allow a temporary sand cleaning package to be connected for sand bagging and removal during platform turnarounds or as required. Produced sand that accumulates within the vessel will be mobilised and fluidised using the nozzles to prevent the sand hardening, such that removal is possible during the periodic maintenance campaigns using a temporary sand cleaning package.

Two online oil-in-water analysers (which include microscopy for dispersed oil measurement) monitor the oil concentration of the produced water discharged overboard with high alarms connected to the DCS. These analysers have the flexibility to be operated either both online, or one online and one on standby with idle mode in zero flow conditions. Each analyser has two sensors; the first uses laser induced fluorescence to measure mainly the aromatic proportion of hydrocarbons which fluoresce, while the second uses microscopy for measurement of the dispersed oil-in-water concentration which is directly comparable to the project limit of ≤30 mg/L dispersed oil-in-water. The analysers can be fully monitored remotely. In addition, a flow meter and flow totaliser are installed in the line overboard to measure the total produced water discharge flow with a manual sample installed. The system also includes switchover valves that enable the produced water flow to be temporarily routed to the LP flare KO drum (capacity of ~32 m^3) for small volumes and short durations (instead of overboard). The platform provides space and weight provision on the cellar deck for the installation of another produced water treatment package (such as hydrocyclones) should this be required in the future to meet required discharge specifications.

6.7.9 Fuel Gas System

The fuel gas system takes process gas for use as fuel gas, which is supplied to the following consumers:

- Power generation gas turbines.
- TEG regeneration stripping gas and blanket gas.
- Produced water gas dissolving tubes.
- High pressure (HP) and LP flare headers purge gas.
- Flare ignition pilot gas.

- MEG storage vessel blanket gas.

The fuel gas is taken from the outlet of the TEG contactor, where it is passed through a scrubber and filter coalescer, to remove any liquids or solids, before finally passing through a superheater to ensure no moisture in the fuel gas prior to distributing to the users. Fuel gas can also be imported from Prelude FLNG to start-up the GTGs (referred to as backflow). This backflow may be undertaken in hot commissioning phase, and any subsequent activity phase during platform start-ups to pressurise the topsides and bring the topsides fuel gas, flare, and power generation system into stable, efficient operating mode. In these circumstances, for the initial and subsequent start-ups, when the facility is in a depressurised state, gas from the export pipeline is routed directly to the fuel gas system thus allowing the HP/LP flare systems and the GTGs to operate without the topsides being pressurised. The topsides can also be pressurised with gas from the export pipeline via the fuel gas preheater. Fuel gas distribution to all major users is monitored by flowmeters and flow totalisers. During start-up and importing backflow gas, the fuel gas is also pre-heated prior to entering the scrubber and pressurising topsides.

6.7.10 Flare System

The facility is provided with HP and LP flares:

- HP Flare System – to safely dispose of emergency streams.
- LP Flare System – to safely dispose of low-pressure streams.

The main streams for each flare system are:

- HP Flare:
  - Pilot fuel gas (continuous during normal operation).
  - Purge fuel gas (continuous during normal operation).
  - Start-up and blowdown flared gas from all hydrocarbon system components (intermittent).
- LP Flare:
  - Pilot fuel gas (continuous during normal operation).
  - Purge fuel gas (continuous during normal operation).
  - TEG regeneration off gas - flash gas plus stripping gas (continuous during normal operation).
  - Rich TEG flash drum off gas (continuous during normal operation).
  - Relief from MEG storage vessel.
  - Produced water degasser off gas (continuous during normal operation).

The flare system is designed to meet and comply with relevant Shell standards, including reducing flaring emissions to ALARP. The Shell Group has set a target to eliminate routine flaring in upstream operations by 2025 subject to the completion of the sale of Shell Petroleum Development Company of Nigeria Limited (SPDC). The target is consistent with the World Bank Zero Routine Flaring by 2030 initiative, which targets routine flaring of gas during oil production (upstream operations) and therefore does not apply to gas projects (i.e., including Crux). While this target does not apply, Shell intends to minimise flaring to ALARP and acceptable levels (refer Section 9.12 for further details).

The HP flare system is designed to enable depressurisation of the facilities in a sufficient time that reduces the risk of vessel failure and loss of facility integrity in case of emergency, and for safely pressurising and depressurising the facility during start-ups and shutdowns and maintaining required export flowrates. The LP flare is designed to dispose of low-pressure gases. Each system includes a flare header with liquids knockout drum prior to the exit of gas through the flare boom pipework where the waste gas is combusted in separate HP and LP flare tips. Both flare systems have a liquids header routed to the respective knockout drums. The LP flare knockout drum receives liquids separated out and recovered from the produced water degasser vessel (Section 6.7.8), rich TEG flash drum intermittently (Section 6.7.6), and closed drains (Section 6.7.13) and is purged with fuel gas. Gases from the LP flare knockout drum are routed to flare, liquids can be routed back to the production manifold for reprocessing or routed to the waste oil storage tank (Section 6.7.12). The HP flare knockout drum receives liquids from various high-pressure relief, depressurising and sample station sources, and condensate routed from the fuel gas package.

The flare tips are designed for efficient combustion over the anticipated flow ranges. Fuel gas is used for the flare pilots, and a remotely triggered flare ignition package is provided; with flare ignition provided by a high energy ignition (HEI) system, whilst manual remote flare ignition is provided by a flame front generator (FFG) system. Both ignition systems are selectable, self-sufficient, and independent of each other. The FFG is used to create a flammable gas/air mixture within the flame front line. When this mixture completely fills the line between the flare ignition package and the HP or LP flare tip, a spark is produced in the ignition chamber automatically and the flammable mixture is ignited. The resulting flame front travels through the mixture and will arrive at the flare tip where it will discharge via the pilot nozzles and ignite the pilot flames.

Each pilot is fitted with a flare pilot monitoring system, which includes thermocouples for pilot flame monitoring and reignition sequence initiation. The pilot status is displayed on the Distributed Control System (DCS) and by red/green lamps on the front of the flare ignition panels. A CCTV thermal imaging camera provides visual flame indication to the operator, with analytical software that will detect simultaneous flame-out. In case of loss of main power this will be powered by the 90-minute uninterruptable power supply (UPS) battery system. The flare pilots also have backup propane gas supply for up to ~72 hours. Ultrasonic flow meters are installed on both the HP and LP lines to the flare tips to measure the total gas flow to each flare tip.

The HP and LP flare headers are continuously purged by fuel gas to prevent air ingress into the system. On loss of fuel gas for purge gas, back-up nitrogen (inert gas) is provided. There is continuous low-pressure flaring from the LP flare when the TEG regeneration and produced water systems are in operation (in addition to the pilot and purge gas), refer above and Sections 6.7.6 and 6.7.8. There will also be flaring associated with well clean-up (stage 1 through a temporary flare), during hot commissioning whilst starting up the fuel gas system and GTGs, during initial start-up to test the emergency systems, and during facility shutdowns, trips, restarts and upset scenarios throughout all activity phases. The flare system will be operational from hot commissioning activity phase onward throughout the remainder of field life through all activity phases. Temporary flare facilities will be provided during first stage well clean-up (see Section 6.8) and during future workovers during operations phases, as required (see Section 6.11.3.1) with flowmeters to record flows to the temporary flare.

Nitrogen, supplied via the normal flare header purges, is provided to allow the flare headers to be swept immediately prior to hydrocarbons being introduced to the flare header during start-up and restarts following a shutdown (and upon initial or subsequent start-ups).

6.7.10.1 Learnings from Prelude FLNG

The Prelude FLNG flare has had repeat flame-out / cold venting events reported with GHG emissions of ~1.4 $ktCO_2$-e (0.0014 $MtCO_2$-e) from ~35 reported events since 2021 until end of 2024. Crux's design, like other modern offshore facilities, does not expect to have a high risk of regular flare flame-outs (i.e., unlike Prelude FLNG). Engineering review and vendor consultation (Crux and Prelude share a common flare tip package vendor) were used by the Crux Project to apply learnings, improvements and additional control measures from the Prelude design and operations to the Crux design and operating philosophy. The historical observations on Prelude include:

- cold venting events owing to loss of a pilot/s flame and re-ignition failure.
- false flame-out events (false pilot status alarms, proven by CCTV visual observation).

An engineering review of the Crux flare tip design incorporating Prelude learnings was completed and these are summarised below and in Table 6-5:

- purge gas is supplied by fuel gas rather than nitrogen.
- three thermocouples per pilot (instead of two) with duplex sensing elements (instead of simplex) enabling redundancy if one sensor fails.
- improved secondary detection system (both CCTV and thermal imaging camera) relative to Prelude's partial CCTV capabilities.
- DCS notification and alarm capability will be employed with smart logic.
- improved re-ignition sequence logic where Crux's reignition logic will bypass pilots in fault to ensure reignition is available for each individual pilot failure, relative to Prelude's impairment to automatically re-ignite pilots once an individual failure is observed on any given flare tip. High Energy Ignition system was consequently impacted when the thermocouples fail due to the auto-sequence interlock.

- Variable slot design for Crux HP flare tip (LP flare tip not possible owing to low flow rates and low risk of flame-out).

Table 6-5: Flare System Learnings from Prelude FLNG

Design Aspect	Prelude	Crux Design Improvements
Purge Gas	Primary continuous purge gas supply is nitrogen (secondary is fuel gas) – fuel gas backup was reverted to during periods of known pilot flame-out vulnerabilities due to increased reliability associated with Fuel Gas.	Primary continuous purge gas supply is fuel gas (at both HP and LP flare). Continuous fuel gas purge will be able to assist in keeping the pilot flame lit.
Pilot Gas	Sourced from dry fuel gas distribution header (post molecular sieve dehydration).	Sourced from dehydrated gas (TEG Contactor outlet and/or pipeline).
Number of Pilots	3-4	3
Pilot Detection System (Primary)	2 x Thermocouple (15m long Simplex Type 'K' element) per pilot.	3 x Thermocouple (20m long Duplex Type 'K' element) per pilot. Duplex type means each thermocouple has two sensors, and one signal reporting back to DCS. The thermocouple can detect and report if one out of two sensors has failed.
Pilot Detection System (Secondary)	CCTV.	CCTV + Thermal Camera.
Ignition Logic	Upon thermocouple failure, the primary ignition sequence will allow the thermocouple to return a healthy signal – if unsuccessful, the reignition failure alarm is activated.	Reignition logic is like Prelude, including the reignition failure alarm. However, the failure to reignite status of a single pilot will not inhibit reignition of remaining pilots on the same flare tip if future failure is to occur. Further, as the Crux logic is to be configured on DCS instead of LCP, sequence improvement can be implemented if/as required in the future.
Cold Venting Alarming	If all pilots are reporting in alarm, then an alarm is generated to alert the operator to act to manually relight pilot.	A robust solution equivalent to Prelude which can be tested and maintained in accordance with the CMMS.
Flare Tip Design	Fixed slot.	HP Flare tip is variable slot, LP Flare tip is fixed slot. Note: The benefits of variable slot design include the reduced required purge rate (reducing GHG emissions), prevention of lazy flame / subsequent burn back, and minimisation of air ingress.

6.7.11 Power Generation System

The power generation system comprises of three Solar GTGs (rated at ~2.8 MW each) which provide the main source of platform power when in operations, a black start diesel generator (BSDG) (rated at ~800 kW), and a battery powered UPS.

Temporary diesel generators (various rating from small units up to ~1200 kW) will also be used on the platform topsides throughout all activity phases to provide power demand as required for completions, hot commissioning, start-up, and operations activities including minor and major maintenance and repairs, refurbishment, turnarounds, well interventions and workovers. During completions, hot commissioning, and start-up, two temporary diesel power generators of ~1200 kW each (primary and backup) may be in operation to supply temporary electrical loads during these phases, in addition to standalone temporary generators used by the completions spread contractor.

Users of electrical power include the TEG reboiler (Section 6.7.6), electric motors for pumps, air cooler fans (etc), fuel gas heater (Section 6.7.9), utilities such as air compressors and HVAC, electric crane, lighting, small power and the UPS battery units. Intermittent and temporary users through all activity phases may also include temporary engines, pumps, compressors, lighting, small power, and batteries, as required.

Under normal conditions, two GTGs will be in operation while the third unit will be on cold standby (therefore not combusting fuel). In the event of failure of one GTG, the fast load shedding system removes sufficient non-critical loads to match the remaining generated power until the standby unit is up and running, thus avoiding a shutdown scenario. Given the remote location and improved efficiency, the GTGs are equipped with conventional burners, and fuel gas consumption is metered for each GTG.

The BSDG provides power to the platform when no production gas is available to generate electricity from the GTGs, when the production is shut-down and depressurised. The BSDG may also provide emergency power when an emergency shutdown is initiated, and the production process is shutdown.

The UPS units will provide for backup power for critical items, instrumentation and telecom loads in the event of loss of power from the GTGs. These systems are essential for safe monitoring and control of the production process and for essential communications. Battery power is provided for DCS functions required to monitor blowdown; UHF, marine VHF, public address, and platform audible alarms; status lights; emergency and escape lighting; switchboard assembly (e.g. protective relays, auxiliary relays, etc.); fire and gas detection and alarm systems; CCTV; DCS functions required for fire and gas, communications, and remote black start; SOLAS communications equipment; and satellite or fibre optic telecommunications system functions required for remote operation/monitoring and navigation aid systems.

The platform has a Power Management System (PMS) which is part of power generation package required to gather real time data and balance the generation and consumption on Crux platform, load shedding functionality, load-sharing, remote switching operation and interfaces with high voltage protection modules. An electrical distribution system (including transformers and cables) is installed to distribute power to the electrical users via high voltage and low voltage distribution switchgear.

The GTG and BSDG both have fire suppression/water mist systems (Section 6.7.15) and the GTGs have a periodic water wash system including engine cleaning vessel located on the main deck (that may use imported demineralised water) to remove deposit built-up on the GTG blades.

6.7.12 Open Drain System

The system is segregated into these categories based on drain source (see Figure 6-8):

- Oily water open drains
- Chemical open drains
- Overboard open drains.

The oily water open drain system is open to the atmosphere and is designed to safely collect, contain and remove oily water in an open drains separator, and therefore dispose of deck run-off and liquids from potentially oil/hydrocarbon contaminated surfaces (which may be in hazardous or non-hazardous area classifications) as a consequence of storm events, accidental spillage or washdown. The open drains separator is a horizontal three-phase separator with a single weir arrangement (for liquid-liquid separation), and a plate pack for oil droplet removal and bucket for oil collection. The only continuous influent to the open drain separator is the small stream from the produced water oil-in-water analysers (Section 6.7.8) which discharges reject sample water. All other influents to the open drain separator occur during rainfall events, washdown/jetting operations when manned, or following accidental spills and any subsequent responses such as suppression mists.

The first flush of stormwater from potentially oil contaminated areas will be captured for treatment; drainage water above the first flush will be considered clean and discharged directly overboard via overflow piping in the system. The wellbay area is classified as potentially oil contaminated when well activities are being undertaken and provided with containment for that period, but otherwise in normal operations classified as not contaminated (overboard drains).

The chemical open drain system is designed to safely collect and contain chemical contaminated spills as a consequence of maintenance activity to prevent these liquids from being discharged overboard. When required, deck drains, bunds and tundishes are routed through the chemical drain system to the oil bucket of the open drains separator, and the collected fluids disposed to the waste oil storage tank for disposal onshore.

Outside maintenance periods, the system will discharge rainfall/runoff overboard via either the open drain separator or drain boxes.

The overboard open drain system is open to the atmosphere and is designed to safely collect, contain, and dispose of deck run off water from first flush rainfall overflow from areas which are not classified as having the potential for oil contamination. During periodic testing or actual emergency use, suppression water or the deck integrated firefighting system will be normally discharged overboard. Similarly, emergency uncontrolled spills have potential to lose containment in grated decking areas directly overboard depending on the size of the event.

Bunding is provided for the main deck chemical and oil storage areas with bund drain boxes and valve connections that can be closed during maintenance or refilling to avoid accidental discharge to the environment.

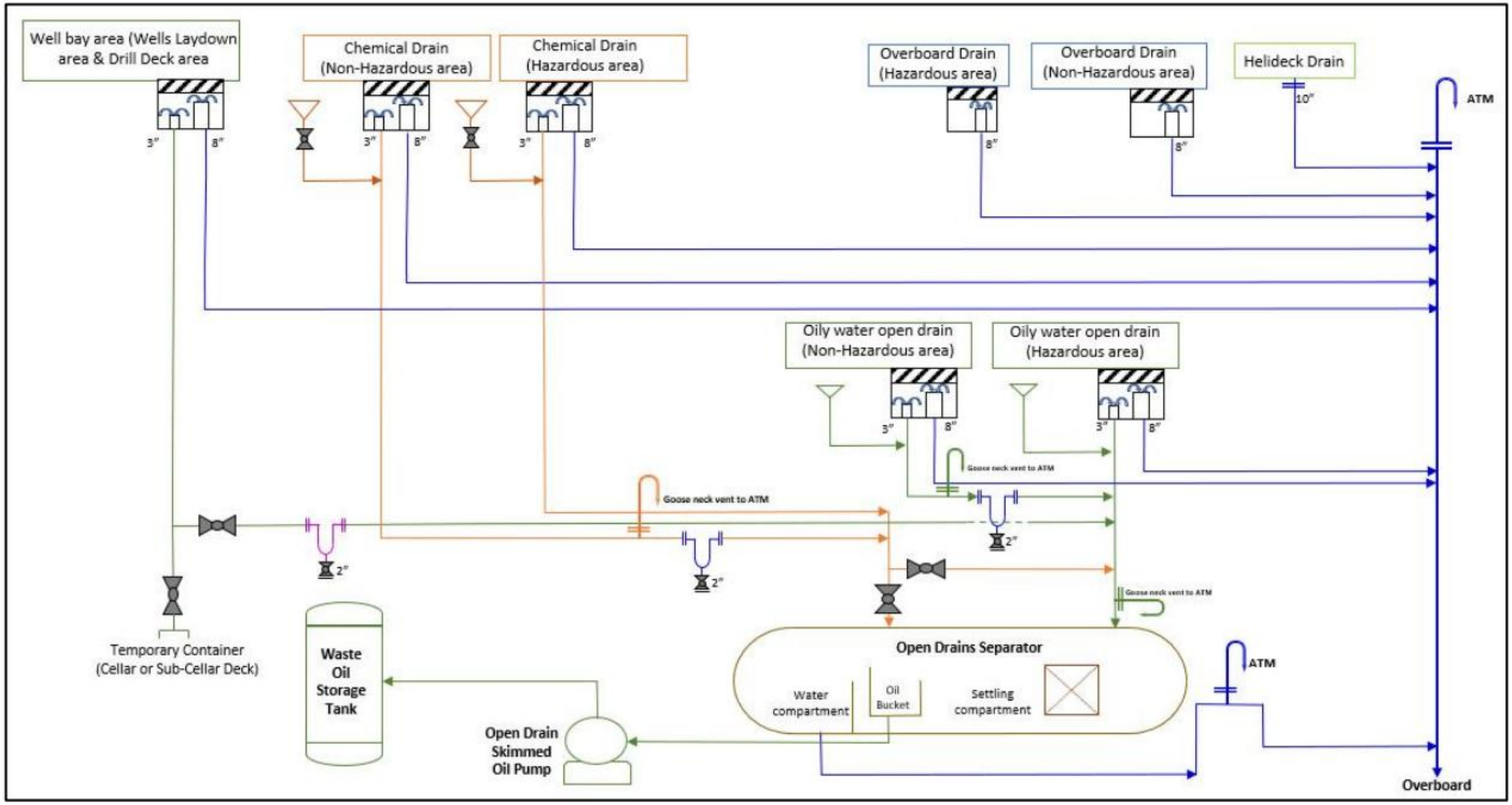


Figure 6-8: Simplified Open Drain System Schematic (Indicative)

6.7.13 Closed Drains

The closed drains system is a non-atmospheric piping system that collects the depressurised liquids from equipment and piping low points in preparation for maintenance and routes them to the LP flare knockout drum that also acts as a closed drain drum (Section 6.7.10). Filling of the LP flare knockout drum from the closed drain is managed procedurally since this a manual operation. This activity only occurs when the vessel or equipment to be drained has been depressurised. The HP flare knockout drum also has provisions to drain liquids to this system.

6.7.14 Chemical Injection System

The following chemicals and associated injection systems will be bunkered, delivered, stored and ready for use, or in continuous use, throughout all activities (including periodic replacement). Tank design storage volumes are provided (working volumes and supply chain transition volumes will differ). First fill totes may still be in storage or in use during the completions, hot commissioning, and start-up activity periods.

- Corrosion inhibitor for continuous injection into the condensate export stream to protect export pipeline (storage tank ~15.6 m^3 with two refill tote tanks ~4.2 m^3 each).
- MEG for well hydrate inhibition and for valve pressure equalisation during start-up (storage vessel ~34.85 m^3 and four refill tote fill tanks ~4.2 m^3 each).
- TEG make-up for TEG dehydration system (~96 m^3 storage vessel).
- TEG pH adjuster for occasional batch dosing to control pH in the TEG system (~4.05 m^3).
- TEG anti-foam for occasional batch dosing to control foaming in the TEG system (~4.05 m^3).
- Biocide to prevent micro-organism growth in diesel or waste oil system (~<1 m^3).
- Hypochlorite injection to prevent micro-organism growth in service water, grey water, and sewage system which may be in the form of sodium hypochlorite or calcium hypochlorite (~<1 m^3).

In addition to the above, space, weight and tie-in piping allowances have been made for potential future injection of the following chemicals which are not expected to be required in the activity period, but which may be required, after surveillance of the relevant systems:

- Wax inhibitor or scale inhibitor may be required to inhibit wax or scale deposition in the export pipeline or at the wellhead respectively (~50 m^3 storage vessel with associated tote tanks as required).
- Demulsifier to assist oil and water separation in the produced water degasser by breaking emulsions (transportable tanks).
- Water clarifier to assist oil and water separation in the produced water degasser by clarifying particles (transportable tanks).
- Additional MEG storage capacity if required for future wells hydrate inhibition and valve pressure equalisation as required (storage vessel up to ~100 m^3).

If these futures chemicals are required in the activity timeframe for the purposes of pipeline or process integrity, the necessary modifications will be made to install the remaining tanks in the allotted space and install pipework to connect to the tie-ins, prior to filling for operational use.

TEG is supplied by bunkering from a supply vessel into the permanent storage vessel using a dedicated bunkering hose reel. All other chemicals are supplied in transportable tanks. Hose couplings on transportable chemical re-supply tanks are dry-break type to avoid loss of containment. Hose couplings for connecting to transportable chemical re-supply tanks are unique and have colour-coding and labelling to avoid cross-contamination of the chemicals.

6.7.15 Service Water System

Service water is bunkered to the platform and stored in the service water tank. A pump delivers service water to the relevant users and for recirculation, which include:

- Helideck deck integrated fire-fighting system.
- Utility points such as wash stations, wash down, flushing, washing, and sand removal.

- Heating, ventilation, and air conditioning (HVAC) system chilled water make-up.
- BSDG coolant make-up, and associated utilities including fire suppression.
- Gas turbine generator coolant make-up, water wash, and associated utilities including fire suppression.
- Ablution module, temporary refuge, and laboratory container (utility, sinks, showers and flush).

Service water may therefore be discharged periodically through the open drains and produced water system discharge points through all activity phases, in addition to the water flush line for the system which is routed overboard.

A hypochlorite injection package injects sodium hypochlorite downstream of the pump to manage bacterial growth with a chlorine analyser monitoring the chlorine level in the water return to the service water tank (which will normally be kept at 0.5–3 ppm with occasional shock dosing up to 5 ppm, as required). Calcium hypochlorite tablets or granules may also be added via the tank hatch for bacterial control. Hypochlorite may also be injected and discharged into the sewage disposal caisson prevent bacterial growth.

An ultraviolet steriliser is also provided on the feed to the temporary refuge. The package includes cartridge filters to remove possible residuals (e.g. rust, scaling) from the service water system. Potable water for drinking will be sourced from accommodation vessels and, if required, stored in potable water containers in the temporary refuge.

6.7.16 Diesel System

Diesel fuel is required for the following consumers throughout the facility lifecycle and all activity phases:

- BSDG to provide power to start-up the topsides from a depressurised state when GTGs are unavailable through all activity phases (including regular testing).
- Temporary diesel fired equipment (diesel generators, completion spreads, air compressors, well completions, workover units, pumps, drilling facilities, maintenance spreads, etc.) through all activity phases.
- Hose dispensers for well temporary laydown area, temporary diesel generator and Totally Enclosed Motor Propelled Survival Craft, including the regular testing of all those components.

Diesel is supplied by bunkering from a supply vessel to the crane pedestal diesel storage tank (~77.6 m^3) using a dedicated diesel bunkering hose reel or temporary hose arrangement across the gangway. The BSDG uses a day tank (~2.1 m^3) and an additional diesel storage tote tank (~14.7 m^3) is located on the upper main deck, which can be refilled by tote tank, to provide a redundant supply of diesel on the platform. Diesel is reticulated to the well laydown area for use when activities are occurring in that area. Although not a currently planned activity, diesel may also be used for pressure vessel performance testing in the completions, hot commissioning and start-up activity period which would not result in any discharges. Some tasks through the activity period may require temporary diesel storage tanks to be mobilised on the platform. During all activity phases, the diesel fuel may be sourced from any of the tank storage locations on the facility to enable operational flexibility and redundancy in the event a pump or component is offline.

Level indication is provided on the crane pedestal diesel storage for monitoring the level inside the tank. Local level indication is also provided at the bunkering station via a level indicator, common alarm horn, common beacon light and common acknowledgement push button. Tank filling will be managed based on the required fill volume and using the bunkering pump flow meter. The tank filled volume is indicated on the DCS. Biocide dosing is injected into the diesel transfer pump suction line to prevent micro-organism growth in the crane pedestal tank. Note that the platform crane, whilst providing diesel storage in the pedestal structure, does not consume diesel as it uses an electric motor.

6.7.17 Utility Systems

Nitrogen as required during all activity phases for the purging of equipment containing flammable substances and to allow the flare headers to be swept immediately prior to hydrocarbons being introduced to the flare header during the restart process following a shutdown (and upon initial or subsequent start-ups). Nitrogen will be supplied by a combination of cylinders and a nitrogen generation system. Nitrogen will also be used for MEG storage tank blanketing gas back up (fuel gas is normal blanket gas) and other utility stations.

An electrical distribution system (including transformers and cables) is installed to distribute power to the electrical users via high voltage and low voltage distribution switchgear, including an electrical equipment room, field auxiliary room and transformer area. Additional utilities include and instrument and service air system that supplies dry compressed air for various users including tools, instruments, flare ignition package, air driven pumps and instrument air purges (motors, panels, junction boxes, etc, as required).

Heating, ventilation and air conditioning (HVAC) systems with refrigerants are installed (including temperature, humidity, air motion, air quality, noise, and cleanliness) to provide a safe (non-hazardous) working area for personnel and equipment.

6.7.18 Control and Monitoring Systems

All well functions can be controlled remotely from Prelude FLNG or the Integrated Operations Centre (IOC). The primary communication from Crux to Prelude FLNG is by subsea fibre optic link provided over the North-West Cable System (NWCS), a subsea fibre network owned and operated by regional network telecommunication service provider. Should the primary fibre link fail, an alternative communication link using a VSAT satellite system will be used to enable continued monitoring and control of Crux from the host facility (Prelude FLNG). A Closed-Circuit Television (CCTV) system provides a visual feed back to the Prelude FLNG control room. Control systems on have been designed and built for a minimally manned platform that allow for extended periods of continuous operation with no human supervision on location. Therefore, a plug and play philosophy with high reliability and low maintenance requirements was applied to the systems design. Control, monitoring, reset and restart of equipment can be controlled locally or remotely and managed by an Integrated Control and Safeguarding System (ICSS), which consists of the following major subsystems for monitoring, controlling, safeguarding, maintaining, and managing the Crux facility which be available for use through all activity phases:

- Human Machine Interface (HMI) to manage control of Crux platform between the Prelude FLNG control room and Crux. In degraded communications mode (i.e. primary communications link failure), the HMI provides sufficient information for the operator to make necessary decisions regarding continued safe operation and enable an orderly shutdown if required.
- Distributed Control System (DCS) for implementation of non-safety related automation, control, and monitoring functions (including process and utilities), physically and functionally independent from the Instrumented Protective System (IPS) and Fire and Gas System (FGS). The DCS ensures plant operation within predetermined operational and design limits; uses automated controls minimising operator intervention; effective process control for all designed operational and transient scenarios; and alarm management and handling.
- Instrumented Protective System (IPS) which continuously monitors for abnormal events (including loss of containment or fire/hazardous event); detects abnormal process parameters and initiates partial or full shutdown and/or isolation of process/utility/electrical equipment in an orderly and safe manner; depressurises (blowdown) the process inventory to make the facility safe; initiates alarms for mustering and evacuation of personnel; and provides levels of emergency shutdown (ESD), including:
  - Emergency Shutdown 0 (ESD0): Total offshore facility shutdown and electrical isolation while maintaining the battery power.
  - Emergency Shutdown 1 (ESD1): Shutdown level upon confirmed detection of fire or gas (at temporary refuge or intakes) or confirmed fire or gas in non-hazardous utility area.
  - Emergency Shutdown 2 (ESD2): Shutdown level with process system depressurisation upon confirmed detection of fire or gas in process area.
  - Process Shutdown: Lower level of shutdown initiated by a process upset to prevent escalation to emergency level.
- Fire and Gas System which detects the loss of containment of hazardous inventory (gas and liquid), detects fires, raises alarms and interfaces with the emergency shutdown system for protective responses acting as a mitigation control in the event of a release, preventing a fire or explosion escalation. The system will monitor air spaces for hydrocarbon releases/accumulation, alert personnel by initiating alarms and finally initiating signals that enable necessary actions such as process or emergency shutdown for

inventory isolation, blowdown, shutdown of ignition sources and HVAC intake dampers minimising the consequence of a potential fire or release.

- Sequence of Events Recorder captures the status change of all ICSS input and outputs, system parameters, operator actions, equipment status, inhibit and override statuses and other nominated signals for high resolution audit trail in one common database.
- Real Time Data Base is used to store and retrieve all online data collected from Crux.
- Instrument Asset Management System is used to manage and maintain Highway Addressable Remote Transducer type field instruments, Digital Valve Controllers (DVC) etc.
- Alarm Management System manages all alarms generated in the DCS, IPS, FGS as well as alarms originated from third party systems which are interfaced to the ICSS.
- Electrical Network Monitoring and Control System (ENMCS) which monitors and/or controls (where applicable) the Crux electrical network consisting of GTG, BSDG, power management system, switchgears, transformers, and UPS systems as part of the platform DCS.

During hot commissioning and start-up activity, local control of the platform will be provided by a temporary control station in the Temporary Refuge. This will transition to remote operations at Prelude FLNG or IOC. The following remotely operated functions are possible from the existing Prelude FLNG Control Room or IOC without the need for local operator support and/or intervention on Crux platform:

- Remote monitoring, control and diagnostics of all equipment and machinery.
- Remote start-up and control of main power generation (GTGs).
- Remote start-up (including BSDG), pressurisation, shutdown, and depressurisation of the facility.
- Maintain the process and utilities within predefined limits or tolerances.
- Remote monitoring and reporting of regulatory reservoir, process, and environmental parameters.
- Alarm management and handling.
- Remote modification, configuration, programming, maintenance, testing, troubleshooting and update the ICSS and its subsystems.
- Asset management, diagnostics and maintenance of some smart field instruments, valves, and detectors.
- Data archiving, recording, trending, and reporting etc.

The ICSS has the flexibility to expand for future facilities and is designed on a modular concept allowing additional equipment to be added into the system for future expansion.

6.7.18.1 CCTV system

A CCTV system has been incorporated into the design to allow remote operators from the Prelude FLNG facility to have ‘eyes on board’ the Crux platform. This system includes pan tilt zoom CCTV cameras which have been placed on the northern, eastern, southern, and western external boundaries of the platform. This orientation allows the operator to observe the topsides equipment and the surrounding environment. There is also a fixed thermal CCTV camera (with flame detection software) pointed to the maximum practical extent at the flare flame (Section 6.7.10), to provide backup confirmation that the flare is lit.

6.7.19 Protection Systems

The topsides have several mechanisms which help protect against loss of containment events, which include:

- Fire and explosion protection which includes blast walls to minimise the consequences of explosions and mitigate the impacts of explosions on equipment and areas of the platform. Blast resistance is also applied to structure and critical elements that may potentially be exposed to blast loads but are required to perform their function after an explosion event. Self-contained water mist suppression systems are provided for protection of GTG and BSDG enclosures.
- Low pressure trip that is designed to operate in the event a major export pipeline leak or rupture.

- Passive fire protection coatings provided to process equipment (saddle/skirt and support), shutdown valves (riser ESDV), primary structures, and critical piping to maximise continued integrity of equipment under predicted fire conditions.
- Water in condensate analysers are installed to monitor and provide alarm if the water content in the condensate export and dew point in the TEG contactor outlet is exceeding limits, thereby providing warning for any situations that could impact the integrity of the export pipeline.
- Navigational aids to enable the facility to be visible to marine and aviation traffic, and to signal a safe line of approach or departure for helicopters, radar beacon and main navigation lights to alert marine vessels and aircraft of the position and prevent collision with the facility.
- Collision avoidance Automatic Identification System (AIS) is provided on the platform for collision avoidance to detect marine traffic and provide warning.
- Metocean data gathering system provides a Real Time Metocean Monitoring System to alert personnel to adverse weather by providing accurate, continuous, real-time metocean data for decision making when conducting weather sensitive activities to help prevent weather related incidents.

In addition to these protection mechanisms, the structural design intent of topsides and substructure (materials, corrosion protection, etc) is to maintain structural integrity under all expected actions through service life and provide sufficient robustness to maintain availability of critical systems during a major incident. Handling equipment on the topsides (e.g. underhung gantry crane, monorails, davit, and pedestal crane) is designed to ensure that loads can be lifted and mechanically handled, without dropped object or swinging load risk. Process containment equipment (such as process vessels, heat exchangers, rotating equipment, piping and relief systems are designed to maintain integrity of the containment envelope through protection for mechanical failure (e.g. gas detectors, flame monitoring and dedicated suppression/water mist), materials corrosion and erosion allowances, vibration control and protective coatings. Design accounts for transient pressure and temperature, environmental, mechanical, and dynamic loads with relief devices to prevent overpressure in pressurised hydrocarbon gas/condensate containment systems in the event of loss of process control, fire or any other credible overpressure scenarios. Ignition control systems are also designed to prevent the ingress or build-up of flammable hydrocarbon gas-air mixtures or dangerous atmospheres by ventilation systems, certified electrical equipment, earth bonding devices, and area classifications. Helicopter facilities include a passive fire retarding helideck, helideck perimeter lights, self-contained deck integrated firefighting system (DIFFS), safety perimeter net and helicopter crash/rescue equipment.

6.7.20 Export System

The export system combines the dehydrated gas stream from the TEG contactor and the dehydrated condensate stream from the condensate coalescers and transports the combined export stream to the rigid 26″ export riser. The gas and condensate export streams are metered separately by flowmeters and totalisers. A removable export pipeline pig launcher is provided to enable risk-based intelligent pigging for pipeline integrity and wax removal (the pig receiver is located on Prelude FLNG).

6.7.21 Other Facilities

6.7.21.1 Ablutions

The following systems will discharge grey water from basins/showers and/or macerated sewage in separate headers to the sewage caisson which discharges ~15 m below the sea surface:

- Ablution module (grey water and macerated sewage) for up to ~80 POB.
- Temporary refuge (grey water and macerated sewage) for up to ~2 toilets, ~2 basins, and integrated shower, with emergency sleeping space for up to ~40 POB.
- Laboratory (grey water from basins), contaminated water is self-contained for onshore disposal.

Each toilet has its own integrated macerator to convert solids and fluids into fine slurry before being expelled into the sewage line. Sodium hypochlorite will be injected into the disposal caisson on a regular basis. Temporary, self-contained toilet/ablution modules that are not discharged to the sewage or grey water header may also be used during hot commissioning, start-up and any subsequent planned or unplanned campaign depending on scope requirements. Sewage or greywater from these temporary units will be discharged

through temporary piping/hoses for short durations or shipped onshore for disposal as required. No food waste is discharged from the platform.

6.7.21.2 Laboratory

The premise for laboratory testing in not-normally manned operational modes is that Prelude FLNG and/or mainland laboratories will be used for testing requirements. Temporary laboratory module facilities will support completions, hot commissioning, start-up phases and will be retained/mobilised as required during the remainder of operations phase activities.

6.7.21.3 Chemical storage

During the activity lifecycle, non-injected process, and other miscellaneous chemicals such as hydraulic fluid, lube oil/seal oil, coolants, instrument air dryer beds, radioactive sources/nucleonics, TEG activated charcoal filters, biocide treatment, well annulus fluid and generic cleaning fluids (as examples) will be used for specific tasks, maintenance, and operational requirements. Chemicals are selected in accordance with the Shell chemical selection and approval guidelines (see Section 10).

6.7.21.4 Lighting system

The lighting system on the Crux platform is limited to the illumination required for safety, navigational and emergency lighting. Portable lighting may be needed for short durations if night activities are required for works through all activity periods.

6.7.21.5 Bird deterrent system

An acoustic bird deterrent system has been included in the Crux platform helideck for operation when the facility is in unmanned mode. The system basis is to discourage bird nesting and habitat creation on the helideck, and therefore minimise the potential for bird strike during helicopter operations when the facility is manned. Speakers are included in the helideck and will both intermittently and on demand (e.g. prior to helicopter landing) play the acoustic bird deterrent distress call, of which there are several options available, including the Canadian goose and birds of prey. The system will be turned off when the platform is manned, given the presence of personnel is a deterrence to birds.

6.7.21.6 Fire and suppression systems

The Crux topsides Deck Integrated Fire Fighting System (DIFFS) is a passive system and contains no chemical foam (water only) pressurised via nitrogen. If it needs to be tested offshore (or used in emergency situations) it would discharge ~1.2 m^3 of water per minute and the water tank working volume is ~6.5 m^3. The water within the water tank may be dosed to control water quality (e.g. prevent bacteria or marine growth). Self-contained water mist suppression systems are provided for protection of GTG and BSDG enclosures. During periodic testing or actual emergency use, suppression water may be discharged overboard through grated decking.

6.7.21.7 Metocean monitoring

A real-time metocean monitoring system is installed on the platform to support helicopter and vessel operations at the platform. There may also be deployment of metocean monitoring equipment (such as waverider buoys) throughout the Activity Area for any of the activity phases to provide a comprehensive understanding of meteorological, oceanographic, or biological conditions for monitoring and surveillance purposes, planning activities, and informing inspection, repair, or major maintenance activities.

6.8 Well Completions Activities

6.8.1 Perforation

The well completions activities include well perforation and well clean-up to prepare the wells for producing hydrocarbons to the platform. The activities will use either a temporary wireline spread or coiled tubing unit (CTU), each with pressure control equipment including blowout preventer which will be attached to the dry trees. The wireline/CTU will retrieve the intermediate and deepset plugs, installed under the Shell Crux Development Drilling EP and Shell Crux Installation and Cold Commissioning EP, to enable access to the target formation. If a wireline spread is used to retrieve the plugs, then it will be demobilised; and (if not already in place) a temporary CTU with pressure control equipment is mobilised on the platform to perforate the production liner set in the reservoir for each of the wells. The temporary CTU perforates the well using shaped

charge guns; a process which will leave gun debris in the wellbore that need to be cleaned up before flowing the wells for production. The shaped charge creates a high-pressure jet that penetrates the casing and formations, allowing hydrocarbons to flow into the wellbore. Once perforated, the guns are retrieved from the wells. The systems will be powered by temporary diesel generators (TDG) and engines, pumps and other machinery with diesel sourced from either temporary or permanent tank systems. Directly fired diesel equipment will include air compressors, pumps and hydraulic power units. The BSDG may also be used to provide facility power for short periods if problems arise with the TDG. The activities may require a range of utility services such as base oil completions fluids, LPG, hydraulic fluids, compressed air, nitrogen, lubricants, MEG, and other chemicals required to undertake the operation.

During the perforation activity, small quantities of trapped well gas will be bled from the coiled tubing pressure control equipment, the majority of which is expected to be flared via the temporary flare boom. A small well test package, referred to as a 'bleed off' package will be used to perform this activity. There is potential for small volumes of fugitive gas releases during this process. Liquids accumulated in the bleed off package will be either:

- Uncontaminated base-oil completion fluid – which will be collected and either re-used or shipped back to shore for re-use or disposal.
- Contaminated base-oil/condensate – which will be collected and shipped to shore for disposal.

It is not expected to incinerate meaningful quantities of liquids offshore during the perforation activity.

6.8.2 First Stage Well Clean-Up

The next stage of well completions is commencement of well clean-up operations. After perforation, each well will contain base oil completions fluid, some brine, solids from perforating debris, sand, and cement. The primary objective of the clean ups is to remove these components from the well bore and clean the formation near to the perforation tunnels to reduce the perforation skin as much as possible. The well clean-up will be undertaken in two stages, with only the first stage taking place during well completions activities. The first stage well clean-up will be performed on all five wells during the well completions phase at a rate of ~60–90 MMscfd per well subject to ongoing design and optimisation, with well fluids directed through a temporary well test package to separate and dispose of gun debris and liquid contaminants that remain from the drilling activity. The first stage clean-up is expected to take ~24–72 hours per well. This first stage clean-up is expected to be sufficient for two of the wells (classified as 'non-deviated' or 'low inclination' wells) to be ready for start-up, however the remaining three wells (classified as 'deviated' wells) will require a second stage clean-up (see Section 6.10).

The temporary well test package is a spread of equipment that enables three phase separation of the well constituents. It will remove well effluent, including liquid and solid contaminants, from the wellbore and MEG used for hydrate inhibition. First, solids are removed from the flow stream in the desander; all solid waste is shipped to shore for disposal. Flow is then directed to a temporary three-phase separator which meters all three phases (gas, oil, and water). Gas is directed to the temporary flare boom, where it is flared. It is intended that water, and oil (condensate, condensed water, and base oil completions fluid returns) from the separator will be recombined after metering and incinerated in the oil burner mounted on the flare boom. Any residual water that is not incinerated in the flare boom will be filtered and disposed overboard in batches by piping which discharges at an elevation above the sea surface. Where technically possible, water will also be passed through the filtration system at the end of the completion activity for overboard discharge. Water discharges may contain residual oil in water (not captured by the three-phase separator), which will be measured by an analyser, with all discharge volumes recorded based on tank level readings. During the well test and first stage clean-up process there is possibility for vented and fugitive emissions of dry hydrocarbon gases from the system, for example by the surge tank vent lines; bleeding off small, trapped volumes; sampling; leaks; tank and vessel vents; unplanned flare-outs; and emergency overpressure relief. This may include emergency relief for the steam exchanger, separator, and surge tank gas relief lines with potential for minor amounts of hydrocarbons (in emergency scenario).

The temporary three-phase separator is a horizontal separator fitted with fixed weir plate that can be run in either 2-phase or 3-phase mode. Once stable flow is established, it is expected that the water cut will be less than ~10%, which will enable operation in 2-phase mode to reduce the amount of water processing required and reduces the burner combustion temperature which also reduces heat radiation and NOx emissions. High frequency noise is reduced by selection of 'whisper trim' proprietary control valves.

The temporary flare boom and incineration system is expected to use proprietary high efficiency liquid burners designed with multiple burner nozzles to maximise flame turbulence and air ingestion and therefore optimise combustion efficiency and minimise potential for smoke emissions and flame-out. The gas flare is expected to incorporate a low-velocity tip to improve combustion efficiency, and reduce lift-off / flame-outs, particularly of gas with a high inert-content. Other features include:

- To maximise the flare performance in all wind conditions, two sets of ignition systems will be run on both the flare tip and the oil burner. The primary ignition system uses a conventional spark-lit burner, with a pilot assembly on each burner head assembly and the flare tip. A thermocouple detects flame-outs and initiates re-ignition on the primary system. A secondary (redundant) manual ignition system is designed to minimise common-mode failures with separate power and pilot gas supply. The flare system has emergency shutdown capability, and manual ignition control panels.
- Three personnel in rotation will be dedicated on each shift to perform flare watching duty to ensure the flare is always supervised. The personnel will rotate between watching the flare and performing safety checks and other duties to manage fatigue. At no point will the flare be unsupervised, and the person watching the flare is both watching for flare outs/unstable conditions and monitoring the sea for any sign of fall-out. The well test area is permanently manned by ~6 experienced personnel.

The activities will also require pressure testing water and test fluids sourced from service water or imported water. Water is likely to be dosed with oxygen scavenger, biocide, and corrosion inhibitor at a concentration around ~1,000 ppm. Chemicals are selected in accordance with the Shell chemical selection and approval guidelines (refer Implementation Strategy, Section 10). The test fluids do not represent a significant volume and will be either incinerated in the oil burner or filtered and discharged with the other water discharges. Water curtains (deluge) sourced from seawater (via temporary seawater intake hose and pump) will be used for safety reasons during the clean-up flaring to provide cooling to protect people and equipment from heat radiation. Depending on wind direction, deluge water may accumulate on deck and discharge through the open drain system or grated decking; however, it is not chemically dosed and will return to the marine environment.

The well test package and components will be powered by temporary diesel generators (TDG) and engines, pumps and other machinery with diesel sourced from either temporary or permanent tank systems. Directly fired diesel equipment will include air compressors (utility air and flare burner air), steam generator boiler, booster pumps, hydraulic power units. The BSDG may also be used to provide facility power for short periods if problems arise with the TDG. The activities will require a range of utility services such as completions fluids, steam generator boiler, MEG, emulsifiers, compressed air, hydraulic fluids, nitrogen, fresh water, sea water, lubricants, and other chemicals required to undertake the operation.

Two twin-compartment surge tanks (~15 m^3 each) are provided for receiving liquids from the separator (one intended for water, one for condensate/base oil). The two surge tanks are connected both via an inlet bypass and the outlet, so that fluids can be transferred between them if necessary. A sand skip is included in the system, incorporating a flushing water reservoir and twin sandbags each capable of storing & separating ~250 litres of solids. The sand skip is an atmospheric vessel, where slurry enters the unit at the top and is guided into one of two hydrophobic sandbags. Solids are retained in the bags, whilst flush water is drained out into a flush water holding tank. It is possible that small amounts of condensate are drained to the sand skip, and if so any flashed gas from the condensate is vented to a safe area (considered to be immeasurably low volume). In the highly unlikely event that a condensate level builds in the sand skip holding tank, a facility is provided to pump the liquids out to a slops tank (which will be transported for onshore disposal).

During early stages of the clean-up, monoethylene glycol (MEG) will be injected into the flow stream at a rate of ~5 L/min to prevent hydrate formation. MEG primarily partitions to the water phase exiting the separator and will be incinerated under normal circumstances.

Following first stage well clean-up the wells will be shut-in and isolated, and all temporary equipment disconnected ready for demobilisation. The well test equipment and remaining wells equipment will be demobilised and shipped off the platform in an appropriate time window after this stage (first stage clean-up equipment is not required for second stage clean-up).

Piping spools and other piping components will be installed to hookup the xmas trees and wells to the topsides hydrocarbon process system ready for introduction of well hydrocarbons to the topsides (and second stage clean-up). This will also involve leak testing, pressure testing, connecting hydraulic and electric lines, instrument connections, etc.

6.8.3 Second Stage Well Clean-Up

It is expected during the start-up activities (Section 6.10) that the remaining three 'deviated' wells will require a second stage clean-up over several days to remove any residual gun debris before they can produce at higher rates. The second stage clean-up will be performed at rates up to 200 MMscfd per well using the permanent topsides separation, produced water handling and flare systems, with the addition of a temporary desander package.

Unlike the first stage clean-up, hydrocarbons are expected to be produced for export to Prelude FLNG rather than disposal by flare, allowing for reduced emissions. Produced water will be separated in the permanent platform separation facilities and treated by the produced water treatment system (Section 6.7.8) for discharge overboard. Any water used in the temporary equipment during second stage well clean-up (e.g. pressure testing, flushing) will be disposed of via the closed drain system, if not contaminated, to also be treated in the produced water treatment system. Any contaminated water not suitable for the produced water treatment system will be collected in tanks and shipped to shore for disposal. Solids removed during the second stage well clean-up will also be shipped to shore for disposal.

Throughout all well completions activities, other general cold commissioning activities will be ongoing during these activities such as pipe spool tie-ins, leak testing, pressure testing, flushing, cleaning, filling, and systems performance and functionality testing. The activities will require a range of utility services such as base oil completions fluids, LPG, hydraulic fluids, compressed air, nitrogen, lubricants, MEG, and other chemicals required to undertake the works.

6.9 Hot Commissioning Activities

6.9.1 Export Pipeline Pressurisation

Hot commissioning of the Crux platform topsides requires hydrocarbon gas to enable the required activities to be carried out. This may be provided via the Crux export pipeline being pressurised by backflowing (importing to the Crux facilities) vaporised LNG from Prelude FLNG (base case option) or by flowing from a Crux well after clean-up and completion (contingency option). Pressurisation of the pipeline is an activity that may take place during or following the well completions activities to execute the hot commissioning activities detailed in this section. If the hydrocarbon gas is to be provided by a Crux well, this will be undertaken by production from one or two Crux wells after first stage clean-up (whilst remaining wells are cleaned-up) in which case there will be parallel and simultaneous well completions, hot commissioning, and start-up activities.

6.9.2 Pressurisation of Topsides and Fuel Gas Commissioning

Bypass piping is installed on the topsides to enable routing of the backflow gas directly to the inlet facilities via the topsides fuel gas system (Section 6.7.9) to enable it to be pressurised, conditioned, and made ready for use. Backflow gas provides alternative initial fuel gas required to commission the fuel gas system in advance of the two clean non-deviated wells being ready for start-up. If backflow gas is not available, gas from the two clean non-deviated wells may be used instead (contingency option). Equalisation of the export header valve or wellhead valves will require small volumes of MEG injection which will eventually flow via the produced water treatment system (Section 6.7.8).

The introduction of hydrocarbon gas will require the ignition and availability of the high-pressure and low-pressure flare systems (Section 6.7.10) to ensure safe operation. Purge gas and pilot gas will initially be provided using nitrogen and propane respectively until fuel gas can be safely and reliably supplied (nitrogen from the pipeline or system purging will be vented during this period). The gas dehydration (Section 6.7.5) and TEG regeneration system (Section 6.7.6) are not in operation until the wells are producing, however, some components may be prepared, energised or in recirculation mode ready to transition to start-up. Most systems are being prepared for use, ready for use, or in use during hot commissioning. Once the fuel gas system is commissioned and ready for use, fuel gas can be supplied to the GTGs for sequenced start-up of the power generation system (Section 6.7.11). Once stable and reliable power is available from the power generation system, the TDG and BSDG are no longer required to supply ongoing power requirements.

Pressurisation of the topsides with hydrocarbon gas is included in hot commissioning activities to prepare the topsides for start-up activities. Final checks, inspections, and sampling will take place prior to and during start-up activities including validation of gas and condensate instrumentation and analysers. Flaring of gas is expected during hot commissioning activities to ensure a safe operating envelope is achieved for both the Crux and Prelude FLNG facilities and activities.

Throughout all hot commissioning activities, other general cold commissioning activities will be ongoing such as pipe spool tie-ins, leak testing, pressure testing, flushing, cleaning, filling, and systems performance and functionality testing. The activities will require a range of utility services such as base oil completions fluids, LPG, hydraulic fluids, compressed air, nitrogen, lubricants, MEG, and other chemicals required to undertake the works.

6.10 Start-up Activities

The start-up activities (also referred to as start-up ramp-up) involves the progressive start of the five wells producing hydrocarbons for export to Prelude FLNG (forward flow of hydrocarbons through Crux export pipeline) to Prelude FLNG which are expected to take 9 to 24 months. The two non-deviated wells that only require a first stage clean-up will be preferentially started to commence safe production (and may also be the contingency source of hydrocarbon gas for hot commissioning). Some preparation activities will be conducted as systems transition from hot commissioning activities to ensure readiness for start-up. During start-up all remaining topsides equipment and systems described in Section 6 and throughout this EP will be systematically energised, started up and brought into operation. Inspections, checks, and tests are undertaken to assure the system for producing hydrocarbons. If hot commissioning uses the Crux non-deviated wells (as a contingency to backflow from Prelude FLNG) there will be simultaneous well completions and hot commissioning activities during start-up of Crux wells (i.e. start-up of Crux wells will be required to hot commission the GTGs and prepare hydrocarbon system for production).

During this start-up period, operators will take time to ensure all activities and facilities are operating to design intent, safely and reliably. In the initial start-up period, it is predicted that additional proving and assurance periods will be required to ensure that equipment is operating to design intent. Aligned with the commissioning strategy this may apply to the equipment such as the inlet separator, cooling systems, degasser vessel, turbines, flare system, open drain separator, gas dehydration system, TEG regeneration system, condensate system, produced water system and all associated analysers, meters and control systems. Functionality of equipment, calibration, verification, and other assurance activities will be undertaken during this period to bring the facilities and activities up the required standards defined by the commissioning test procedures, start-up procedure and performance tests. Examples may include functionality of instrumentation, analysers, fuel gas system, produced water degasser, dissolved gas flotation, open drains separator and export specifications.

It is expected during the start-up activities that the remaining three ‘deviated’ wells will require a second stage clean-up (Section 6.8.3). Once sufficient well gas is available and export specifications have been met, gas production rates will be slowly increased to system capacity of ~550 MMscfd of combined gas and condensate export to conduct the facility performance tests. Additional specific tests need to be undertaken including emergency shutdown and emergency depressurisation. During the initial start-up proving period and during testing, the process may be exposed to trips, restarts, or other causes of relief or blowdown to the flare system.

Throughout all start-up activities, other general cold commissioning activities will be ongoing during these activities such as pipe spool tie-ins, leak testing, pressure testing, flushing, cleaning, filling, and systems performance and functionality testing. The activities will require a range of utility services such as base oil completions fluids, LPG, hydraulic fluids, compressed air, nitrogen, lubricants, MEG, and other chemicals required to undertake the works.

6.11 Operations Activities

Operations include all activities associated with operating the facilities for the purposes of production and exporting gas and liquids to Prelude FLNG. The commencement of Operations occurs after the start-up period and defined in phases as outlined below.

6.11.1 NNM Operations Phase 1

Crux operations will move into not normally manned (NNM) phase 1 when it is decided that the platform can safely and reliably switch to periods of unmanned, remote operation with intermittent planned minimally manned campaigns. Subject to detailed planning at the time, manned campaigns at the platform may be reduced to ~80% of the time (outside of turnarounds, or any other activities that warrant higher POB). The remaining periods will be classified as ‘unmanned’, and the platform will be remotely operated from Prelude FLNG or IOC.

During manned campaigns, personnel will be residing on the W2W vessel and any crew change may be by helicopter. The W2W vessel will depart during unmanned (remote operation) phases.

During unmanned (remote operations) periods, unplanned events may require personnel to attend the platform (e.g. interventions, inspection, maintenance, analysis, or repair, referred to as 'react visits').

During this period, the platform is also likely to certify the Final Acceptance milestone which indicates Shell's final acceptance that the platform has been built to the accepted design specification.

6.11.2 NNM Operations Phase 2

Crux operations will move into NNM phase 2 when it is decided that the platform can safely and reliably switch to periods of unmanned, remote operation with intermittent planned minimally manned campaigns, and therefore achieve NNM operation to optimise production from the platform (stable, routine operation). Subject to detailed planning at the time, manned campaigns at the platform may be reduced to ~30–50% of the time (outside of turnarounds, or any other activities that warrant higher POB). The remaining periods will be classified as 'unmanned', and the platform will be remotely operated. The longest unmanned periods are expected to be up to 12 weeks.

During manned campaigns, personnel will be residing on the W2W vessel and any crew change may be by helicopter. The W2W vessel will depart during unmanned (remote operation) phases.

During unmanned (remote operations) periods, unplanned events may require personnel to attend the platform (e.g. interventions, inspection, maintenance, or repair, referred to as 'react visits').

During NNM phase 2 operations, Shell may choose to install an accommodation module during a turnaround to replace the primary need for the W2W vessel.

6.11.3 Inspection, Maintenance and Repair

Inspection of the facilities (subsea, wells, substructure, topsides) will be conducted in accordance with a risk-based inspection schedule and may occur throughout all activity phases to preserve the safety, reliability, and integrity of the platform and maintain efficient conditions. Planned maintenance is scheduled in the Computerised Maintenance Management System (CMMS). Whilst forecast to be typically implemented during operations activities, they may also be required at any activity phase documented in this EP (i.e. well completions, hot commissioning, start-up, and operations).

Maintenance and inspection activities are extensive, and include risk-based inspection (RBI), predictive maintenance, condition monitoring, and generic maintenance. Maintenance on the platform is wide-ranging and can include, but is not limited to:

- breaking containment of vessels, opening lines, topping up and changing over fluids, chemical cleaning, pressure testing, draining water systems, testing valve function, changing filters, localised surface abrasive blasting and painting, general cleaning, and pressure cleaning.
- removal, replacement, repurposing, and installation of equipment to facilitate operational live in line with design intent and to maintain safe and reliable operations.

Surveillance, inspection, and monitoring programs may also use any combination of manned, robotic, autonomous (e.g. underwater vehicles, underwater drones, aerial drones) or semi-autonomous vehicles (e.g. ROVs connected via umbilical) and deployed from the platform, vessels, Prelude FLNG or mainland.

Section 572(2) of the OPGGS Act requires a titleholder to maintain in good condition and repair all structures, equipment, and other property (hereafter collectively referred to as 'property') that is within the title area and is used in connection with the operations authorised by the title. Inspection, Maintenance and Repair (IMR) is undertaken to ensure that the integrity of the hydrocarbon system is maintained at or above acceptable standards. IMR activities may occur at any time during the activities (subsea, wells or topsides). Typical IMR activities include:

- regular visual inspections of equipment condition.
- inspection and, as appropriate, refurbishment of cathodic protection equipment.
- ongoing management of a detailed integrity database which includes details of the location and condition of all subsea equipment.
- repair/replacement and reinstatement of failed equipment items.
- field operation (typically valves, control modules, flying leads).

- provision of contracts, tooling, and spares to support an effective IMR response over life of field.

A risk assessment and supporting demonstration that impacts and risks are managed to as low as reasonably practicable will be conducted for any temporary liquid discharges or air emissions associated with maintenance activities that are any different to what is covered by the described activities.

6.11.3.1 Well Surveillance, Inspections and Maintenance

Management of the wells will be in accordance with the WOMP, which sets out requirements for ongoing wellhead monitoring and leak detection. Through implementation of the WOMP, Shell is meeting its regulatory obligation under the OPGGS Act (s.572(2)) to 'maintain in good condition and repair all structures that are, and all equipment and other property that is, in the title area and used in connection with the operations'. As part of ongoing well and subsurface systems maintenance, during the activity period, there will be ongoing well and subsurface integrity testing and surveillance undertaken using vessels, ROVs, and equipment mobilised onto the platform such as pressure control heads, wireline, and saturation/production logging equipment. Related activities may include pressure testing, repairs or replacement of components, lubrication and rectification works to address integrity issues such as corrosion, leakage, erosion and general wear and tear.

Surveillance and inspection activities may indicate the requirement for further maintenance on system components which will be scheduled for maintenance periods. This may include tubing downsize, replacement or repair or valve inserts (such as surface-controlled subsurface safety valves), trees, or tree components, well perforations, water shut-off (in the event of formation water breakthrough), and upper completions replacement (as examples). Depending on the nature and scale of these maintenance tasks, additional well intervention equipment may be mobilised on the platform alongside vessels and ROVs. This equipment may include Hydraulic Workover Units (HWUs) (or less likely a modular platform rig), coiled tubing, slickline, wireline and well test equipment (with temporary flare and separators). For well intervention works, depending on the task and activity, well bore fluids, well plugs or inhibited brine may be required to make wells safe during the activity. These well maintenance activities, functional requirements and environmental aspects are similar to those described for well completions (see Section 6.8).

There are planned inspection and surveillance activities during the five-year life of this EP, however there are no planned workover activities unless identified by the inspection and surveillance program (workover however, may be required throughout the activity lifecycle).

6.11.3.2 Subsea Inspections and Surveys

Subsea inspections provide assurance that infrastructure is being maintained and operated according to design and proactively identifies maintenance or repair activities that may be required. Inspection generally involves the use of a vessel travelling along the route of the subsea system with an autonomous underwater vehicle (AUV) or remotely operated vehicle (ROV) (and in some cases, divers).

Inspections are typically conducted more frequently during ramp up and operations, with the frequency likely to decrease over time during steady-state operations, depending on previous inspection results. Inspection techniques may include:

- visual inspections may involve ROVs or AUVs deployed from a vessel; may also involve divers and a dive vessel.
- marine acoustic surveys may include the use of side-scan sonar (SSS) and multibeam echo sounders (MBES) and are typically done from a vessel using towed acoustic instruments, ROVs, or AUVs.
- non-destructive testing (e.g. for pipeline wall thickness) may include pigging, ultrasonic testing, or electrical resistance testing, which are typically undertaken using an ROV or AUV deployed from a vessel.
- cathodic protection measurements may be completed using ROVs or AUVs and conductivity probes or by making visual assessments of anode wastage.
- fatigue monitoring/inspection may use fatigue monitoring equipment to be installed, inspected, and/or retrieved by a ROV deployed from a vessel.
- seabed, benthic and marine growth sampling.
- sub bottom profiling using low frequency echo sounder.

- dimensional/laser surveys.

Pigging or intelligent pigging may be used to inspect the export pipeline condition. Conditioning (cleaning or batch) pigging is typically required before a pigging inspection run and requires a pig to sweep any debris and gauge the pipeline to ensure that the pipeline is in suitable condition for a subsequent pigging inspection. Batch pigging may also be required to distribute chemicals (e.g. corrosion inhibitor) or remove hydrates or other contaminants. Pigs are launched from the platform through the export pipeline to the receiver on Prelude FLNG.

Monitoring of subsea infrastructure refers to the process of surveillance of the physical and chemical environment that a subsea system or component is exposed to determine if damage may occur, and (where relevant) predict the rate or extent of that damage. Monitoring activities may include process composition testing, corrosion mitigation checks, metocean and geological seismic monitoring, and cathodic protection testing.

6.11.3.3 Subsea Maintenance and Repair

Subsea maintenance activities, system maintenance, equipment replacements, refurbishments and change-out may be undertaken during all activity periods to prevent deterioration and/or failure of infrastructure; maintain reliability and performance of infrastructure, and ensure infrastructure is adequately maintained to enable the potential for future removal. Valve function testing and cycling of valves may be performed from the platform with observations by the ROV or control system, or manually performed by ROV, and routine testing is likely to result in small quantities of fluids being discharged. Marine growth and calcareous deposit removal may also be undertaken by water jetting from an ROV or by divers, generally with potable water or seawater, although items exhibiting calcareous deposit accumulation may require acid washing or soaking (typically using water-soluble sulphamic acid or similar). This task may precede other maintenance activities, where operation of or access to the equipment is hindered by marine growth or calcareous deposits. Stabilisation may be required to manage spanning and scouring around the subsea system and may involve installing mattresses, grout bags, rocks, frond mats or similar stabilisers, or trenching (etc). Localised excavation may be conducted directly adjacent to the subsea system, allowing access to buried or partly buried infrastructure. Typically, this is conducted by jetting and/or digging equipment from an ROV or vessel. This task generally precedes valve function testing, pipeline repair and equipment change-out. Flushing of hydraulic lines may be required for replenishment or repair of hydraulic systems. Leak and pressure testing may be required to test integrity of infrastructure.

Maintenance and repair activities are typically conducted in response to inspection findings, engineering analyses, and/or external events. The activities are likely to be performed by ROV from the IMR vessel (or similar) used for inspections, or in exceptional circumstances may require the use of a larger vessel. IMR activities may involve the occasional subsea discharge of small quantities of fluids (typically MEG, biocide, hydraulic fluids, acid or well fluids) and/or minor seabed disturbances.

Estimated discharge compositions and volumes for typical IMR activities are subject to change and specific task assessment but indicative estimations include:

- chemical dye releases (~10–20 litres) during pressure and leak testing
- control fluid releases (~5 to 10 litres) during hotstab/coldstab interventions and valve function testing
- hydrocarbon (~1 to 10 m^3), MEG (~100 litres) and scale inhibitor (~50 litres) during intervention isolations and subsea equipment replacements.
- acid-water mix (~20 to 200 litres typically citric or sulphamic acid) during calcium deposit and marine growth removal, also associated with water jetting, brush systems, and sand/abrasive blasting.
- hydraulic fluid (~20 to 100 litres) from operation of ROVs.
- staurolite products used for abrasive/sand blasting to clean and remove marine growth, the main component is staurolite, which is a naturally forming mineral.
- dilute preservation fluids such as corrosion inhibitor, oxygen scavenger, biocide (~5 to 10 litres).
- grout bag filling/hose flush (~20 to 200 litres), typically concrete based.

Subsea IMR activities such as pressure leak testing, flushing, hot stab operations, umbilical or hydraulic flying lead replacement, SSIV flushing (etc) all have potential for minor releases of residual hydrocarbon liquids and gas, chemicals, nitrogen, control fluids, and hydraulic fluids the volume of which depends on the geometry, pumping rates and task specific requirements.

If sediment builds up around trunkline or other subsea infrastructure, an ROV-mounted suction pump unit may be used to relocate the sediment to allow inspection/works to be undertaken. This activity is limited to the relocation of small amounts of sediment material in the immediate vicinity of the subsea infrastructure.

Equipment, materials, or tools may need to be temporarily wet stored on the seabed in the Activity Area during minor repairs. This could include, but not be limited to, work baskets for ROV tools prior/after connection, damaged components, etc. Wet stored items will ultimately be removed from the seabed.

6.11.3.4 Subsea Major Repairs

There may be scenarios within all activity phases where major repairs of the pipeline and subsea infrastructure system or system components may be required (these may be emergency repair scenarios). Repair durations may extend beyond six months requiring the mobilisation of equipment such as hydraulic-actuated pipeline lifting and repair equipment deployment frames and pipe preparation tools; including but not limited to, coating removal, weld seam removal, end preparation, and water blasting equipment; pipeline specific repair clamps and flange adaptors. Depending on the seabed conditions at the repair location, additional seabed area immediately surrounding the pipeline system infrastructure may be disturbed, or concrete mattresses or rock stabilisation measures installed post-repair.

Following a major defect or full-bore rupture, the field would be shut-in, and the pipeline allowed to naturally depressurise to subsea ambient pressure, resulting in free flooding of the pipeline with sea water. The pipeline may then be flooded with sea water inhibited with chemical additives (such as biocide and oxygen scavenger) that will propel a flooding pig towards the defect location. Flooding, cleaning, gauging, and testing may be undertaken from both ends of the pipeline, resulting in a release of seawater, gas, condensate, and rich MEG to the marine environment at the location of the defect equivalent to the volume of the repair section.

The pipeline repair equipment is likely to be operated using ROVs, controlled from the vessel. The ROVs are electrically powered from the vessel and deliver hydraulic pressure to the operating parts of the repair system. The repair process will include a pre-deployment surveys stage before removal of the damaged section, repair system deployment and installation of a new replacement section followed by stabilisation activities as required. The pre-deployment survey may require different surveys to be undertaken (and potentially at distances from the pipeline). The types of survey will depend on the location and event causing the pipeline defect, but may include side scan sonar (SSS), multibeam echo sounder (MBES) or similar, ROVs or piezo cone penetration tests, or similar.

If required, damaged sections may have any stabilisation material physically removed. The damaged section of the pipeline will then be cut using appropriate cutting tools. Once cut, the damaged section of pipeline will be wet stored on the seabed whilst it is cut into smaller sections (if required), then loaded into debris removal baskets and transferred back to the vessel.

Subsea transponders may be deployed to ensure accurate seabed positioning of the pipeline repair equipment. The deployment of transponders may result in localised seabed disturbance of <10 m^2 (per transponder). Ultra-short baseline (USBL) and long baseline (LBL) acoustic positioning systems may be used. Typically, USBL transponders are attached to subsea equipment, and LBL transponders are fixed to seabed frames, which are deployed and then fully recovered once the infrastructure is correctly positioned. LBL and USBL systems emit short non-continuous pulses (‘chirps’) of medium- to high-frequency sound that typically last 3–40 milliseconds at a frequency of 19–33 kHz. The units will be retrieved after use.

Once no longer needed these transponders are recovered back to the vessel using an ROV. The lifting frames and cradles for repositioning of the pipeline are then deployed and installed. The length of pipeline over which a typical repair will take place depends on the extent of the damage or defect. There may be seabed disturbance resulting from lift frame mudmats, deployment frames, and temporary wet storage of materials and equipment during the repair operation.

Once the damaged section of pipeline is removed, the pipeline ends are prepared (coating and weld seams removed) to allow installation of pipeline repair components followed by hydrostatic pressure testing of the pipeline or section. If the leak testing fails, the repair will need to be rectified, and re-installed. The leak test

may comprise flooding, cleaning, gauging, testing with cleaning pigs or an alternative spread that uses chemical injection, filtration, and pumping equipment.

Depending on the seabed conditions at the repair location, additional seabed area may be disturbed by permanent concrete mattresses and post-repair rock stabilisation measures. However, this is location specific and thus will need to be determined at the time of event. Following a successful hydrostatic pressure test, the pipeline must be recommissioned via a dewatering and conditioning pig train. The conditioning pig train is expected to comprise slugs of compressed air, treated potable water, and MEG which will be discharged subsea or via temporary piping either subsea, on the platform or Prelude FLNG. Other applicable discharges include those described in Section 6.11.3.3.

6.11.4 Turnarounds

Turnarounds (also referred to as maintenance shutdowns or pitstops for smaller scale events) are planned activities, predominantly in the NNM operating phases 1 and 2 however may occur in any activity phase. These activities will involve shutting down, depressurising, and purging the topsides via the flare system to make safe and stop production. The purpose of a turnaround is to conduct inspection, maintenance, replacement, modifications[8] and/or repair works that cannot be safely completed during production operations; in addition to modification or repair works required to enable production performance to achieve technical maximum capacity and/or optimise production efficiency. A typical turnaround campaign may require the mobilisation of an ASV and the W2W vessel and includes transportation support from helicopters, vessels, bunkering vessels, and any associated heavy lift or construction-type vessels. Temporary facilities for waste handling and temporary equipment spreads for various activities may be required to inspect, clean or repair equipment. A risk assessment and supporting demonstration that impacts and risks are managed to as low as reasonably practicable will be conducted for any temporary liquid discharges or air emissions associated with turnaround activities that are any different to what is covered by the described activities.

6.11.5 Removal of Equipment

Throughout all activity phases, when equipment is replaced, an assessment of the redundant equipment will be undertaken to assess the feasibility and risks associated with removal. Where removal is deemed to pose an unacceptable risk to existing operational infrastructure, redundant infrastructure items may be left in-situ. Items are recorded as part of the ROV as left survey (if subsea) and included in the asset register. The asset register is used to track equipment to enable planning for future removal. Any redundant equipment left in-situ will be maintained in the asset register.

6.12 Logistics and Manning (All Activity Phases)

A range of vessel types carry out the activities associated with the activity. Sections 6.12.1 to 6.12.5 describe the vessel types, indicative activities and presence during different activity phases. Note: Timing, duration, and vessel selection for all activities is subject to change due to project schedule requirements, vessel availability, unforeseen circumstances, and weather.

Personnel access to the platform, ASV or W2W vessel will be by helicopter (via Prelude FLNG or Western Australian mainland) or vessel Motion Compensated Gangway.

Section 6.12.6 describes the manning requirements during the different activity phases.

6.12.1 Aviation Support

Throughout all activity phases, Crux platform requires logistics support from the mainland of Australia and via Prelude FLNG. The primary means of mobilising personnel to the facility is by helicopter. Aviation operations may include offshore helicopter access on platform, vessels, ASV and the W2W vessel in the Activity Area. Refuelling may occur on the platform or any of these vessels. Helicopters may be used for shipment of freight to and from the platform and vessels and to undertake medevac operations, if required.

6.12.2 Marine Support Vessels

Throughout all activity phases, marine support vessels will transfer and receive goods and materials (including equipment, modules, fuel, chemicals, fuel, consumables, spreads, parts, solid and liquid wastes, etc) to the

[8] There are currently no planned modification works planned as of December 2024. However, planned modification works will be carried out in accordance with regulation 39 of the OPGGS (Environment) Regulations and the Shell MOC process described in Section 10.3.5.

platform via the platform cranes, davit, bunkering hoses, baskets (etc). Marine support vessels may also be mobilised for the purposes of crew transfer, fast rescue, emergency support, emergency response, IMR and other surveillance activities.

Vessels will typically use dynamic positioning (DP), however in certain circumstances, use of pre-laid moorings may be required. Vessels are likely to be fuelled by marine diesel oil (MDO) or Marine Gas Oil (MGO) including low sulphur Marine Gas Oil (LSMGO). Vessels are generally expected to return to port to bunker, although may occasionally bunker at sea. Vessels routinely discharge a variety of wastewater streams to the marine environment including ballast, sewage, greywater, food waste, cooling water, brine, bilge; and some vessels may also incinerate solid wastes.

6.12.3 Inspection, Maintenance and Repair (IMR) Vessels

Throughout all activity phases, vessel IMR activities could occur at any time during the petroleum activity. Vessels used are expected to range between 30 and 130 m in length. Vessel type and specifications will depend on availability and specific activity requirements. Most vessels will operate using dynamic positioning (DP) preventing the need for anchoring (except in vessel safety related emergency situations). Inspection vessels conducting marine acoustic surveys will not be required to be DP vessels; however, neither will they anchor while conducting the petroleum activity. Lifting and transfer of equipment and supplies between vessels may be required in the activity area and crew transfers may be undertaken by helicopter.

6.12.4 Accommodation Vessel (ASV)

The platform will require a medium sized operational team for well completions, commissioning, and start-up activities. The facility has been designed such that it can employ an ASV for accommodation during completions, hot commissioning, and start-up activity phases (example ASV in Figure 6-9). This ASV will use DP to maintain its position and will be equipped with a motion compensated gangway allowing transfer of personnel on and off the facility. The ASV may also be contracted for maintenance activities during Operations, such as Turnarounds.

Figure 6-9: Indicative Accommodation Vessel (ASV)

Table 6-6: Typical ASV Specification (indicative only depending on contracting strategy)

Detail	Example Specifications
Main engine capacity	Up to 35,000 kW
Engine configuration	Diesel electric
POB	Up to ~500 (base case ~350)

Detail	Example Specifications
Length overall	100–125 m
Weight (gross)	27,000–37,706
Operating draft	15–25 m
Dynamic positioning	DP3
Tank Capacities	
Ballast	10,168–11,397 m³
Total fuel oil	1,893–2,240 m^3 (largest single tank is 545 m³)
Fresh water	957–1,000 m^3

6.12.5 Walk to Work (W2W) Vessel

The W2W vessel is expected be on station within the Crux 500 m petroleum safety zone after start-up and continue to be on station during manned periods in NNM modes and supporting campaigns. It will connect to one of the three landing points within two landing zones on the platform using a motion compensated gangway. Generally, all personnel will mobilise to the W2W vessel via helicopter, landing either on platform or on the W2W vessel. The functions of the W2W vessel include:

- Provide accommodation for ~80 personnel plus up to ~26 marine vessel support crew (~106 POB maximum) with furnished offices, workshops, storage, communications and craneage.
- Helideck platform for the operation of a helicopter.
- Functionality to maintain station at the Crux facility and facilitate personnel transfer by motion compensated gangway (or equivalent).
- Support for campaign maintenance, fuel, and chemical resupply, well interventions, turnarounds, in addition to supporting unplanned interventions on an ad-hoc basis.
- Primary port access via Broome or Darwin.
- Gas detection and emergency shutdown.
- Dynamic positioning power plant and thruster system shall be diesel electric and use marine diesel oil (MDO) or marine gas oil (MGO).
- Helicopter refuelling facilities shall be made available on the Vessel. Fixed, portable or a combination of helifuel tanks may be utilised.
- SOLAS compliant Fast Rescue Craft.
- Functionality to supply emergency power from a deck mounted generator to the Crux platform (with quick release system).
- Tankage of MDO/MGO for the vessel plus ~250 m^3 for the platform; potable water sufficient for a seven-day reserve, daily consumption, and delivery of ~400 m^3 to for the platform; ~200 m^3 triethylene glycol (TEG); MDO/MGO fuel delivery capability of > 600 m^3 and potable water > 900 m^3.
- Liquids transfer system with sufficient storage to be able to receive, store and discharge potable water, MDO/MGO and TEG to/from vessels or to the platform.
- Several reverse osmosis water makers with ultraviolet sterilisers and potable water tanks dosed with chlorine.
- Handling and transporting other production chemicals, lube oils, etc delivered to the platform.
- Garbage compactor and food waste macerator.

6.12.6 Manning

6.12.6.1 Well Completions

In well completions activity phase, the workforce will be accommodated on an ASV with a workforce of ~400 POB (subject to further planning, ASV capacity may be up to ~500 POB) accessing the platform using a motion compensated gangway. Additional personnel may arrive by helicopter on the ASV helipad or platform helipad.

6.12.6.2 Hot Commissioning & Start-up

This ASV will remain on station during the hot commissioning activities and start-up activities. In this phase, a W2W vessel may replace the ASV and be stationed at the platform accessing the platform using a motion compensated gangway and additional personnel may arrive by helicopter.

During start-up, the platform is likely to be manned up to 100% of the time by personnel residing on either the ASV or W2W vessel to enable fast response to any stability or functional issues that may arise. The start-up activities are expected to take 9–24 months. Personnel will be accommodated on either an ASV or W2W vessel accessing the platform using motion compensated gangways and additional personnel may arrive by helicopter. The phase will transition into NNM Operations (Section 6.11) when it is decided that the platform can safely and reliably switch to periods of unmanned operation followed by planned minimally manned campaigns. In this phase, a W2W vessel will replace the ASV and be stationed at the platform accessing the platform using a motion compensated gangway and additional personnel may arrive by helicopter.

6.12.6.3 Operations

The platform topsides facilities are designed for minimal manning with no living quarter accommodation (other than emergency/unplanned/stranded person beds in the temporary refuge which may allow muster for up to ~80 POB and temporary sleeping provisions for up to ~40 POB). Manning requirements will vary depending on activities and stage of operation and will be supplemented as required by the W2W vessel. The platform has a helideck, multiple access points accommodation and vessels including specific landing areas on north and west sides for motion compensated gangways. Activities will be 24 hours per day, 365 days per year. Vessel-related activities within the Activity Area will comply with this EP. Vessels supporting the activities when outside the Activity Area (e.g. transiting to and from port) are outside the scope of this EP (except where EP requirements or commitments explicitly apply outside the Activity Area) and must adhere to applicable maritime regulations and other relevant requirements which are not managed under this EP. Simultaneous operations (SIMOPS) may occur between any activities. Timing, duration, and vessel selection for all activities is subject to change due to project schedule requirements, vessel availability, unforeseen circumstances, and weather. During all activities routine and non-route lifting (e.g. heavy lifting, engineered lifts) and handling of materials and equipment on the topsides will occur (including to, from, and between vessels) using equipment such as the pedestal crane, underhung gantry crane, monorails or davit along with materials handling equipment on the vessels.

NNM operations – phase 1

Minimal manning operations will commence once remote operation, safety and reliability is deemed to be suitably demonstrated. NNM phase 1 operations will commence reducing personnel occupancy at the platform to ~80% of the time (outside of turnarounds, or any other activities that warrant additional people). The longest unmanned periods are expected to be ~3 weeks.

NNM operations – phase 2

NNM phase 1 operations will transition once remote operation, safety and reliability is deemed to be suitably demonstrated for unmanned operation. NNM phase 2 operations (stable operation) will commence reducing personnel occupancy at the platform to ~30–50% of the time (outside of turnarounds, or any other activities that warrant additional people). The longest unmanned periods are expected to be up to 12 weeks.

NNM manning levels and W2W vessel

When manned for planned campaigns during NNM phase 1 and phase 2, personnel will reside on the W2W vessel along with any additional personnel that may arrive by helicopter. During unmanned periods, the W2W vessel will depart the platform and/or platform operators will no longer be residing on the W2W vessel.

Planned campaigns

Planned campaigns on the platform will include all inspections, testing, and maintenance activities required to operate the platform.

Remote operations

During unmanned operation, the Crux platform is designed to be operated remotely from Prelude FLNG or IOC, and the platform will be operated according to the Integrated Control and Safeguarding System (ICSS) (manned or unmanned).

Unplanned events (when unmanned)

During unmanned periods, unplanned events may require personnel to re-attend the platform by helicopter or vessel (e.g. unplanned interventions, testing, inspection, maintenance, analysis, or repair), and this may also require the mobilisation of a W2W vessel, or subsequently an ASV.

Planned turnarounds and maintenance campaigns

Any turnarounds or unplanned interventions/workover activities that occur during NNM operations are likely to require the mobilisation of an ASV or the W2W vessel.

6.12.7 Waste Handling

Process, equipment, parts, consumables, industrial supplies, packaging, domestic and related wastes are expected to be generated during all activity phases during maintenance campaigns, general maintenance, and general domestic activities. When an ASV or the W2W vessel are on station most domestic wastes will be isolated on those vessels. The platform topsides have space provisions for storing and using waste receptacles on the main deck laydown (hazardous and non-hazardous waste storage areas of ~10 $m^{3,}$ where required); cellar deck laydown (hazardous, non-hazardous and recyclables waste storage areas of ~15 m^3, where required). The nucleonic level indicator for the produced water degasser (Section 6.7.8) may occasionally require replacement (if required) and will need to be stored, handled, transported and managed by contracted licensed radiation specialists. Any mercury accumulated in process vessels or equipment will be drained or removed periodically during maintenance when offline and at low pressure. Mercury waste will be managed by trained personnel and placed in suitable containers for transfer to an approved specialist onshore waste management facility for treatment and disposal. Equipment will occasionally need to be mobilised on the platform for solids and liquids wastes removal, such as desanding and filtration equipment, through all activity phases.

7 Description of the Receiving Environment

7.1 Planning Area and Subcategories

This section describes the Planning Area, including details of the values and sensitivities within that environment that could be affected by the activity (planned and unplanned), as required by sections 21(2) and 21(3) of the OPGGS(E) Regulations. The Planning Area has been defined as an area where a change to ambient environmental conditions may potentially occur, but it should be noted that a change does not necessarily imply an adverse impact (see Table 7-1). The planned activities have been subdivided into specific subcategories to delineate the maximum extent of ecological and social impacts, as described in Table 7-1.

The spatial extent of the receiving environment encompasses the physical, biological, cultural, and socioeconomic receptors that may be affected by planned and unplanned activities. The majority of the impacts and risks from the activity occur in close proximity to the Activity Area, however some impacts and risks may extend further. The credible worst-case hydrocarbon release scenarios determined by modelling studies are predicted to present the greatest spatial extent of all the impacts and risks identified. The outer boundary of the area that may be influenced by the activity, identified by the modelling, and referred to as the Planning Area, has been used as the outer boundary for the description of the receiving environment. The worst-case hydrocarbon releases during the activity have a remote likelihood of occurring, and Shell implements a range of controls to ensure such incidents are prevented, and risks mitigated to ALARP and acceptable levels. The Planning Area for the combined worst-case credible hydrocarbon spill from the activity is shown in Section 9.13 and represents the area potentially affected at low exposure thresholds (see Table 7-1). See Section 9.14 for additional information on hydrocarbon spill modelling and risk management and associated impact thresholds applied for the assessment.

A detailed description of the physical, natural, socio-economic, heritage and cultural features and associated values and sensitivities of the EP was informed by:

- EPBC Act protected matters reports (Appendix F).
- stated values in the Marine Bioregional Plans for the North-West Marine Region (NWMR) (Department of the Environment, Water, Heritage, and the Arts [DEWHA] 2008a).
- Shell environmental studies (Section 7.2.1).
- relevant publicly available information.
- information obtained through consultation (Section 5.12).

The EPBC Act protected matters reports for the Planning Area and subcategories (Appendix D) were used to identify environmental receptors protected under the EPBC Act. This information was used to inform the assessment of environmental impacts and risks presented in Section 9.

Marine and coastal species identified in the protected matters report (Appendix F) are described, with a focus on protected species that are threatened and migratory. It is important to note that this EP describes the environmental values and sensitivities that occur within the boundaries of the Planning Area, whereas the Protected Matters Search Tool (PMST) incorporates an in-built buffer and hence may report on matters that are outside the Planning Area.

Table 7-1: Description of the Planning Area and Subcategories

Areas	Description
Description of the Environment	
Planning Area	The Planning Area refers to the zone where ambient environmental and socioeconomic conditions may alter based on emergency events. The spatial extent of the Planning Area was determined by combining 300 stochastic oil spill simulations based on the worst-case spill scenario (uncontrolled surface release of Crux condensate [87,077 m^3]) (see Section 9.14), using low exposure thresholds for each oil phase (1 g/m^2 floating, 10 g/m^2 shoreline, 10 parts per billion (ppb) entrained, and 10 ppb dissolved).

Areas	Description
	At low exposure thresholds, a sheen may be visible on the sea surface or shoreline (at ~2 teaspoons of oil per m^2), potentially affecting visual amenity; however, it does not necessarily imply an adverse ecological impact.
Planned Activities	
Activity Area	The Activity Area is defined in Section 6.2.
Light Assessment Area	The Light Assessment Area is defined as 20 km[9] around the Activity Area with an additional 38 km radius surrounding the Crux Platform. The 38 km radius surrounding the Crux Platform is the predicted worst-case extent of the potential light impact during the activity and used to inform the light impact assessment (Section 9.4). The Light Assessment Area is used to inform the light impact assessment (Section 9.4). During normal operations, the spatial extent of predicted light impacts occurring from the Crux Platform is ~9 km.
Noise Assessment Area	The Noise Assessment Area is defined as 20 km around the Activity Area. The 20 km buffer has been applied to align with the Light Assessment Area and is considered a conservative assessment area considering the predicted worst-case extent of the modelled noise impact during the activity to reach behavioural harassment criteria is 18.6 km. The Noise Assessment Area is used to inform the noise impact assessment (Section 9.5).

[9] A precautionary limit of 20 km was applied to align with the National Light Pollution Guidelines for Wildlife (DCCEEW 2023b).

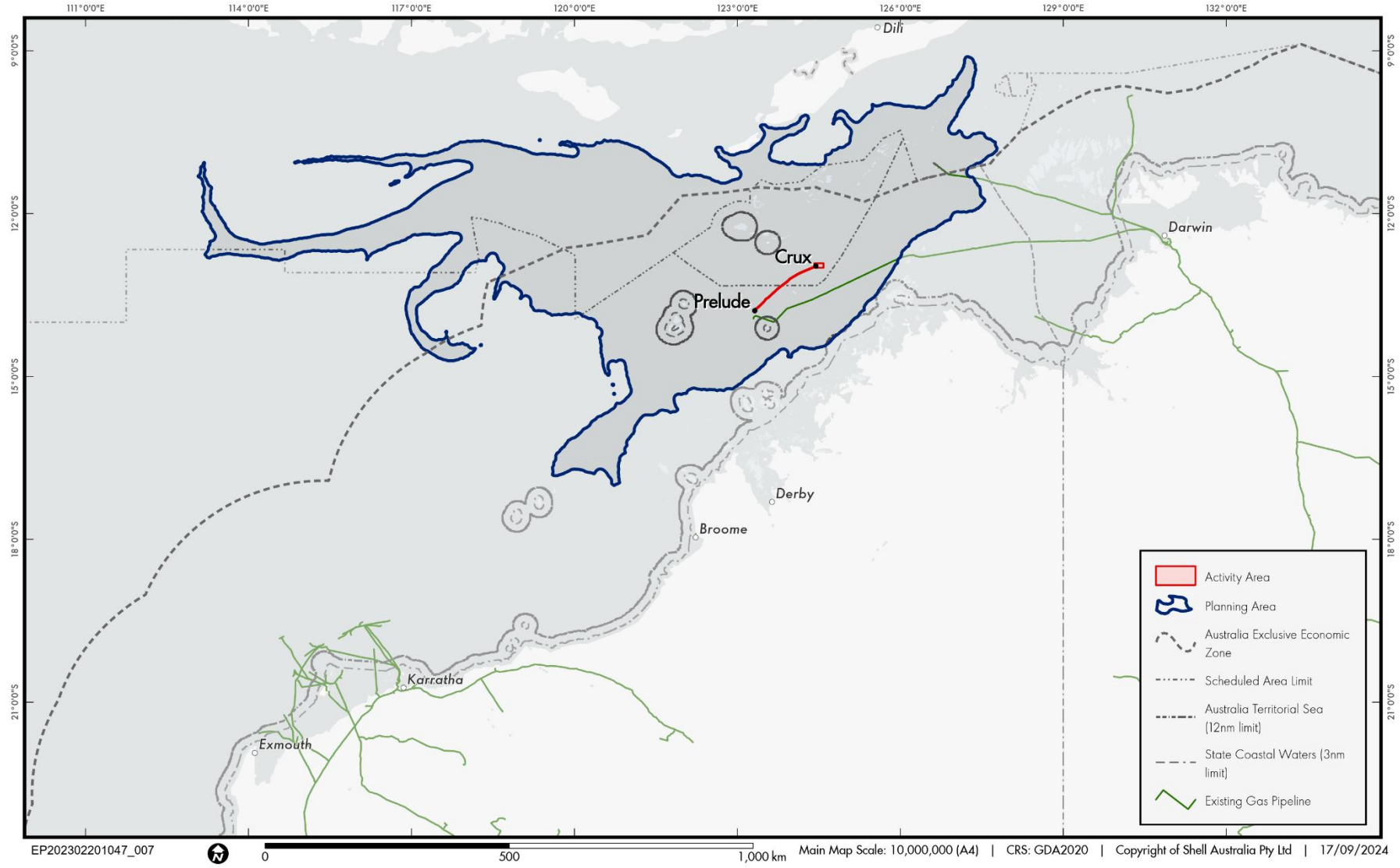


Figure 7-1: Activity Area and Planning Area

7.2 Information Sources

The description of the environment was sourced from:

- Shell baseline and additional studies.
- Relevant publicly available information, including published literature and government databases.
- Information obtained from consultation.

7.2.1 Prelude and Crux Developments Baseline Studies and Additional Studies

An extensive environmental baseline studies program has been undertaken to characterise the existing marine environment within and surrounding the Activity Area. The studies involved field-based campaigns to capture seasonal variability in the area, as well as desktop modelling studies to contribute to the understanding of the baseline environment. Table 7-2 provides a summary of the relevant environmental baseline studies. Further detail and copies of the earlier studies are provided in the Crux OPP (Shell 2020) (as information previously given under section 56(1) of the OPGGS(E) Regulations.

Table 7-2 summarises the additional relevant Shell initiated environmental, heritage and cultural features studies undertaken to inform the understanding of the environment after the initial baseline studies program.

Table 7-2: Summary of Crux Environmental Baseline and Additional Studies

Study type	Description of study	Reference
Field-based studies		
Metocean study	Collection of metocean data (e.g. current, conductivity, wave, and wind data) on the surface and through the water column for a full 12-month period from late April 2016 to early May 2017 within and in the vicinity of the Crux field and along the export pipeline route.	RPS Metocean (RPS) 2017
Water quality study	Collection of baseline data on physical and chemical components of water quality, along the proposed pipeline corridor and within the Crux field. The surveys were completed over two survey events in April/May 2016 and October/November 2016.	AECOM 2016
Sediment, water quality and infauna study	Collection of baseline data on sediment quality, water quality and infauna communities, along the proposed pipeline corridor and within the Crux field. The study was completed in October/November 2016.	AECOM 2017
Benthic habitat study	Collection of baseline data to characterise topographic features, benthic habitats and macrofaunal communities, along the export pipeline corridor and within the Crux field, using underwater transects (towed video camera) and geophysical methods (multibeam, SSS, seismic reflection, and sub-bottom profiling). This study was completed in April/May 2017, as part of a combined geophysical and environmental survey scope.	Fugro 2017a
Australian Institute of Marine Science (AIMS) Applied Research Program (ARP)	Shell is an industry partner, together with INPEX, in support of the AIMS ARP, to develop a comprehensive environmental baseline for waters in the Browse Basin. As part of this project, AIMS is leading a collaborative partnership of trusted research organisations including CSIRO, the University of WA, Curtin University, Monash University and the Western Australian ChemCentre. The ARP research programs of relevance to informing the regional baseline context are:	ARP 2: CSIRO 2017 ARP 7: Heyward et al. 2017a

Study type	Description of study	Reference
	• ARP 2 – Baseline hydrocarbon surveying in the Browse Basin. • ARP 4 – Evaluating the effects of hydrocarbon exposure on non-avian marine wildlife. • ARP 6 – Investigating the breeding and foraging parameters of seabird species in the Browse Basin to determine their vulnerability to impacts associated with potential oil spills, and their ability to recover. • ARP 7 – Subtidal benthos: towards benthic baselines in the Browse Basin.	
Geotechnical study	An assessment of the geotechnical conditions of the seabed in the Crux field and along the export pipeline route. This study was completed in 2016, with a further study completed in April 2018.	Fugro 2017b
Sediment, water quality, macrobenthos and plankton communities study	Sampling and data collection in the WA-371-P title area from 11–19 July 2008 for determination of sediment and water quality, microbenthic, and plankton communities.	ERM 2008
Cetaceans and other marine megafauna study	Vessel and aerial surveys, and acoustic logger monitoring of cetaceans and other marine megafauna in the region undertaken for INPEX Browse Limited (INPEX) and made available to Shell through an information sharing agreement.	RPS 2007
Cetacean surveys	Four 20-day cetacean surveys, conducted by Shell, Woodside and INPEX, to coincide with the expected northern and southern migratory periods for pygmy blue whales through the Browse Basin.	Jenner and Jenner 2009
Underwater noise study	A baseline survey of underwater noise from September 2006 to August 2008 undertaken for INPEX and made available to Shell through an information sharing agreement.	Duncan and McCauley 2008
Desktop/modelling studies		
Drill cuttings and drilling muds dispersion modelling study	To calculate the fate of discharged drill cuttings and unrecoverable drilling muds, including the likely area of coverage, bottom deposition (thickness and accumulated load) and assess the risk to key values and sensitivities from contact with cuttings and muds discharged during development drilling operations.	RPS 2018a
Produced Formation Water (PFW) modelling study	To quantify the extent of the mixing zones of the PFW discharge (based on the maximum pre and post PFW breakthrough flow rates) and assess the potential risk to key values and sensitivities under various seasonal conditions.	RPS 2018b
Pipeline hydrotest discharge modelling study	To quantify the potential mixing zone from the release of chemicals within the hydrotest discharge (e.g. biocides) during commissioning activities.	RPS 2018c
Hydrocarbon spill modelling study	To quantify the movement and fate of spilled hydrocarbons that would result from an accidental, uncontrolled release from four determined scenarios that are considered representative of the maximum credible worst-case spills that could result from project activities. The scenarios include a well blowout during development drilling, a significant rupture of the export pipeline during operations, a spill	RPS 2018d

Study type	Description of study	Reference
	from the Crux platform and a pipelay vessel collision during installation of the export pipeline. The study assessed the potential risk to key values and sensitivities from these spill scenarios.	
Hydrodynamic model validation study	Data from the metocean study were used to validate the underlying hydrodynamic model used to develop the liquid discharge and oil spill models. The results of the study have been incorporated into RPS 2018a-d.	RPS 2018e
Light modelling study	To characterise the sources of light emissions from the operation of the Crux project and assess the predicted impact of light in the context of the nearest sensitive receptors.	Imbricata 2018
Underwater noise modelling study	To predict the effects of underwater noise emissions from the Crux project, specifically piling of the Crux platform footings and from vessel movements during operations, on key values and sensitivities.	SVT 2018
Additional studies		
First Nations Underwater Cultural Heritage Impact Assessment.	Desktop assessment of the potential presence of First Nations underwater cultural and social values within the Activity Area. First Nations UCH was defined as all tangible and intangible cultural expressions that are associated with and claimed by Indigenous groups within Australia (past and present) and which occurs in and is attributable to contexts that are now submerged by waters.	Cosmos Archaeology 2023
Acoustic and Animat Modelling for Assessing Marine Fauna Sound Exposures	Underwater noise modelling study for expected noise levels from Crux vessels, as well as for down the hole (DTH) (construction) drilling operations at the Crux platform location.	Connell et al. 2023

7.3 Regional Context

7.3.1 Protected Areas

7.3.1.1 Commonwealth Marine Area

The Planning Area occurs in Commonwealth and WA State Territorial Waters. The Commonwealth Marine Area is defined as any part of the sea, including the waters, seabed, and airspace, within Australia's EEZ or over the continental shelf of Australia that is not state or NT waters, and extends from 3 to 200 nautical miles (nm) from the coast. The Commonwealth Marine Area environment is protected as a MNES under the EPBC Act, and its physical, natural and heritage values within the Planning Area are described in Sections 7.5, 7.7 and 7.11 respectively.

7.3.1.2 Marine Conservation Reserves

The Activity Area—including the Noise and Light Assessment Areas—does not overlap any AMPs or WA marine parks or reserves. The Planning Area is within North-West Marine Parks Network (Director of National Parks 2018a). Table 7-3 lists the AMPs within the Planning Area and these are shown in Figure 7-2. Table 7-4 lists the WA marine parks and reserves within the Planning Area with distances from the Activity Area; these are shown in Figure 7-2. Many marine conservation reserves have management plans that outline the objectives for managing the protected area. Where applicable, Shell considered these management objectives in the environmental risk assessment (see Section 9.14).

Table 7-3: AMPs within the Planning Area

AMPs	IUCN Category	Description	Distance from Activity Area (~km)	Distance from Crux Platform (~km)
Kimberley	Multiple Use Zone (IUCN VI)	The Kimberley AMP covers ~74,469 km^2. The Kimberley AMP's conservation values include the provision of important foraging areas for migratory seabirds, dugongs, dolphins, marine turtles and a migration pathway and nursery areas for humpback whales. The Kimberley AMP ranges in depth from less than 15 m to 800 m and provides protection for the communities and habitats of waters offshore of the Kimberley coastline. There are two KEFs that are represented in the Kimberley AMP (both within the Planning Area)—Ancient coastline and Continental slope demersal fish communities (see Section 7.7.6) (Parks Australia 2023b). The Kimberley AMP supports or is adjacent to recreational and commercial fishing, tourism activities and areas of Native Title claims and determinations (Parks Australia 2023b). Within the Planning Area is a Multiple Use Zone (IUCN VI) (DNP 2018a).	80	94
Cartier Island	Sanctuary Zone (IUCN Ia)	The Cartier Island AMP covers a relatively small area (172 km^2) and is comprised of a Sanctuary Zone (IUCN Ia). The Cartier Island AMP provides an important area for a number of EPBC Act listed species, including sea snakes, turtles and migratory seabirds. Additionally, it supports some of the most important seabird rookeries on the North West Shelf (NWS) (DNP 2018a).	80	100
Ashmore Reef	Sanctuary Zone (IUCN Ia)	The Ashmore Reef AMP comprises a 550 km^2 Sanctuary Zone (IUCN Ia) and a 33 km^2 Recreational Use Zone (IUCN IV) (DNP 2018). It provides an important area for a number of EPBC Act listed species, including sea snakes, marine turtles, dugongs and migratory seabirds. Ashmore Reef also supports important cultural and heritage sites, such as Indonesian artefacts and grave sites (Parks Australia 2023b). Ashmore Reef AMP is a Ramsar and nationally important wetland (see Section 7.3.1.3) (DoEE 2018).	128	149
	Recreation Use Zone (IUCN IV)		148	174
Oceanic Shoals	Multiple Use Zone (IUCN VI)	The Oceanic Shoals AMP comprises a 71,743 km^2 area, with ~39,964 km^2 designated as a Multiple Use Zone (IUCN VI) (DNP 2018b). The depths range from less than 15 m to 500 m. The Oceanic Shoals AMP supports rich sponge gardens, corals, a diversity of fish life and important resting and feeding areas for breeding marine turtles (Parks Australia 2023a). The represented KEFs within the Planning Area include Carbonate bank and terrace system of the Sahul Shelf and Pinnacles of the Bonaparte Basin (see Section 7.7.6) (DNP 2018b).	162	178
	National Park Zone (IUCN II)	The 146,003 km^2 Argo Rowley Terrace AMP comprises 108,812 km^2 of Multiple Use Zone	322	455

AMPs	IUCN Category	Description	Distance from Activity Area (~km)	Distance from Crux Platform (~km)
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)	(IUCN VI), 1,141 km^2 of Special Purpose Zone (Trawl) (IUCN VI) and 36,050 km^2 of National Park Zone (IUCN II). The depth ranges between 220 m and 6,000 m (DNP 2018). It provides foraging areas for migratory seabirds, loggerhead turtles and sharks and connectivity between the Mermaid Reef AMP. The representative KEFs include Canyons linking the Argo Abyssal Plain with the Scott Plateau and Mermaid Reef and Commonwealth waters surrounding Rowley Shoals (both outside of the Planning Area) (Parks Australia. 2023b).	330	472
	Special Purpose Zone (Trawl) (IUCN VI)		510	661

Table 7-4: WA Marine Parks and Reserves within the Planning Area

WA Reserves	Description	Distance from Activity Area (~km)	Distance from Crux Platform (~km)
WA Marine Park			
North Kimberley	The 18,450 km^2 North Kimberley AMP features geomorphologically complex and varied seascapes and marine habitats, including bays and estuaries with mangroves, sandy beaches, coral reefs, rocky reefs, seagrass meadows and sponge gardens. There are in excess of 1,000 islands within the North Kimberley AMP which provide valuable intertidal and subtidal habitats used by manta rays, dugongs, dolphins, turtles, sawfish and seabirds/shorebirds (DPAW 2016).	80	160
Nature Reserves			
Browse Island	See Section 7.7.4.4.	42	159
Scott Reef	See Sections 7.3.1.4 and 7.7.4.6.	153	294

7.3.1.3 Wetlands of International and National Importance

Sites recognised under the Convention on Wetlands of International Importance (the Ramsar Convention), referred to as Ramsar wetlands, are protected under Part 3 of the EPBC Act and are MNES. Table 7-5 describes the Ramsar and nationally important wetlands identified within or adjacent to the Planning Area (Appendix F), as shown in Figure 7-4. The closest wetland to the Activity Area is Ashmore Reef, ~128 km away.

Table 7-5: Ramsar and Nationally Important Wetlands within the Planning Area, including Distance from Activity Area

Wetland	Description	Distance from Activity Area (~km)	Distance from Crux Platform (~km)
International Importance (Ramsar)			
Ashmore Reef Commonwealth Marine Reserve	Ashmore Reef supports an abundance and diversity of birds; 72 species have been recorded at this Ramsar site, with 12 species recorded breeding (Hale and Butcher 2013). Ashmore Reef was designated as a Ramsar wetland based on these characteristics: • largest atoll in the region. • managed for conservation purposes since 1983. • each wetland type is in near natural condition, with low densities of coral predators and disease. • its three islands are the only vegetated islands within the Timor Province bioregion. • supports 64 threatened species. • considered a true 'hotspot' of biological diversity within the Timor Province bioregion and within the broader NWMR. • supports 47 species of waterbird listed as migratory under international treaties and three species of migratory turtle (green, hawksbill and loggerhead). • supports breeding of green and hawksbill turtles, dugongs and 20 species of waterbird. • regularly supports >40,000 waterbirds including large numbers of migratory shorebirds and breeding seabirds (Hale and Butcher 2013). Ashmore Reef is also recognised as a KEF and is within the Ashmore Reef AMP (see Section 7.3.1.2).	128	155
Nationally Important Wetlands			
Ashmore Reef	Ashmore Reef is one of only three emergent oceanic reefs in the north-eastern Indian Ocean, and the only one with vegetated islands. The Ashmore Reef reserve comprises three islets surrounded by intertidal reef and sand flats and deeper subtidal reef and sand flats. Some 95 bird species have been recorded from the reef and its adjacent waters, 43 of which are listed on the JAMBA and CAMBA migratory birds agreements. The islets are an important staging point for wading birds migrating between Australia and the northern hemisphere (DCCEEW 2023).	128	155

7.3.1.4 Commonwealth and National Heritage Places

No Commonwealth or National Heritage Places are within the Activity Area. Table 7-6 lists and Figure 7-5 shows the Commonwealth and National Heritage Places within the Planning Area.

Table 7-6: Commonwealth and National Heritage Places within the Planning Area

Listed Place	Description	Distance from Activity Area (~km)	Distance from Crux Platform (~km)
Commonwealth Heritage Places			
Ashmore Reef National Nature Reserve	The Ashmore Reef National Nature Reserve protects Ashmore Reef, a large platform reef with coral reefs, sand flats and three vegetated islands (DCCEEW 2023). Specific values of this site include: • breeding and foraging habitat for marine turtles. • considered to have the world's greatest abundance and diversity of sea snakes. • habitat for 569 species of fish, 255 species of corals and 433 species of mollusc, as well as species not previously recorded or rarely recorded in Australia. • an important seabird rookery and provides an important staging/feeding area for many seabirds and migratory shorebirds (Environment Australia 2002). • breeding and feeding habitat for a small dugong population (<50 individuals) (DCCEEW 2023).	128	155
Scott Reef and surrounds	Scott Reef (see Section 7.7.4.6) is considered regionally important for the following features: • high diversity of marine fauna, including corals, fish and marine invertebrates. • physical characteristics of the reefs create environmental conditions which are rare for shelf atolls, including clear deep oceanic water and large tidal ranges that provide a high physical energy input to the marine ecosystem. • high representation of species not found in coastal waters off WA and for the unusual nature of their fauna which has affinities with the oceanic reef habitats of the Indo-West Pacific, as well as the reefs of the Indonesian region. • important for scientific research and benchmark studies into long term geomorphological and reef formation processes due to the age of the reef and the documentation of its geophysical and physical environmental characteristics (DCCEEW 2023af).	153	294
National Heritage Places			
The West Kimberley	The West Kimberley is known for its ancient geology, Aboriginal culture, stunning landscapes, and biological richness. The West Kimberley holds extensive history of Aboriginal people who have lived in the area for at least 40,000 years and provides remnant habitats for many native animals and plants which are now absent elsewhere in Australia (DCCEEW n.d.a)	147	160

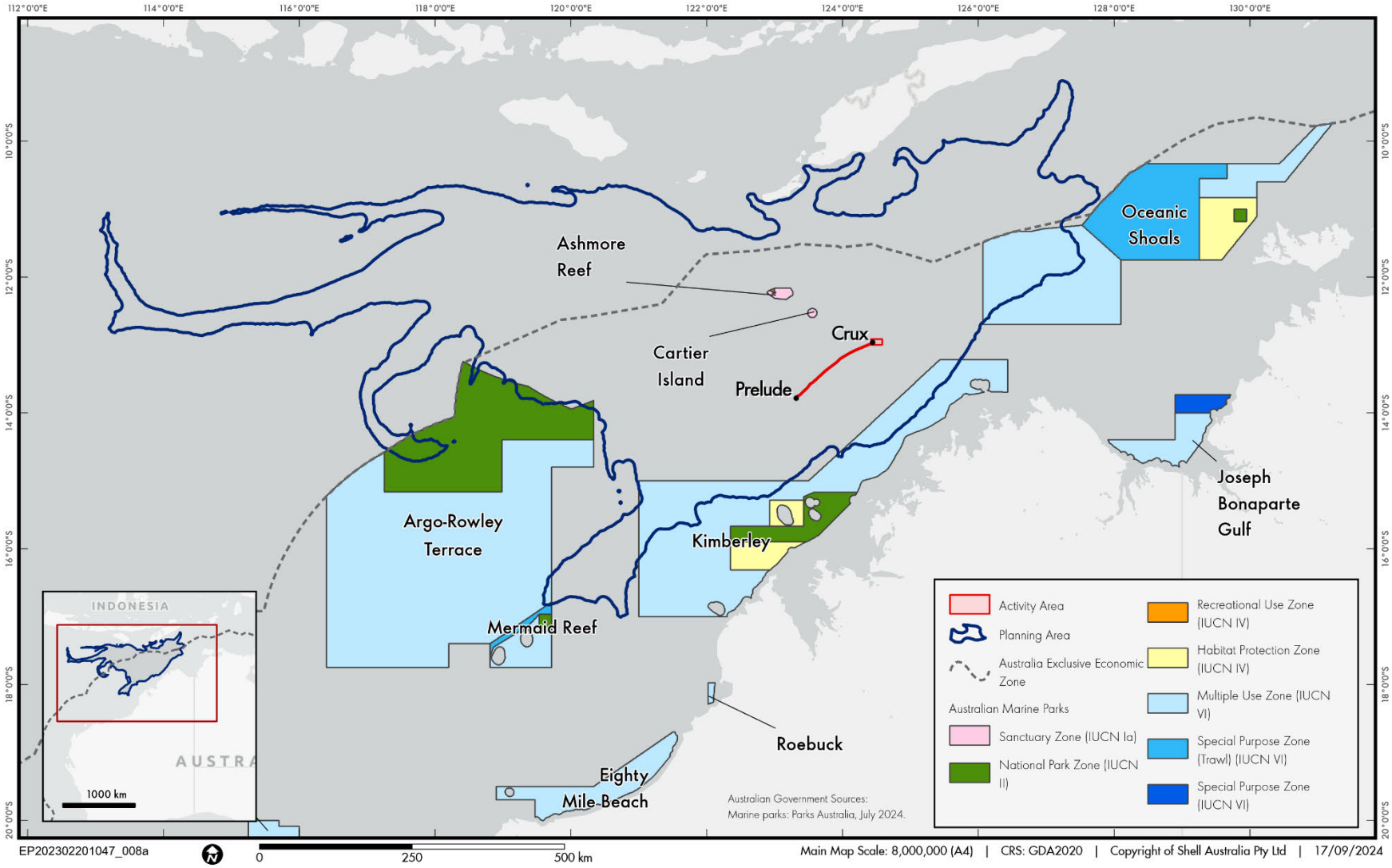


Figure 7-2: Australian Marine Parks within or Proximal to the Planning Area

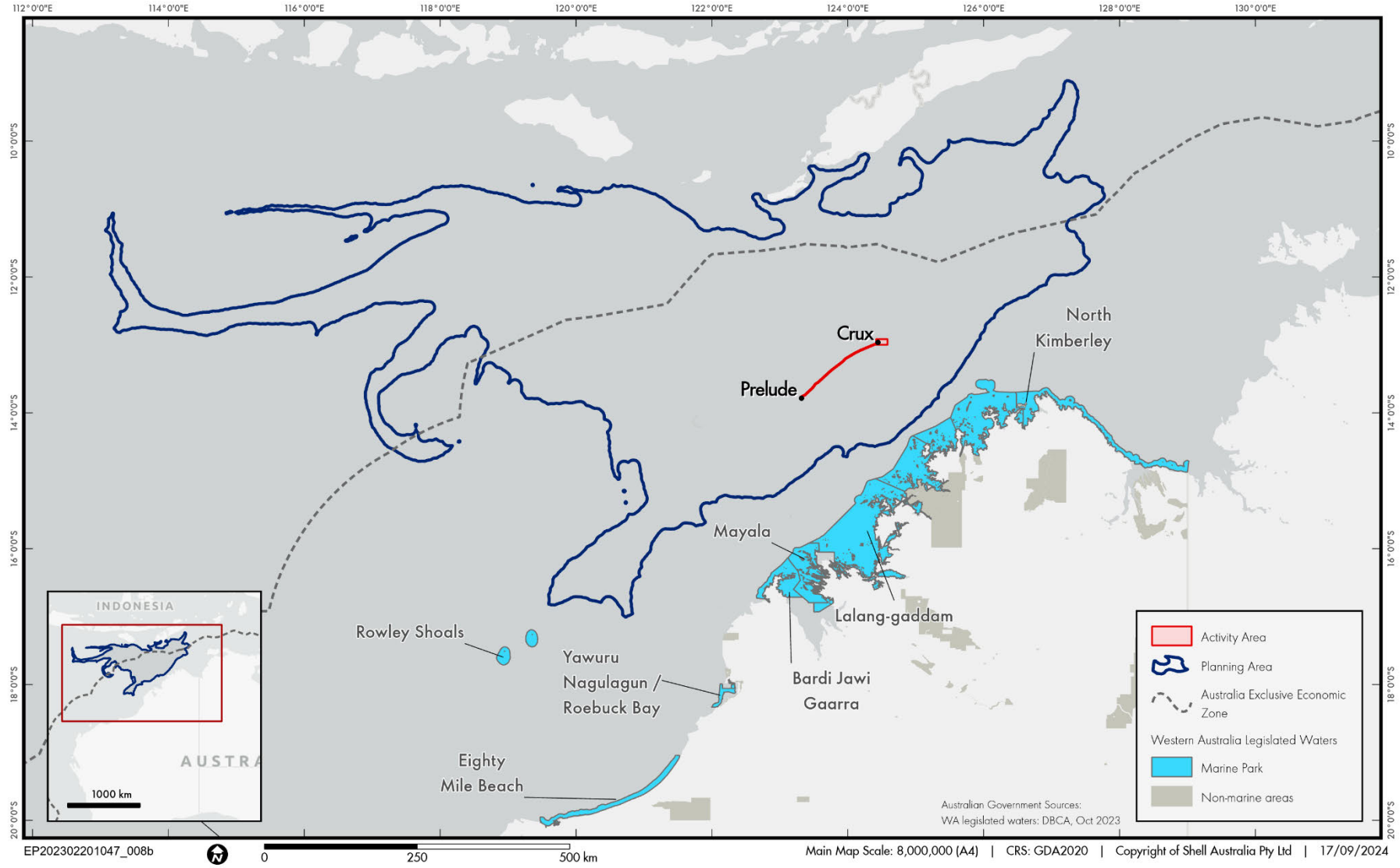


Figure 7-3: WA Marine Parks within or Proximal to the Planning Area

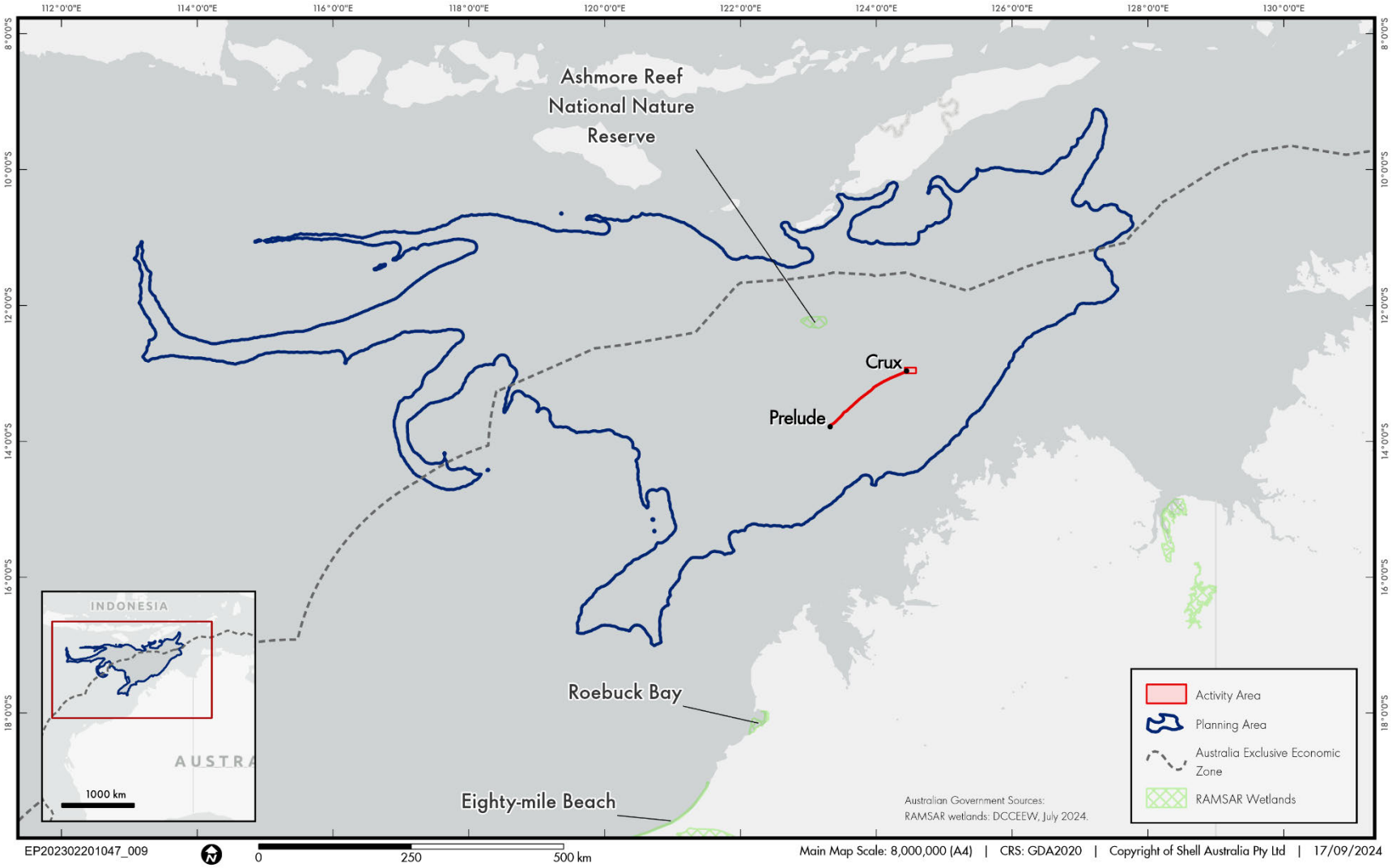


Figure 7-4: Ramsar Wetlands within or Proximal to the Planning Area

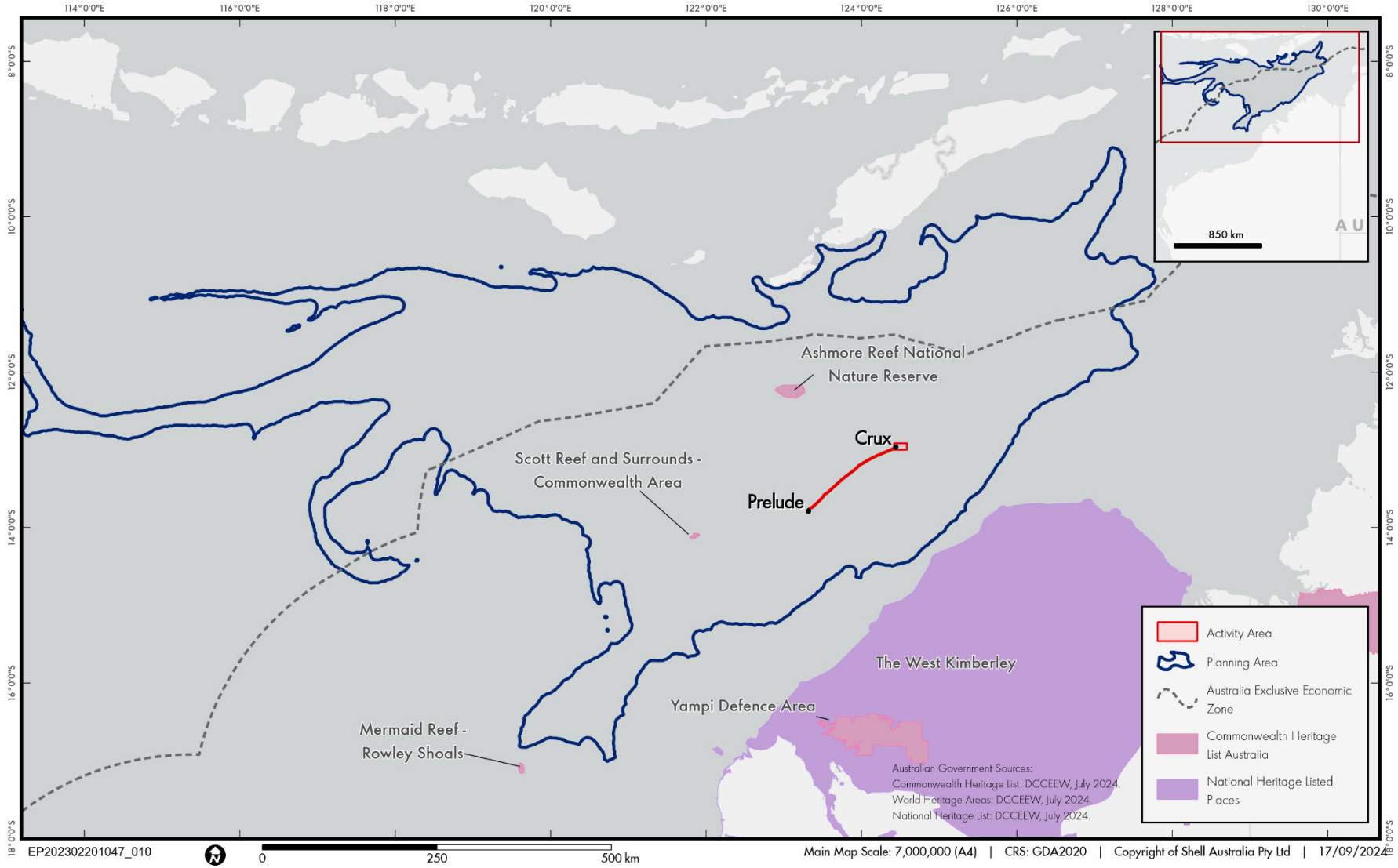


Figure 7-5: Commonwealth and National Heritage Places

7.4 Physical Features

7.4.1 Marine Regions

The Activity Area and Planning Area are located within the NWMR (see Figure 7-6). The NWMR extends along the WA–NT border to Kalbarri, WA from the state waters boundary 3 nautical miles (nm) (5.5 km) from shore to the edge of Australia's EEZ, 200 nm (370 km) from shore. The region's north-western boundary is defined in accordance with the Perth Treaty negotiated with the Republic of Indonesia and includes areas over which Australia exercises jurisdiction over both the water column and the seabed and its associated resources.

The NWMR is characterised by shallow-water tropical marine ecosystems and is home to globally significant populations of internationally threatened species (DEWHA 2008a). The NWMR is subdivided into provincial bioregions—the Activity Area is within the Timor Province (Integrated marine and Coastal Regionalisation of Australia [IMCRA]). The Planning Area also overlaps additional provincial bioregions, including the Northwest Shelf Province, Northwest Transition, Northwest Shelf Transition, Northern Shelf Province, and Timor Province, as shown in Figure 7-6.

The main physical features of the NWMR (not limited to the Planning Area) are:

- extensive areas of continental shelf and slope, plateaux and terraces including the Northwest and Sahul shelfs, the Exmouth and Scott plateaux, the Wallaby Saddle, and the Rowley Terrace.
- the narrowest continental shelf on Australia's coastal margin, which occurs near Northwest Cape where the shelf is just 7 km wide.
- coralline algal reefs, and carbonate pinnacles and shoals in the far north of the region.
- coral reefs including Ashmore, Hibernia, Scott, Seringapatam, Ningaloo and the Rowley Shoals, all of which have a high diversity of corals and associated fish and other species of both commercial and conservation importance.
- the Joseph Bonaparte Gulf, a muddy basin with sparse coverage of sessile filter-feeding organisms and mobile invertebrates.
- a number of major canyons on the continental slope that act as conduits for sediment and nutrient transport, including Cape Range, Cloates, Carnarvon and Swan canyons.
- two areas of abyssal plain (Cuvier and Argo) with depths >5000 m.
- the Indonesian Throughflow, a low-salinity water mass that is one of the major elements of the global transfer of heat and water between oceans and which plays a key role in initiating the Leeuwin Current.

The NWMR is relatively shallow (<200 m deep over >40% of the region) and strongly influenced by surface currents, notably the Indonesian Throughflow. It is the primary driver of the oceanographic and ecological processes in the region.

The strong seasonality in wind direction and rainfall is another important factor driving ecological processes. The region experiences monsoonal climate patterns with highly variable tidal regimes and a pronounced cyclone season between December and March. The weakening of the Indonesian Throughflow and Leeuwin Current in the dry season (April to September and particularly during El Niño years), along with the seasonal reversal in wind and cyclones, enhances biological productivity through increased mixing of the deeper, cold, nutrient-rich waters with surface waters.

7.4.2 Australian Environment

The term 'Australian environment' encompasses the collective receptors (Sections 7.3.1 to 7.11) considered in the context of assessing potential climate change or pests/diseases impacts. This broad definition is employed to incorporate the precautionary principle, acknowledging the inherent uncertainties in the relationship. For example, the contribution of GHG emissions and the effects of climate change to these receptors or the potential introduction and establishment of pests and diseases to Australian waters.

7.5 Physical Values and Sensitivities

The following sub-sections detail the physical values and sensitivities that have recognised measures of acceptable impacts within the Planning Area.

7.5.1 Air Quality

The Planning Area is located within the remote ocean, distant from anthropogenic air pollutant sources and therefore expected to exhibit generally high air quality. Temporary regional increases in airborne particulates in north-western Australia may result from fires and/or dust storms occurring from Australia or South-east Asian countries (EPA 2007; Vadrevu et al. 2014; Kim Oanh et al. 2018). In offshore areas, commercial shipping and petroleum production facilities may contribute to localised reductions in air quality. Parts of the Planning Area nearer to resource processing/handling sites may also be affected by industrial emissions, which typically include carbon monoxide (CO), oxides of nitrogen and sulphur, and/or ozone (IQAir 2023; EPA 2007).

Shell's Prelude and Crux (once operational) facilities, marine traffic, and other operating petroleum production facilities in the immediate region, such as the Montara FPSO facility (~36 km from the Crux platform) and the Ichthys facilities (~17 km to the south-west of Prelude FLNG), are likely to represent the main sources of localised reductions in air quality in the area.

7.5.2 Water Quality

The marine waters within the Planning Area can be considered pristine, but subject to considerable spatial and temporal variation in characteristics. As a generalisation, offshore waters are frequently clear, oligotrophic, and largely free of anthropogenic influences.

Localised reductions in water quality can be expected around marine discharges associated with industrial developments, including offshore oil and gas facilities.

Natural offshore seeps may locally contribute to hydrocarbon concentrations, with the Browse Basin described as the best-known area of natural hydrocarbon seepage in the marine environment in Australia (Logan et al. 2010). Hydrocarbon seeps have been observed at the Cornea oil field and Heywood Shoals on the northern Yampi Shelf, ~65 km south of the Crux development area (Jones et al. 2005; Rollet et al. 2006; Logan et al. 2010), and expulsion of gas bubbles suggesting seep activity observed along the southern flank of the Ashmore Platform, ~70 km north of the Crux development area (Stalvies et al. 2017). However, studies for Shell by CSIRO (2017) indicate the abundance of benzene, toluene, ethylbenzene, xylenes (BTEX) and higher molecular weight polycyclic aromatic hydrocarbon (PAH) compounds in the Browse Basin is generally low to very low, and where present likely the byproduct of wildfires.

Further detail of the water quality of the Activity Area, based on surveys conducted for Shell in 2008 (ERM 2008 reported in Shell 2009) and 2016 (AECOM 2016, 2017), and with reference to water quality default guideline values (DGV) defined in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Australian and New Zealand Governments [ANZG] 2018) where relevant, is provided in Sections 7.5.2.1 to 7.5.2.3.

7.5.2.1 Physico-chemical

Temperature, salinity, pH, and dissolved oxygen (DO) recorded in the Activity Area are relatively consistent across sites and comparable to ranges measured by other studies in the region, including INPEX 2010, CSIRO 2017 and ConocoPhillips 2018. As with other regional surveys, there was evidence of spatial and seasonal variation in some parameters.

Surface temperatures (up to 10 m depth) range between ~30° C to 31° C (AECOM 2016, 2017), decreasing to a minimum of ~16° C at 250 m deep (Shell 2009). A distinct thermocline was recorded in the Prelude development area, but this was relatively indistinct during sampling near Crux.

Average surface (0 m–10 m) salinities are ~34–35 Practical Salinity Units (PSU) with slightly lower salinity levels recorded in deeper waters.

In-situ pH ranged between ~7.1 and 8.3. No clear vertical gradient in pH was observed, although a trend of decreasing pH through the water column to the seabed was noted at some sites during the Crux surveys.

Average DO percent saturation was higher in the upper water column and decreased consistently with depth to the seabed. Average surface DO percent saturation ranged from ~86–109%, with DO near the seabed ranging between ~41% to 56%. The high levels of DO in surface waters is consistent with mixing in the upper water column.

Turbidity is consistently low throughout the water column, which can be expected for offshore marine environments.

7.5.2.2 Hydrocarbons and Metals

Hydrocarbon and metal concentrations in waters of the Activity Area are generally below laboratory detection levels and/or DGV in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018).

Zinc was detected at levels above the 99% species protection DGV by sampling at Crux (AECOM 2016, 2017) and cadmium and longer chained total petroleum hydrocarbons were recorded in some water samples at Prelude (Shell 2009). The sources of these contaminants are unknown, but, at least for some zinc detections, sampling or laboratory cross contamination may have been involved (Shell 2020).

7.5.2.3 Nutrients and Photosynthetic Pigments

Nutrient concentrations, including nitrite and nitrate, total nitrogen, and total phosphorus, are low across the Activity Area, as are levels of photosynthetic pigments, consistent with the generally oligotrophic nature of offshore NWS waters. Limited seasonal or spatial variation in these properties was apparent from sampling surveys (AECOM 2017, Shell 2009).

Nitrite/nitrate and total nitrogen concentrations generally increase with depth. Nitrite and nitrate range from typically below detection levels at the surface (AECOM 2017, Shell 2009) to mean concentrations of 0.20 mg/L at 150 m and 0.31 mg/L at ~250 m (Shell 2009). Mean total nitrogen concentrations increase from below detection levels to 0.18 mg/L at 150 m and 0.3 mg/L at ~250 m (AECOM 2017, Shell 2009). No spatial or vertical variation in seawater Total Kjeldahl Nitrogen (TKN) levels were reported (Shell 2009).

Concentrations of total phosphorous measured in surface waters in the Crux development area ranged from below detection to 0.012 mg/L (AECOM 2017).

For the four photosynthetic pigment parameters analysed in surface waters in the Crux development area (Chlorophyll a, b, c and phaeophytin), concentrations were consistently low, ranging from below detection to 0.0002 mg/L (AECOM 2017).

7.5.3 Sediment Quality

Sediments in the Planning Area are generally considered to be pristine outside of areas receiving marine discharges from operating facilities, including offshore oil and gas facilities. Within the NWMR, the influence of terrigenous sediments tends to be confined to the coastal boundary and in waters less than 100 m water deep, particularly in areas adjacent to rivers (DEWHA 2008a).

Surveys conducted over the NWS indicate that similar sediments occur extensively over this geographic region, but with spatial variation in the grain size and origin of the surface sediments. Sediments generally become finer with increasing water depth, ranging from sand and gravels on the shelf to mud on the slope and abyssal plains (DEWHA 2008a).

Further detail of the sediment quality of the Activity Area, based on surveys conducted for Shell in 2008 (ERM 2008 reported in Shell 2009) and 2016 (AECOM 2016, 2017), and with reference to DGV from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality where relevant, is provided in the following sections.

7.5.3.1 Metals

Within the Activity Area the mean sediment metal concentrations is generally very low, below relevant Guideline values and with no obvious spatial trends (Shell 2009, AECOM 2017). Only one individual site sample from the Prelude surveys exceeded the DGV for one analyte (mercury) (Shell 2009) and one sample from the Crux surveys (but near Prelude) exceeded the DGV for nickel (AECOM 2017).

Mercury concentrations in commercially important fish species within the Browse Basin, including areas adjacent to the Crux platform site, were assessed as part of the Applied Research Program (ARP)5 baseline monitoring program conducted in December 2015. The study focused on goldband snapper (*Pristipomoides multidens*), red emperor (*Lutjanus sebae*), and spangled emperor (*Lethrinus nebulosus*), with fish samples collected from nine sites across the region using commercial fish traps and baited remote underwater video systems. Fish fillets were analysed for mercury and other trace metals using accredited laboratory methods, with results compared against the Australia New Zealand Food Standards Code (FSANZ) maximum allowable level of 1.0 mg/kg wet weight.

Across all sites, mercury concentrations in goldband snapper ranged from 0.03 to 0.38 mg/kg (mean 0.244 ± standard error of the mean (SEM) 0.153 mg/kg), while red emperor ranged from 0.08 to 0.53 mg/kg (mean 0.250 ± SEM 0.146). Spangled emperor, sampled at one site, showed mercury levels of just 0.003 mg/kg ± SEM 0.002 (Babcock *et al* 2017). These values are well below the FSANZ threshold and are considered safe for human consumption. No evidence of anthropogenic mercury contamination was found, and the measured concentrations are consistent with natural background levels typically observed in marine environments. The results provide a robust baseline for mercury in key commercial fish species in the region and confirm that fish from the Browse Basin are safe for consumption with respect to mercury. This baseline will support future monitoring and impact assessments where required in future.

7.5.3.2 Hydrocarbons

Petroleum hydrocarbon (total petroleum hydrocarbon [TPH], Total Recoverable Hydrocarbons and PAHs) levels in sediments in the Activity Area are very low, below relevant DGV and typically below laboratory detection/reporting levels.

Oil and grease were recorded during the Crux surveys at concentrations ranging from 510–2,200 mg/kg and an average concentration of 1,142.8 mg/kg with no evidence of spatial trends in concentrations. At Prelude, oil and grease were generally below detection levels, with three individual samples having concentrations between 530 and 3,400 mg/kg.

7.5.3.3 Naturally Occurring Radioactive Material

Sediment concentrations of gross alpha and gross beta radionuclides were measured during the Crux surveys and found to range between 560 Becquerel (Bq)/kg–1,860 Bq/kg, and well below the low screening level of 35,000 Bq/kg for sum of gross alpha and beta indicated in the National Assessment Guidelines for Dredging 2009 (CoA 2009).

7.5.3.3.1 Nutrients

Sediment nitrogen levels were measured during the Crux surveys and are predominantly present across sites as TKN with a small nitrate plus nitrite (NOx) component at some sites. TKN concentrations range from 210 to 1,040 mg/kg. NOx concentrations were very low where detected, with concentrations ranging from 0.1 to 1.8 mg/kg. There were no spatial patterns evident for nitrogen.

Reported concentrations of phosphorus range from 816 mg/kg to 10,200 mg/kg. There are no DGVs for nutrients in sediments.

7.5.4 Underwater Noise

Noise in the marine environment is generated by both natural and anthropogenic sources.

Natural noise sources include those produced by wind, waves, currents, rain, earthquakes, echo-location and communication noises generated by cetaceans and fish. Natural background noise levels have been recorded as ranging between 90 decibels (dB) to 110 dB (re 1 micropascal (µPa)), representing the typical range for calm to windy conditions, though heavy rain can result in higher noise levels (Shell 2009).

Anthropogenic sources of underwater noise include shipping, marine construction (e.g. dredging, drilling) and marine acoustic signals, notably seismic airguns but also sonar, sidescan and bathymetric surveys.

Baseline noise monitoring undertaken by INPEX for the Ichthys project, located ~17 km to the south-west of Prelude FLNG, recorded average ambient noise levels of 90 dB (re 1 µPa) under low sea states (INPEX 2010). Baseline noise monitoring for the proposed Barossa Gas Project, ~713 km north-east of the Crux platform, observed average ambient sound levels ranging between ~97 dB and 119 dB (re 1 µPa) (ConocoPhillips 2018).

The Prelude underwater noise monitoring program recorded both natural and anthropogenic sources (Shell 2009), including:

- several regular fish choruses (i.e. schooling fish calling en masse).
- several great whale calls including humpback song, a possible great whale signal, pygmy blue whale signals and possible minke whale signals.
- persistent vessel noise.

- seismic survey noise, associated with marine seismic survey signals.

The biological noise sources recorded in the Ichthys field were similar and included regular fish choruses, infrequent calls from nearby fish and several whale calls from humpback whales, pygmy blue whales, minke whales and other unidentifiable species (INPEX 2010). Anthropogenic noise sources recorded included low frequency noise from vessels and that generated from seismic surveys being conducted in the region (INPEX 2010).

7.6 Natural Features

The Planning Area overlaps (Figure 7-6) these marine bioregions:

- Northwest Shelf Province (Section 7.6.1).
- Northwest Shelf Transition (Section 7.6.2).
- Northwest Transition (Section 7.6.3).
- Timor Province (Section 7.6.4).

Plankton comprises a highly diverse mix of phytoplankton and zooplankton, ranging in size from micrometres to centimetres, that fulfil a diverse range of ecological roles. In addition to ubiquitous taxa such as copepods, euphausiids and chaetognaths, the diversity of zooplankton can be enhanced by the occurrence of pelagic larval stages of a number of invertebrates and fish (ichthyoplankton). In the Planning Area, this includes the commercially important southern bluefin tuna (*Thunnus maccoyii*), with the only known spawning ground for this species in an area encompassing Christmas Island's EEZ and extending towards Java, and north-western Australia (Hobbs et al 2021), covering over one million km^2 and including much of the NWMR (DCCEEW 2024i).

Plankton distribution is often patchy and linked to localised and seasonal productivity that produces sporadic bursts in phytoplankton, zooplankton and tropical krill production (DEWHA 2008a). Fluctuations in abundance and distribution occur horizontally and vertically in response to tidal cycles, seasonal variation (light, water temperature and chemistry, rainfall, currents and nutrients) and cyclonic events. Generally, in offshore Australian waters, the mixing of deeper, more nutrient-rich waters with warmer surface waters (i.e. areas of upwelling) generates phytoplankton production and zooplankton blooms.

The Planning Area extends over a large area with a wide range of water depths, proximity to terrestrial inputs, geomorphic features and metocean conditions that may all influence plankton communities. The majority of the Planning Area is within oceanic, oligotrophic waters where plankton abundance is generally low. Macrobenthos consist of organisms that live within (infauna) or on (epifauna) the seabed sediments. In the shallower coastal waters of the continental shelf and on reefs and shoals/banks in <50 m water depth, communities of benthic epifauna are abundant and diverse. However, seafloor communities in deeper waters, such as those found within the majority of the Planning Area, including the Activity Area, are generally expected to be less abundant and diverse.

Section 7.7 describes the natural values and sensitivities associated with natural features that have particular significance within the Planning Area.

7.6.1 Northwest Shelf Province Bioregion

The Planning Area intersects a small portion (<13%) of the Northwest Shelf Province. The sandy substrates on the shelf within the Northwest Shelf Province are thought to support low density benthic communities of bryozoans, molluscs and echinoids. Sponge communities are also sparsely distributed on the shelf but are found only in areas of hard substrate. Other benthic and demersal species in this bioregion include sea cucumbers, urchins, prawns and squid. The benthic and pelagic fish communities of the Northwest Shelf Province are strongly depth-related, indicative of a close association between fish communities and benthic habitats (Brewer et al. 2007). Numerous migratory species (such as humpback whales and whale sharks) travel through this bioregion (Jenner et al. 2001).

7.6.2 Northwest Shelf Transition Bioregion

The Planning Area intersects less than 20% of the Northwest Shelf Transition. The biological communities of the Northwest Shelf Transition are typical of Indo–West Pacific tropical flora and fauna, and occur across a range of soft-bottom and harder substrate habitats. The softer, muddy substrates are thought to be sparsely covered by sessile filter-feeding organisms, such as gorgonians, sponges, ascidians and bryozoans, and

mobile invertebrates, such as echinoderms, prawns and detritus feeding crabs. The harder substrates are believed to have a more diverse range of sessile benthos, such as hard and soft corals, gorgonians, encrusting sponges and macroalgae, and consequently, a more reef-associated fish and shark fauna.

Pinnacles and carbonate banks are believed to support a high diversity of marine species. This is thought to be because of the channelling of water around these features, which stimulates enhanced local biological productivity through the stirring of nutrients. In addition, the hard substrates are suitable for the formation of filter-feeding coral and sponge communities.

The formation of carbonate banks in the bioregion is thought to be associated with seafloor hydrocarbon seeps (vents in the seafloor through which hydrocarbons and frequently other chemicals enter the water column). Microbial utilisation of hydrocarbons is thought to create carbonate by-products, which precipitate and form the basis of the banks. The hard substrate is then colonised by reef-building organisms that thrive on passing nutrients. Demersal catch records from the Northern Prawn Fishery in the region indicate that the bioregion's demersal communities have a relatively high biomass and further suggest that the bioregion is an area of high species diversity. There are occasional reports of very large catches of some species, such as the cornflake or swimming crab (*Charybdis callianassa*), which are believed to be because of spawning aggregations of this species (Brewer et al. 2007). Healthy offshore populations of crustaceans (including prawns) are indicators of inshore biological productivity, but the direct linkages between these species and marine systems are poorly understood. By-catch from the prawn fishery contains a high level of demersal fish. Adjacent to the Northwest Shelf Transition (within the NWMR), the shoals contain species, such as polychaete worms, crustaceans, brittle stars, gobiid fish, bivalves and sipunculans. It is likely that similar species would be found in the region around the banks and shoals of the eastern areas of the Northwest Shelf Transition.

Sea snakes are also known to occur in the provincial bioregion, including EPBC Act threatened species such as the short-nosed, leaf-scaled anddusky sea snakes.

The Northwest Shelf Transition supports a number of protected marine species. Marine turtles are also believed to feed in the reef habitat of this bioregion, and pinnacles on the mid-shelf may be important feeding sites for green, loggerhead, flatback and olive ridley turtles (Brewer et al. 2007; Donovan et al. 2008; Limpus 2004).

Biogeographically, the Northwest Shelf Transition is a transitional zone between the east and the west of Australia, yet its affinities lie mainly with the Indian Ocean. Marine plant and animal groups are more like those of west coast Australian animal and plant life than that of the east coast of Australia. Cetaceans are not frequently sighted in this provincial bioregion.

There is a paucity of data available on the biology in the Bonaparte Basin. Benthic animal groups are influenced by depth and the grain size of the surface sediments. Some bacterial production may occur but deposit feeders are likely to dominate the basin environment. Swimming crabs (*Charybdis callianassa*) are abundant in the basin muds and may be the dominant first order consumers of detritus. These crabs may also be important prey for predatory pelagic fish species found in the vicinity of prawn fisheries in the provincial bioregion.

The carbonate pinnacles in this provincial bioregion include complex hard substrate environments and provide a very different habitat to adjacent muddy basin sediments. These pinnacles are known to offer refugia for a range of species and may support phototrophic organisms (that obtain energy from sunlight), where they extend into euphotic surface waters.

7.6.3 Northwest Transition Bioregion

The Planning Area intersects a small portion (<5%) of the Northwest Transition. The benthos of the deep ocean areas of the Northwest Transition is likely to support meiofauna (minute animals living between grains of sediment on the seabed, e.g. nematodes), larger infauna (that burrow into sediments, e.g. polychaete worms and isopods) and sparsely distributed epibenthic communities (that live on the surface of the seabed, e.g. seapens) (Brewer et al. 2007). Mobile benthic species, such as deepwater sea cucumbers, crabs and polychaetes are likely to be associated with the seafloor, and the bioregion may support sparse populations of bentho-pelagic fish and cephalopods in low densities. Pelagic fish species likely to be present include grenadiers and hatchetfish (Argyropelecus spp.), as well as transient populations of highly mobile pelagic species, such as sharks and schools of small pelagic fish. Adult and juvenile southern bluefin tuna are thought to migrate through this bioregion on their way to and from spawning grounds in the north-eastern Indian Ocean. However, the timing of these migrations and the use of regional currents to assist their migration is still unclear. Seabirds are likely to feed on small pelagic fish in this bioregion.

The slope habitat of this bioregion is associated with important populations of demersal fish species. A national bioregionalisation of slope fish communities identified the North West Slope (which occurs in this bioregion, as well as the adjacent Timor Province) as supporting the second richest demersal fish assemblage nationally (Last et al. 2005). Over 508 fish species have been identified on the slope in this area, and 64 of these species are endemic. Demersal slope fish species in this bioregion are distributed across a number of distinct depth ranges on the slope, specifically areas of the upper slope (225–500 m) and mid slope (750–1,000 m). The high diversity and endemism of the demersal fish fauna indicates important interactions between physical processes and trophic structures in this bioregion.

7.6.4 Timor Province Bioregion

Surveys in the Activity Area show a diverse but low abundance of plankton communities, with phytoplankton and zooplankton assemblages generally consistent with those recorded in the region's offshore waters (Shell 2009, 2020).

Chlorophyll concentrations (an index of phytoplankton biomass) measured at Crux were very low (AECOM 2017), below DGV for the North West Shelf bioregion (ANZG 2018). Phytoplankton abundance was also very low at Prelude, with key groups identified by sampling including dinoflagellates (Dinophyceae), diatoms (Bacillariophyceae) and Prasinophyceae. The most abundant species included Prasinophyte sp. (Prasinophyceae); Gyrodinium sp. and Heterocapsa sp. (Dinophyceae); Pseudonitzschia sp., Cylindrotheca closterium, Chaetoceros sp., Thalassionemafrauenfeldii sp. and Nitzschia longissimi sp. (Bacillariophyceae) (Shell 2009).

Zooplankton assemblages were only sampled at the Prelude location and present at low densities, primarily dominated by copepod species (Shell 2009); however, a few samples were dominated by euphausiids or chaetognaths. A diverse fish larval assemblage were also recorded. Although the fish larval composition was primarily dominated by neritic species with little or no commercial value, larvae of the commercially targeted Berycidae (alfonsinos), Carangidae (jacks, trevallies), Lutjanidae (snappers), Serranidae (cods), and Scombridae (tunas, mackerels) were also present. The variety of geomorphic features in the Timor Province, together with its varying bathymetry, results in several distinct habitats and biological communities, many of which occur in close proximity. For example, shallow reefs on the shelf break occur in close proximity to adjacent deep water muddy seabeds on the slope (Brewer et al. 2007). The reefs and islands of the bioregion are regarded as biodiversity hotspots and include a range of important pelagic and benthic ecological communities.

The deep-sea seabed (400 m to 600 m) within the Browse development area, ~265 km south-west of the Crux platform, was observed as comprising fine sand and silt with epibenthic fauna limited to isolated individual bryozoan colonies, brittlestars and basketstars, and sea anemones (Woodside 2014). The most abundant infauna recorded were polychaete bristleworms, accounting for 53.4% of all infaunal assemblages (Woodside 2014).

Benthic habitat in the GDF Suez (now Engie/Neptune Energy) Bonaparte Basin retention lease areas (~440 km east of the Crux platform, in water depths 80 m to 100 m) was recorded as soft sediments with epifauna and sessile benthos generally being sparse and characterised by a limited number of common and widespread taxa (GDF Suez 2011). Infaunal communities were also observed to be typical of soft sediment habitat and dominated by polychaete worms (GDF Suez 2011).

Benthic surveys in the Crux development area recorded a very low macrobenthic fauna abundance (AECOM 2017) and reported that the benthic habitats in the area do not support the highly diverse benthic communities characteristic of shoals and banks within the region (Section 7.7.3). Overall, epifaunal abundance was low, with some habitats having little to no visible fauna. The majority of the benthic habitat comprises soft sediments characterised by burrowing macrofauna communities or no macrobiota (<10% cover). The dominant phyla were Annelida (~37%), Mollusca (~24%) and Porifera (~11%). The distribution of benthic infauna is patchy, typical of soft sediment habitats, with no evident spatial trends associated with sediment physicochemical attributes (AECOM 2017). Areas of hard substrate supported a distinct benthic community, including sea whips, branching soft coral, sponges and hydroids. The AECOM (2017) survey sampled a limited number of locations within the Activity Area, with limited sediment sampling depths and volumes, and patches of the seafloor with higher abundances of infauna may not have been sampled. Therefore, Shell considers that the survey data reported by AECOM (2017) are more representative of a broad characterisation of infaunal assemblage within the Crux Activity Area, and plans to undertake further pre-operations baseline survey(s) (refer Shell 2024a) to obtain data suitable for robust statistical comparison with data collected during operations and decommissioning phases of the Crux Project.

Macrobenthos in the Prelude development area was also recorded as having consistently low abundance and similar composition across the area surveyed (Shell 2009). Eighty percent of individuals were identified from nine different Phyla (Annelida, Chordata, Cnidaria, Crustacea, Echinodermata, Mollusca, Nematoda and Sipuncula).

The seabed within the Ichthys field (235–275 m), ~164 km south-west of the Crux development area, was characterised by bare substrates supporting an infauna dominated by polychaete worms and crustaceans and few epibenthic organisms. Areas of hard substrate exhibited a low cover of epibenthic fauna, comprising filterfeeding communities including sponges, gorgonians and soft corals (INPEX 2010).

The benthic habitats in the Montara development area, ~36 km north-east of the Crux platform, were characterised by homogenous, flat, featureless soft sediments supporting patchy, low abundance macrobenthic faunal assemblages dominated by polychaete bristleworms (abundance of ~40–60%) and crustaceans (e.g. shrimps, crabs) (~13–19%) (PTTEP 2017). The sparsely distributed epifauna assemblage supported hydroids, octocorals (soft corals, gorgonians and seapens), black corals and ascidians.

Ashmore Reef is characterised as a scleractinian coral reef. It is a significant breeding area for green turtles and has a high coverage of seagrass that supports a small dugong population. Ashmore is also internationally recognised for its abundance and diversity of sea snakes (Guinea 2007), including EPBC Act listed threatened species such as dusky, leaf-scaled and snort-nosed. Ashmore Reef and Cartier Island are important staging posts for migratory shorebirds and support some of the most important seabird rookeries in the NWMR.

Scott and Seringapatam reefs are also scleractinian coral reefs and are regionally important for their high biodiversity. They represent the limit of the geographic range of many fish species, including Indonesian species that are not found anywhere else in Australia. In addition, the reefs are the only known habitat in WA for many sea snakes, including the dusky sea snake, fish, molluscs and echinoderms. Scott Reef also supports a small but genetically distinct breeding population of green turtles and is an important staging post for migratory shorebirds. It is also thought to be a foraging area for seabirds, including roseate terns, lesser frigatebirds, brown boobies and wedge-tailed shearwaters (Donovan et al. 2008). There are thought to be highly diverse deep coral water habitats around Scott Reef that are not found elsewhere in Australian waters.

The species composition of all the hard coral reefs in the bioregion is very similar and reflects strong links with Indo–West Pacific fauna, largely as a result of the dispersal of coral spawn via regional currents. The reefs and islands in this bioregion are thought to be important biological stepping-stones between centres of biodiversity in the Indo–Pacific and reef ecosystems further south. There is no significant endemism among the corals of the eastern and western coasts of northern Australia. However, there is greater endemism in biological communities, such as sponges and molluscs, whose larvae are generally not transported long distances by ocean currents. For example, a large component of the sponge fauna of Scott Reef is unique to Scott Reef and does not occur at Seringapatam, despite the close proximity of the two reefs and their connection via regional currents.

Coral reefs in this bioregion support a high biomass of fish species, including tropical reef fish, small pelagic fish, parrotfish and groupers, as well as larger species such as trevally, coral trout, emperors, snappers, dolphinfish, marlin and sailfish. These reefs and their surrounding waters are important habitats for cetaceans and seabirds.

The biological communities of Ashmore, Cartier, Scott and Seringapatam reefs are well understood compared with those of the slope and abyssal plain. Despite their ecological importance, reefs represent only a small proportion of the habitat types that occur in the Timor Province. Based on an understanding of the oceanographic processes that give rise to bursts in biological productivity, it is likely that important demersal communities also occur in the canyons, banks and deep holes of the bioregion, as well as on the Ashmore and Rowley terraces and Scott Plateau.

The North West Slope Trawl Fishery targets scampi in the region. Data from the fishery suggests that muddy sediments in the Timor Province support significant populations of crustaceans (Brewer et al. 2007). In addition, research into the demersal fish communities of the continental slope has identified the Timor Province as an important bioregion because of the presence of a number of endemic fish species and two distinct demersal community types associated with the upper slope (water depths of 225–500 m) and mid-slope (water depths of 750–1,000 m) (Last et al. 2005). This research suggests this bioregion may be distinctive because of the absence of a discrete mid-upper slope habitat, which has been identified in other Australian continental slope bioregions. However, the current understanding of the relationship between demersal fish communities and benthic environments on the continental slope, as well as the trophic relationships of this area, is rudimentary.

A number of migratory species occur in the Timor Province. Migrating whales, including humpback, sperm and blue whales, may 'ride' the northward flows of the Eastern Gyral Current and South Equatorial Current en route to breeding grounds off the Kimberley (DEWHA 2008a; 2008b; 2008c; 2008d).

Blue whales reportedly move between Scott Reef and Browse Island during July (northern migration) and again during October–November as part of their southern migration (DEWHA 2008a; 2008d). Whaling records from the 19th century indicate that historically, the number of sperm whales was high in this bioregion. Although their numbers today are unknown, it is possible that they congregate around canyon heads adjacent to the Scott Plateau, attracted by high levels of biological productivity that support aggregations of prey species.

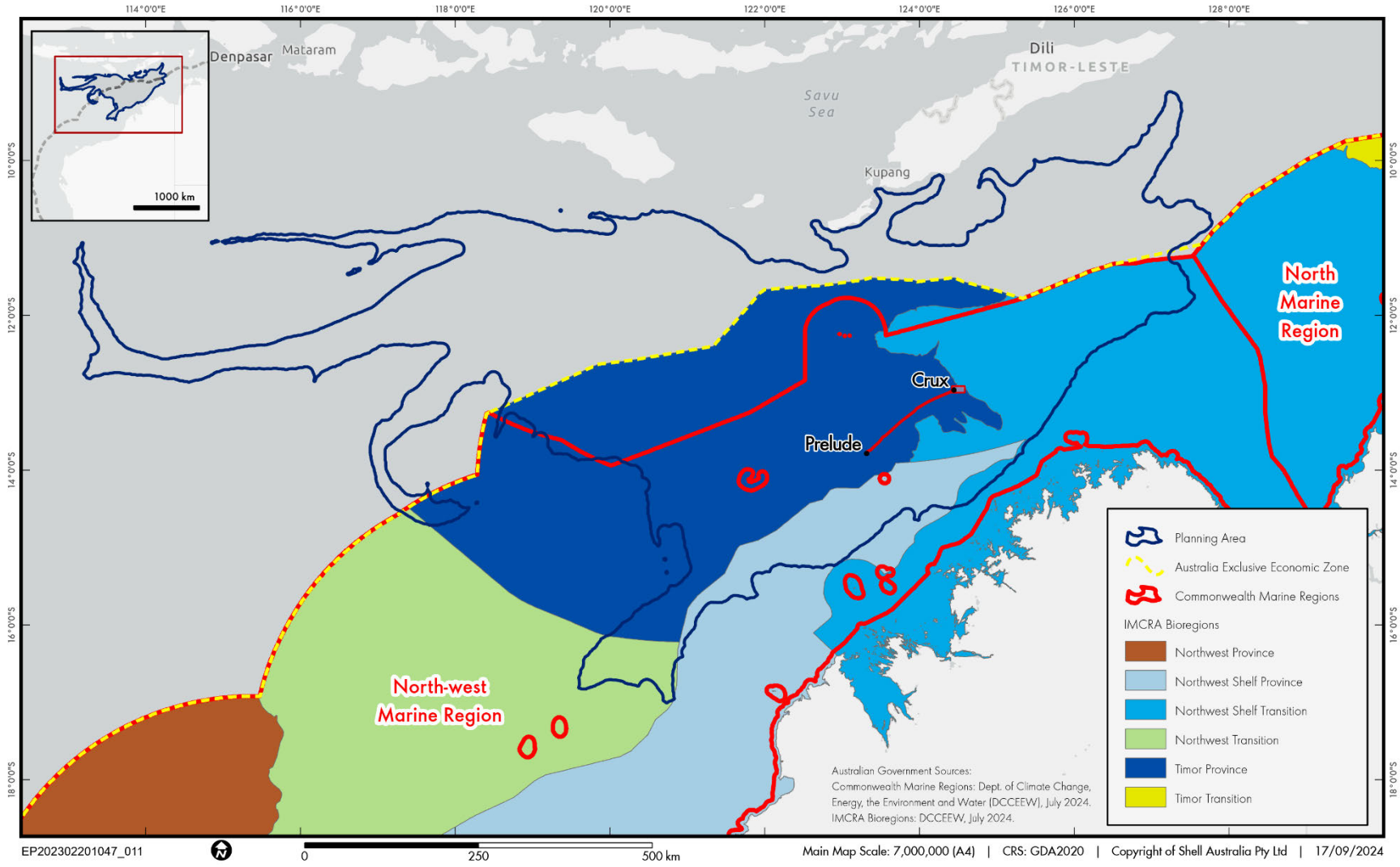


Figure 7-6: IMCRA Provincial Bioregions

7.7 Natural Values and Sensitivities

7.7.1 Biologically Important Areas

BIAs are defined by DCCEEW as '*spatially defined areas where aggregations of individuals of a regionally significant species are known to display biologically important behaviours such as breeding, foraging, resting or migration*' (DCCEEW 2023i). BIAs provide a tool for defining areas of importance for marine fauna species.

The BIAs that overlap the Activity Area and Planning Area are discussed under the relevant species-specific sections in Section 7.7.7.

7.7.2 Habitat Critical to the Survival of a Species

The EPBC Act *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DoE 2013) define 'habitat critical to the survival of a species' as areas necessary:

- for activities such as foraging, breeding or dispersal;
- for the long-term maintenance of the species (including the maintenance of species essential to the survival of the species);
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species.

Such habitat may be, but is not limited to, habitat identified in a recovery plan and/or habitat listed on the Register of Critical Habitat. There are no registered critical habitats within the Planning Area (Appendix F).

The Activity Area does not overlap any known habitat critical to the survival of a species. Section 7.7.7.2 describes the areas considered to represent habitat critical to green turtles within the Planning Area.

7.7.3 Shoals and Banks

Table 7-7 lists and Figure 7-7 illustrates the named shoals and banks within the Planning Area, that have recognised environmental value. An understanding of these features has been gained from the Big Bank Shoals study (Heyward et al. 1997), PTTEP surveys initiated in response to the Montara incident (Heyward et al. 2010; Heyward et al. 2012) and the regional shoals and shelf assessment undertaken by AIMS for the Barossa Gas Project (Heyward et al. 2017b). Other studies which have contributed to the scientific understanding of these features include the INPEX Ichthys surveys, those within the surrounds of the Barossa Gas Project area and the Crux Project baseline studies.

The benthic habitats and associated fauna assemblages of these shoals and banks are highly diverse compared to the surrounding relatively deep and bare seabed which constitutes most of the outer continental shelf. These isolated 'islands' of biodiversity may act as important sources of larvae of important taxa such as fish and corals, which may be advected considerable distances. This supply of larvae may enhance recovery of banks, shoals and reefs following disturbances such as cyclones, fishing, and coral bleaching events, and hence may play a role in regional ecosystem resilience (Wahab et al. 2018).

The shoals/banks support many of the same species found on emergent reef systems of the Indo-West Pacific region such as Ashmore Reef, Cartier Island, Seringapatam Reef and Scott Reef (Heyward et al. 2017b). This indicates a high level of ecological connectivity among the reef systems and between the shoals/banks. This is further supported by an analysis undertaken by AIMS which compared benthic habitat community data from a number of shoals/banks within the Timor Sea and Bonaparte Gulf region. The analysis showed that neighbouring shoals and banks frequently share many attributes in terms of benthic community composition and species (Heyward et al. 2017a).

Corals, such as those supported on shoals/banks, are recognised as a key element of reef ecosystems as they provide the structural framework for reef growth (i.e. they are a habitat-forming species), as well as providing important habitat and food source for a vast range of marine organisms, including species of conservation significance (Depczynski et al. 2017). Corals are recognised as providing high ecological value to the marine environment. For example, extensive coral loss can result in declines in habitat and topographical complexity (Sheppard et al. 2002; Graham et al. 2007), which are critical for sustaining high diversity of reef fishes and other reef-associated organisms (Wilson et al. 2006; Pratchett et al. 2009) (cited in Pratchett et al. 2011). Environmental monitoring following the Montara oil spill has indicated some components of the biological communities of the banks and shoals in the Timor Sea are dynamic, with changes in habitats (e.g. seagrass distribution) and fish assemblages over time.

There is evidence of fishing pressure (particularly illegal fishing such as shark finning) on the banks and shoals in the Timor Sea, with Heyward et al. (2017b) suggesting that this may explain the low abundance of highly prized finfish and sharks. Fishing at banks and shoals may include both subsistence and commercial fishing. While the benthic communities on each shoal/bank reveal a degree of connectivity, the abundance and diversity of dominant benthic species may vary, with subsets of species featuring more prominently on some than others (Heyward et al. 2017b). This variability may reflect different disturbance events (e.g. cyclones, storm damage and coral bleaching) and recruitment histories, as well as potentially different ecosystem trajectories (Heyward et al. 2017b).

Sections 7.7.3.1 and 7.7.3.6 describe the shoals and banks within 120 km of the Crux Platform.

Table 7-7: Shoals and Banks within the Planning Area

Feature	Water Depth Range (~m)	Approx. Distance/Direction from the Activity Area	Approx. Distance/Direction from the Crux Platform
Goeree Shoal	20–170	8 km NNW	13 km NW
Eugene McDermott Shoal	20–150	8 km ESE	18 km SE
Vulcan Shoal	20–180	17 km NNW	22 km NW
Heywood Shoals	20–60	20 km ESE	67 km SW
Echuca Shoals	10–30	52 km ESE	117 km SW
Barracouta Shoals	15–50	57 km NNW	63 km NW
Johnson Bank	9–30	120 km NW	143 km WNW
Woodbine Bank	12–30	98 km NW	116 km WNW
Gale Bank	21–50	161 km ENE	181 km ENE
Vee Shoal	30–220	140 km NNW	145 km NNW
Fantome Shoal	8–20	147 km NNW	154 km NNW
Pee Shoal	7–50	130 km NNE	139 km NNE
Jabiru Shoals	12–200	130 km NNE	140 km NNE
Mangola Shoal	11–30	150 km NE	161 km NE
Barton Shoal	13–50	189 km NE	201 km NE
Dillon Shoal	14–30	237 km NE	250 km NE
Karmt Shoal	19–20	266 km NE	278 km NE
Big Bank Shoals	20–300	283 km NE	295 km NE
Echo Shoals	21–100	306 km NE	321 km NE

7.7.3.1 Goeree Shoal

The bathymetric features of Goeree Shoal are consistent with the patterns observed at other shoals and banks in the region, although Goeree Shoal is smaller than Vulcan and Eugene McDermott shoals. Goeree Shoal rises abruptly from the surrounding seabed, with steep sides of the shoal rising from ~170 m to <40 m. The top of the shoal forms a plateau ranging from ~20 to 40 m deep. The western part of the plateau is relatively shallow and is characterised by hard coral communities.

Like other regional banks and shoals, Goeree Shoal is understood to have formed through in-situ biogenic production of sediments, particularly calcareous green algae in the genus *Halimeda* spp (Heyward et al. 1997). Sediments within and around Goeree Shoal are characterised by sand and gravel fractions (Fugro 2017a). The relatively coarse characteristics of the sediments may be the result of the relatively young geological age of locally produced biogenic sediments (e.g. hard coral rubble or calcareous *Halimeda* spp. fragments) and potential exposure to relatively fast surface currents that may re-suspend fine sediments. Data presented in

Heyward et al. (2017a) indicates sediments at Goeree Shoal are generally coarser than at Vulcan or Eugene McDermott shoals.

Benthic habitats at Goeree Shoal are broadly similar to other regional shoals in a similar depth range. Habitats in <30 m of water are characterised by consolidated reef (and associated turfing algae), sand, hard coral, algae and unconsolidated reef (Heyward et al. 2017b). The relative abundances of these habitats change with increasing depth, with algae and hard corals decreasing in relative abundance in waters around Goeree Shoal between 30 and 60 m depth (Heyward et al. 2012, Heyward et al. 2017b). This is likely to be the result of photosynthetically active radiation decreasing as water depth increases, limiting the depth range of photosynthetic organisms such as algae, seagrass and zooxanthellate corals.

The relatively complex benthic habitats of Goeree Shoal support a diverse fish assemblage compared to the surrounding deeper seabed habitat surrounding the shoal. The greatest fish abundance and diversity is associated with the hard coral habitat found on the western part of the shoal (Heyward et al. 2012). The fish assemblage within this part of the shoal was characterised by species of grouper (Serranidae), damselfish (Pomacentridae) and wrasses (Labridae) (Heyward et al. 2012). The deeper parts of the shoal classified as sparse mixed biota, where hard coral cover is low, were characterised by wrasses (Labridae), houndsharks (Triakidae) and dartfish (Ptereleotrinae) (Heyward et al. 2012).

Analysis of repeated sampling using baited remote underwater video stations at several banks and shoals in the Timor Sea indicated that the cumulative species curves typically do not reach an asymptote. This indicates that these assemblages are likely to be more diverse than has been observed to date (Heyward et al. 2012, 2017).

7.7.3.2 Eugene McDermott Shoal

Eugene McDermott Shoal rises abruptly from the seabed to ~20 m water depth in the shallowest part of the shoal. The plateaued surface of the shoal is somewhat more domed in shape than some other regional shoals; the gradient from the shallowest part of the shoal to ~100 m water depth is less steep than similar shoals in the region. The sides of the shoal become steeper beyond ~100 m water depth, with a similar gradient from this depth to the surrounding continental shelf (<150 m). A high cover of hard coral habitat characterises the relatively shallow domed part of the shoal. The growth of hard coral on this part of the shoal over the Holocene period may account for the geological origin of this relatively shallow feature.

Eugene McDermott Shoal appears to have formed similarly to other regional shoals and banks by in-situ generation of biogenic sediment.

Sampling results indicate that Eugene McDermott Shoal has a higher portion of fine sediments than other regional shoals (Heyward et al. 2017a). This may be a consequence of the greater average depth of Eugene McDermott Shoal, which results in lower current velocities on the shoal plateau, with consequently reduced resuspension and transport of fine sediments.

Benthic habitats on the plateau of Eugene McDermott Shoal are characterised by mixed biota and hard corals interspersed with other habitat types, similar to other regional shoals (Heyward et al. 2012). Habitats in <30 m of water are characterised by consolidated reef (and associated turfing algae), hard coral, sand and algae (Heyward et al. 2017a). The abundance of hard coral habitat at Eugene McDermott Shoal decreases with increasing water depth (Heyward et al. 2017a).

7.7.3.3 Vulcan Shoal

Vulcan Shoal rises steeply from the surrounding continental shelf, from around 180 m water depth to the plateau of the shoal at ~20-40 m water depth. The shoal plateau is relatively large compared to other regional shoals. Shallower regions around the margin of the plateau host hard coral communities.

The geological origin of Vulcan Shoal appears consistent with other regional shoals by in-situ biogenic sediment production from *Halimeda* spp. and hard corals the likely sediment sources. Sediments from Vulcan Shoal are predominantly (>80% by mass) sand-sized or smaller (i.e. <2 mm). The grain size distribution is consistent with shoals of similar depth in the region (Heyward et al. 2017a).

Benthic habitats on the plateau of Vulcan Shoal are characterised by mixed biota covering the central part of the shoal, with hard coral habitat concentrated around the margin of the shoal. Habitats in <30 m were characterised by sand, algae and unconsolidated reef. Between 30 and 60 m the relative portion of sand increased, while photosynthetic taxa (algae and zooxanthellate corals) decreased. Of interest, seagrass

meadows were observed at Vulcan Shoal in 2010 but had significantly declined by 2011 and had not recovered by 2016 (Heyward et al. 2017a).

While larger in size, the composition of benthic habitats at Vulcan Shoal was similar to other nearby shoals. The fish assemblage associated with the relatively shallow areas with high coral cover include angelfish (Chaetodontidae), butterfly fish (Pomacanthidae) and snapper (Lutjanidae). Shallower areas with less reef cover supported species that were less likely to be site-attached and included trevally (Carangidae), wrasses (Labridae) and scad (Carangidae). Deeper areas with low reef cover supported wrasses (Labridae), houndsharks (Triakidae) and dartfish (Ptereleotrinae) (Heyward et al. 2012).

7.7.3.4 Heywood Shoals

Heywood Shoals are located ~67 km south-west of the Crux platform. A detailed survey of the Heywood Shoal fish communities and benthic habitats conducted by the AIMS focussed on the ~31 km^2 of reef plateau, an extended, stepped, gradually sloping platform at depths of 20–60 m (Loya et al. 2019; Heyward et al. 2017a). The study found that the epibenthic organisms appeared normal and healthy, with only limited temporal variability in the nature of seabed and fish biodiversity over the five-year study period. AIMS found the benthic community at the deeper shoal margins to be characterised by mushroom coral species in the family *Fungiidae*, with hard coral cover highest on the deeper secondary plateau in contrast to shallow platforms characterised by encrusting growth forms (*Montipora* and *Porites*) and branching/bottlebrush Acropora. (Heyward et al. 2013, 2017a).

Hydrocarbon seeps have been observed at Heywood Shoals on the northern Yampi Shelf, and fish collected in the vicinity of the Cornea Seep exhibit significant liver detoxification activity, suggesting recent hydrocarbon exposure (PTTEP Australasia 2013).

7.7.3.5 Echuca Shoals

Echuca Shoals are ~117 km south-west of the Crux platform. The shoals are inhabited by diverse and abundant assemblage of reef-associated fishes, sharks, rays and sea snakes, with community structure, species richness and fish abundance mainly driven by depth and hard coral coverage (Heyward et al. 2017a; Moore et al. 2015). The oval shaped reef plateau covers ~11 km^2, with all surveyed epibenthic organisms appearing normal and healthy (Heyward et al. 2017a). With an average depth of 26.1 m, the substrate of Echuca Shoals is 66% rubble, almost half bare (45% bare epibenthic cover) and dominated by hard coral, encrusting organisms and filter-feeders with 14.2%, 13.3% and 10.4% epibenthic cover respectively (Moore et al. 2017). The same study found Echuca Shoals to have a mean species richness twice that of similar mesophotic (20–80 m deep) coral-reef shoals on the Great Barrier Reef.

7.7.3.6 Barracouta Shoals

The egg-shaped Barracouta Shoals cover an area of ~5.8 km^2 ~63 km north-west of the Crux platform. AIMS' benthic habitat and fish assemblage surveys (2010, 2011, 2013 and 2016) found fish community richness and abundance relatively stable across time at Barracouta East Shoal and a shift in species composition at 30 m depth. Although marked declines in soft coral were noted over the duration of the study, species richness was consistently higher across all years, particularly at shallow depths, when compared to Goeree and Vulcan shoals (Heywood et al. 2013, 2017a).

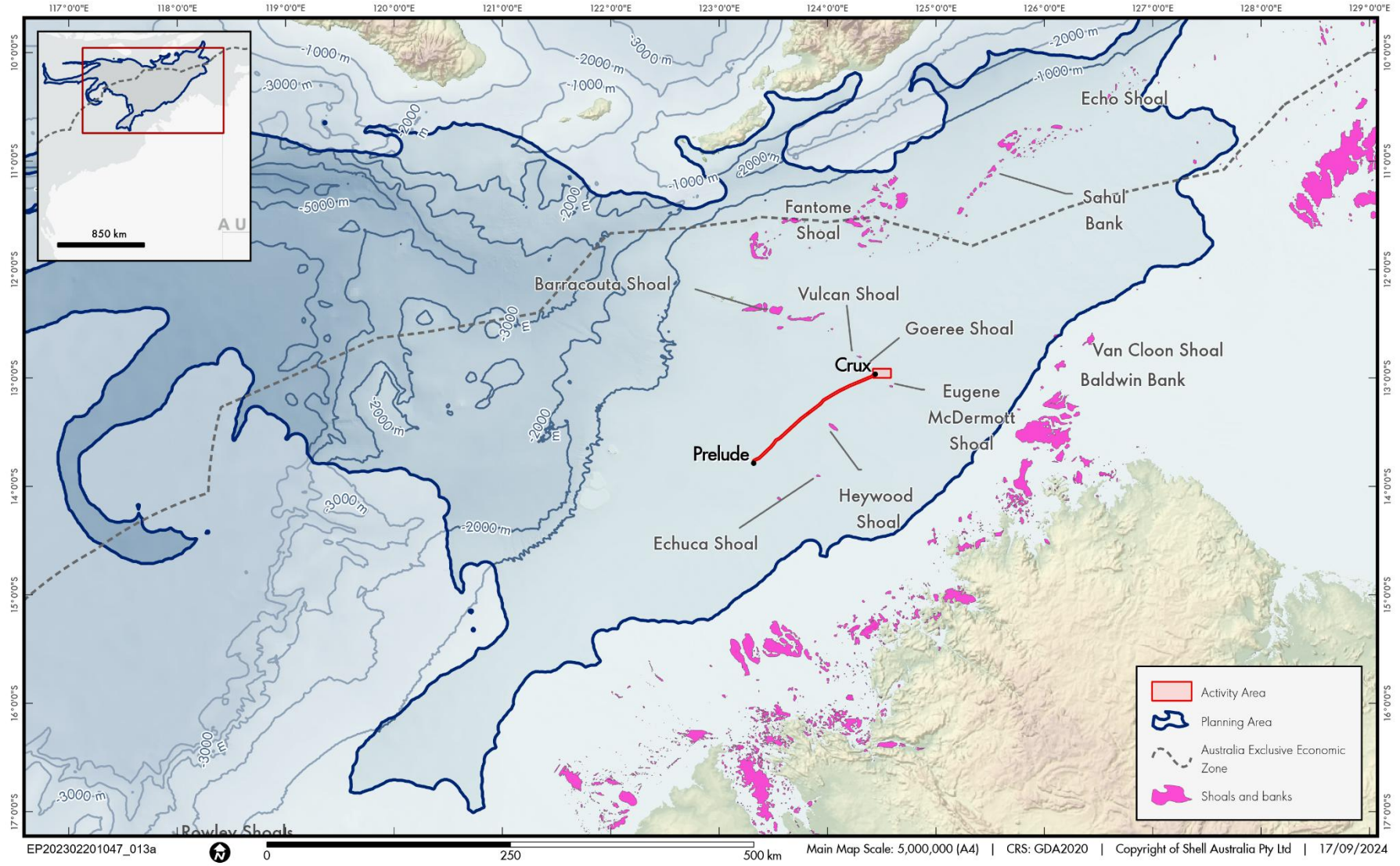


Figure 7-7: Shoals and Banks that are Proximal to or Overlap the Planning Area

7.7.4 Offshore Reefs and Islands

Table 7-8 lists and Figure 7-8 illustrates the offshore reefs and islands within the Planning Area, that have recognised environmental value. Sections 7.7.4.1 and 7.7.4.6 summarise the ecosystem values of the key offshore reefs and islands within the Planning Area.

Table 7-8: Offshore Reefs and Islands within the Planning Area

Feature	Approx. Distance/Direction from the Activity Area	Approx. Distance/Direction from the Crux Platform
Ashmore Reef	130 km NW	155 km NW
Cartier Island	83 km NNW	105 km NW
Hibernia Reef	152 km NNW	160 km NW
Browse Island	42 km SSE	162 km SW
Seringapatam Reef	135 km W	276 km WSW
Scott Reef	147 km WSW	300 SW

7.7.4.1 Ashmore Reef

Ashmore Reef is protected by the Ashmore Reef Marine Park (Section 7.3.1.2). Ashmore Reef is also a designated Ramsar wetland of international significance (Section 7.3.1.3) and Commonwealth heritage place (Section 7.3.1.4).

Ashmore Reef is a large platform reef complex containing an atoll-like structure with two lagoons, large areas of drying flats that become exposed at low tide, shifting sand banks and three vegetated sandy cays: West Island (281,000 km^2), East Island (134,200 km^2), and Middle Island (129,800 km^2) (ConocoPhillips 2018). The surrounding reef consists of a well-developed reef crest and a broad reef flat that can be up to 3 km across. Water depths in the lagoons vary from extremely shallow waters around the sand banks to up to 45 m deep. The three islands within the lagoon are mostly flat, composed of coarse sand with a few areas of exposed beach rock and limestone outcrops (ConocoPhillips 2018; Shell 2009).

7.7.4.2 Cartier Island

Cartier Island and surrounding reefs are protected by Cartier Island Marine Park (Section 7.3.1.2). Cartier Island is an unvegetated sand cay surrounded by a wide platform, that rises steeply from the seabed, and fringing coral reef flats (ConocoPhillips 2018). The coarse sandy beaches of the island support large populations of nesting green turtles.

7.7.4.3 Hibernia Reef

Hibernia Reef is ~40 km north-east of Ashmore Reef and ~60 km north-west of Cartier Island. The reef is less extensive than that at Ashmore Reef and Cartier Island and is roughly oval in shape, tapering to a point on the western side (ConocoPhillips 2018; Shell 2009). The reef complex contains a deep central lagoon and drying sand flats. There is no permanent land at Hibernia Reef, however, large areas of the reef are exposed at low tide.

7.7.4.4 Browse Island

Browse Island and surrounding waters within 3 nm are WA State Territorial Waters. Browse Island is a sand and limestone cay situated on a limestone and coral reef, covering an area of 0.13 km^2 (Shell 2009). The reef is a flat–topped, oval–shaped platform reef with a diameter of 2.2 km at its widest point (INPEX 2010). The reef complex rises from a depth of ~200 m. The intertidal habitats around the island include (INPEX 2010):

- sandy beaches or coarse coral sand, which is a known turtle nesting site for green turtles.
- beach rock, which supports invertebrate fauna.
- a lagoon with sand and coral rubble substrates and live corals such as *Acropora* spp. and *Porites* spp.
- a reef platform containing areas of sand and coral rubble, limestone supporting sparse algal turf and many barren shallow pools, which is exposed at low tide.

- the reef crest, which supports a diverse range of molluscs and hard corals of the Faviidae family (such as *Goniastrea* spp.).
- a wave swept seaward ramp which supports some algae and coral.

The shallow subtidal zone (<20 m deep) of Browse Island ranges from 50 to 200 m wide and is comprised mainly of bare limestone, with the most diverse coral communities (including *Hydnophora rigida*, *Acropora* and to a lesser extent *Porites*) recorded in raised coral reefs in shallower areas around the island (INPEX 2010). The benthic habitats were noted as characteristic of coral platform reefs throughout the Indo-West Pacific region and limited in their extent in the subtidal region.

7.7.4.5 Seringapatam Reef

Seringapatam Reef is a remote atoll covering an area of ~55 km^2 and encloses a lagoon of relatively consistent depth of ~20 m (maximum depth of 30 m) (ConocoPhillips 2018). The lagoon is connected to the ocean by a narrow passage in the northeast part of the reef.

Seringapatam Reef is recognised as a KEF (Section 7.7.6). The reef is a regionally important scleractinian coral reef as it has a high biodiversity. Results from the 2006 WA Museum (WAM) survey noted 159 species of scleractinian corals with a hard coral cover of ~16% (WAM 2009). The dominant benthic habitats of the reef have been observed to include turf algae, macroalgae, hard and soft corals, algae and filter-feeders (e.g. sponges, gorgonians, hydroid, seapens) (ConocoPhillips 2018).

7.7.4.6 Scott Reef

Scott Reef is a large oceanic atoll platform that rises vertically from the seafloor in water depths between ~400 m and 700 m and comprises two lagoonal areas (North and South Scott Reef). North Scott Reef is ~17 km long and 16 km wide (Gilmour et al. 2013, Woodside 2014). South Scott Reef is ~17 km long and ~20 km wide. Water depths within Scott Reef vary between 0 m and 80 m, with areas of the reef flat being exposed at low tide. Sandy Islet, a small sandy cay, is the sole permanently emergent land and is ~700 m long and 60 m wide (Woodside 2012). Sandy Islet is a significant nesting site for green turtles, predominantly during the summer months (Gilmour et al. 2013), and it is a foraging and breeding area for a number of seabird species (Woodside 2012).

Scott Reef is recognised as a KEF (Section 7.7.6) and marine park (Section 7.3.1.2). Coral communities at Scott Reef occur across shallow (<30 m) and deep (>30 m) habitats, with 306 species from 60 genera and 14 families having been identified (Gilmour et al. 2009). Coral communities varied from shallow to deep water with 295 species recorded in shallow water environments and 51 species in deep water. Eleven species were only found in deep water environments. None of the corals recorded were endemic to Scott Reef (Gilmour et al. 2009). Biodiversity at Scott Reef is similar to other regional offshore emergent reefs (e.g. Seringapatam Reef and Ashmore Reef), with the biological assemblages being a sub-set of Indo-Pacific reefs.

7.7.5 Coastal Reefs and Islands

Troughton Island is the only coastal reef or island that overlaps the Planning Area. Troughton Island is a flat island rising 6 m above sea level and less than 1 km^2 in area. The island is known to support flatback nesting and seabird breeding (Conservation Commission of WA 2010) and is maintained and used as an emergency airstrip.

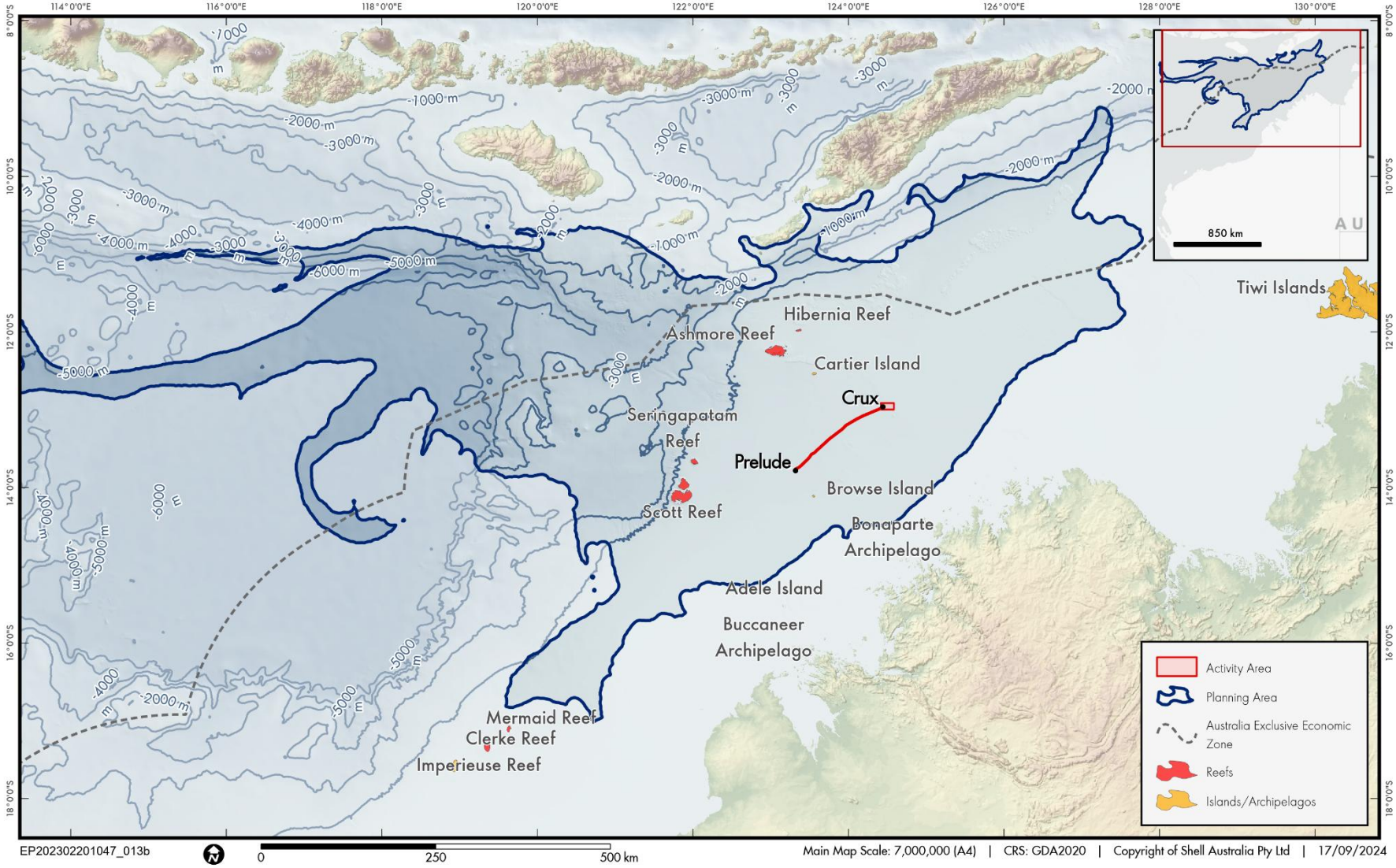


Figure 7-8: Offshore and Coastal Reefs and Islands that are Proximal to or Overlap the Planning Area

7.7.6 KEFs

KEFs are elements of the Commonwealth marine environment that are considered to be of regional importance for either the marine region's biodiversity or its ecosystem function and integrity. Although KEFs are not listed as MNES and have no legal status in their own right, they are one of the values and sensitivities of the Commonwealth marine environment, which is protected as MNES.

The Activity Area intersects one KEF - Continental slope demersal fish communities (see Figure 7-9). This KEF is partially overlapped by 7 km of the export pipeline corridor, with the corridor covering ~14 km^2 of the KEF, representing <0.05% of the total KEF area.

Table 7-9 summarises and Figure 7-9 illustrates the key values of KEFs within the Activity Area and Planning Area. Note: the values described apply to the entire KEF and are not limited to the Planning Area.

Table 7-9: KEFs within the Planning Area, including distance from Activity Area

KEF	Summary of Key Values	Distance from the Activity Area (~km)	Distance from the Crux Platform (~km)
Ancient coastline at 125 m depth contour	*Unique seafloor feature with ecological properties of regional significance* The areas of hard substrate along this ancient coastline, which follows the 125 m depth contour, are thought to provide biologically important habitats in areas otherwise dominated by soft sediments; thereby providing for higher species diversity and richness relative to the wider region. The topographic complexity of these escarpments may also facilitate vertical mixing of the water column providing a relatively nutrient-rich environment for species present on the escarpment. The KEF encompasses an area of ~16,190 km^2.	12.5	30
Ashmore Reef and Cartier Island and surrounding Commonwealth waters	*High productivity and aggregations of marine life* Ashmore Reef is the largest of only three emergent oceanic reefs present within the north-eastern Indian Ocean and is the only oceanic reef in the region with vegetated islands. The emergent reefs are known to provide areas of enhanced primary productivity in otherwise oligotrophic environments. Ashmore Reef and Cartier Islands and the surrounding Commonwealth waters are regionally important for feeding and breeding aggregations of seabirds and shorebirds, and other marine life. Ashmore Reef regularly supports more than 40,000 waterbirds (those ecologically dependant on wetlands) and is estimated to support as many as 100,000 seabirds in a 12-month period (Hale 2013). The marine habitats supported by the reefs are nationally and internationally significant, providing habitat for diverse and abundant marine reptile (including feeding, nesting and internesting areas for green, hawksbill and loggerhead turtles) and marine mammal populations, including dugongs. Species at Ashmore and Cartier include more than 225 reef-building corals, 433 molluscs, 286 crustaceans, 192 echinoderms, and 709 species of fish. Thirteen species of sea snakes occur in high numbers at Ashmore and Cartier reefs but are in decline. Additionally, Ashmore Reef supports the highest number of coral species of any reef off the WA coast and plays a primary role in the maintenance of the biodiversity of reef systems in the region.	95	99
Canyons linking the Argo Abyssal Plain with the Scott Plateau	*High productivity and aggregations of marine life* Canyons linking the Argo Abyssal Plain with Scott Plateau covers an area of ~836 km^2. The Bowers and Oats canyons are major canyons on the slope between the Argo Abyssal Plain and Scott	384	525

KEF	Summary of Key Values	Distance from the Activity Area (~km)	Distance from the Crux Platform (~km)
	Plateau and deeply cut into the Scott Plateau at depths of ~2,000 m – 3,000 m. The ocean area above the canyons is thought to be an area of moderately enhanced productivity, attracting aggregations of fish, sharks, toothed whales and dolphins.		
Carbonate bank and terrace system of the Sahul Shelf	*Unique seafloor feature with ecological properties of regional significance* While little is known about this KEF, the carbonate banks and terrace system of the Sahul Shelf is considered regionally important because of their role in enhancing biodiversity and local productivity relative to their surrounds, largely due to the presence of elevated hard substrates. The seabed features are thought to create enhanced productivity and biodiversity as a result of upwellings of cold nutrient-rich water at the heads of the channels. The KEF covers an area of ~41,158 km^2. The banks rise to depths ranging from 150 m to 300 m and are separated from each other by narrow meandering channels which are up to 150 m deep. The hard substrates of the banks are thought to support a high diversity of organisms including reef-fish, sponges, soft and hard corals, gorgonians, bryozoans, ascidians and other sessile filter-feeders.	46	60
Continental slope demersal fish communities	*Communities with high species biodiversity and endemism* There is a high diversity of demersal fish assemblages on the Australian continental slope from the North West Cape to the edge of the North Marine Region. Specifically, the continental slope between North West Cape and the Montebello Trough has more than 500 fish species, 76 of which are endemic, which makes it the most diverse slope bioregion in the whole of Australia (DEWHA 2008; DCCEEW 2022). The Timor Province and Northwest Transition bioregions, in which the Crux project is located, are the second-richest areas for demersal fish across the entire continental slope. Brewer et al. (2007) suggested that the demersal-slope communities rely on bacteria and detritus-based systems comprised of infauna and epifauna as the basis of the food web. No relevant pressures of concern have been identified for this KEF for the activities in the scope of this EP (DCCEEW 2022). The KEF covers a vast area of ~33,182 km^2.	Intersects	73
Pinnacles of the Bonaparte Basin	*Unique seafloor feature with ecological properties of regional significance* The limestone pinnacles in the western Bonaparte Depression are expected to support a diverse community in an otherwise oligotrophic system. More than 110 pinnacles occur in the Bonaparte Depression, covering a total area of more than 520 km^2. The pinnacles are thought to be the eroded remnants of underlying strata and can be up to 50 m high and 50 km–100 km long.	292	308
Seringapatam Reef and Commonwealth waters in the Scott Reef Complex	*High productivity and aggregations of marine life* The coral communities at Seringapatam and Scott Reefs play a key role in maintaining species richness and aggregations of marine life. The reefs and the waters surrounding them attract aggregations of marine life including humpback whales on their northerly migration, Bryde's whales, pygmy blue whales, Antarctic	130	264

KEF	Summary of Key Values	Distance from the Activity Area (~km)	Distance from the Crux Platform (~km)
	minke whales, dwarf minke whales, minke whales, dwarf sperm whales, spinner dolphins and whale sharks. Green and hawksbill turtles nest during the summer months on Sandy Islet on South Scott Reef. These species also internest and forage in the surrounding waters. Scott Reef is a particularly biologically diverse system and includes more than 300 species of reef-building corals, ~400 mollusc species, 118 crustacean species, 117 echinoderm species, around 720 fish species and several species of sea snakes.		

Source: DSEWPaC 2012; DCCEEW 2023ba-bf

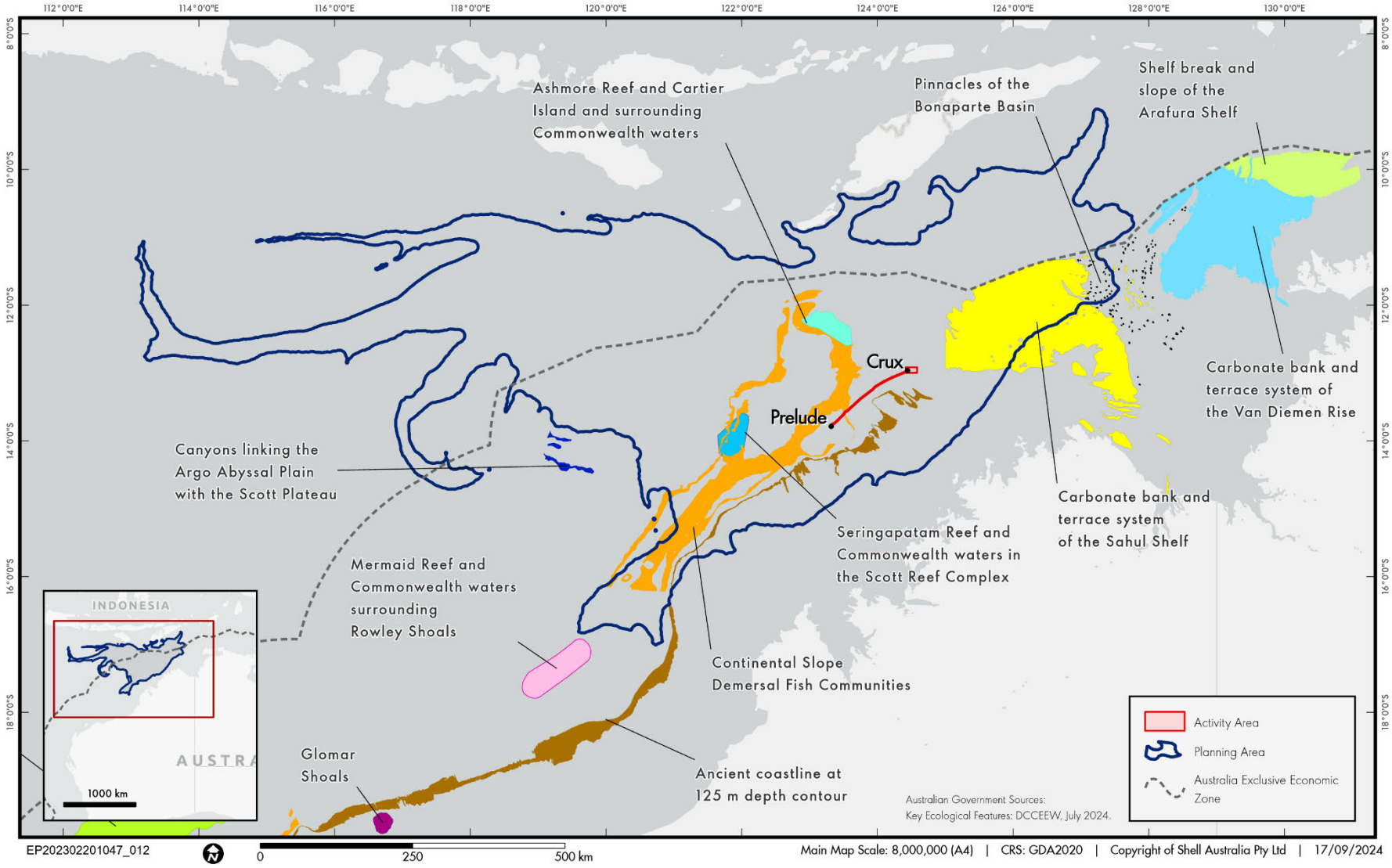


Figure 7-9: Locations of KEFs within the Area

7.7.7 Threatened, Migratory, Marine and Cetacean Species

Table 7-10 lists the natural values and sensitivity (EPBC Act listed threatened and migratory species or species habitat) within the Planning Area and subcategories listed in the protected matters reports (Appendix F). Appendix F also provides a full list of EPBC Act listed marine and cetacean species. Most EPBC Act listed species within the Activity Area are expected to be transitory only; one species—the whale shark—is identified as having important behaviours (e.g. foraging) within the Activity Area (see Figure 7-20).

Table 7-10: EPBC Act Listed Threatened and Migratory Species that May Occur within the Activity Area and Planning Area

Common Name	Species Name	EPBC Act Listing Status		EPBC Act Management Publications	Presence Type	
		Threatened	Migratory		Activity Area	Planning Area
Marine mammals						
Blue whale	*Balaenoptera musculus*	Endangered	✓	✓	Species or species habitat likely to occur within area	Migration route known to occur within area
Bryde's whale	*Balaenoptera edeni*	×	✓	×	Species or species habitat likely to occur within area	Species or species habitat likely to occur within area
Fin whale	*Balaenoptera physalus*	Vulnerable	✓	✓	Species or species habitat likely to occur within area	Foraging, feeding or related behaviour likely to occur within area
Humpback whale	*Megaptera novaeangliae*	×	✓	×	Species or species habitat known to occur within area	Breeding known to occur within area
Sei whale	*Balaenoptera borealis*	Vulnerable	✓	✓	Species or species habitat likely to occur within area	Foraging, feeding or related behaviour likely to occur within area
Sperm whale	*Physeter macrocephalus*	×	✓	×	Species or species habitat may occur within area	Species or species habitat may occur within area
Killer whale, orca	*Orcinus orca*	×	✓	×	Species or species habitat may occur within area	Species or species habitat may occur within area
Spotted bottlenose dolphin (Arafura/Timor Sea populations)	*Tursiops aduncus (Arafura/Timor Sea populations)*	×	✓	×	Species or species habitat may occur within area	Species or species habitat likely to occur within area
Dugong	*Dugong dugon*	×	✓	×	Anecdotally mentioned that species may transit within the area.	Breeding known to occur within area
Australian snubfin dolphin	*Orcaella heinsohni*	×	✓	×	×	Species or species habitat may occur within area
Australian humpback dolphin	*Sousa sahulensis*	×	✓	×	×	Species or species habitat may occur within area

Common Name	Species Name	EPBC Act Listing Status		EPBC Act Management Publications	Presence Type	
		Threatened	Migratory		Activity Area	Planning Area
Marine Reptiles						
Flatback turtle	*Natator depressus*	Vulnerable	✓	✓	Species or species habitat known to occur within area	Foraging, feeding or related behaviour known to occur within area
Green turtle	*Chelonia mydas*	Vulnerable	✓	✓	Foraging, feeding or related behaviour known to occur within area	Foraging, feeding or related behaviour known to occur within area
Hawksbill turtle	*Eretmochelys imbricata*	Vulnerable	✓	✓	Species or species habitat known to occur within area	Foraging, feeding or related behaviour known to occur within area
Leatherback turtle	*Dermochelys coriacea*	Endangered	✓	✓	Foraging, feeding or related behaviour likely to occur within area	Foraging, feeding or related behaviour likely to occur within area
Loggerhead turtle	*Caretta caretta*	Endangered	✓	✓	Foraging, feeding or related behaviour likely to occur within area	Foraging, feeding or related behaviour known to occur within area
Olive ridley turtle	*Lepidochelys olivacea*	Endangered	✓	✓	Foraging, feeding or related behaviour likely to occur within area	Foraging, feeding or related behaviour known to occur within area
Salt-water crocodile	*Crocodylus porosus*	×	✓	×	×	Species or species habitat likely to occur within area
Dusky sea snake	*Aipysurus fuscus*	Endangered	×	✓	Species or species habitat known to occur within area[10]	Species or species habitat known to occur within area
Short-nosed sea snake	*Aipysurus apraefrontalis*	Critically Endangered	×	✓	Species or species habitat likely to occur within area	Species or species habitat known to occur within area

[10] While the EPBC PMST search results identified that this species or species habitat is known to occur within the Activity Area, spatial mapping data within the PMST indicated the nearest area where the species or species habitat may occur was ~4.3 km outside of the Activity Area. The Activity Area does not overlap with any Dusky Sea snake habitat included within the PMST database.

Common Name	Species Name	EPBC Act Listing Status		EPBC Act Management Publications	Presence Type	
		Threatened	Migratory		Activity Area	Planning Area
Leaf-scaled sea snake	*Aipysurus foliosquama*	Critically Endangered	×	✓	Species or species habitat may occur within area	Species or species habitat may occur within area
Sharks, Rays and Other Fish						
Giant manta ray	*Mobula birostris*	×	✓	×	Species or species habitat likely to occur within area	Species or species habitat likely to occur within area
Reef manta ray, coastal manta ray	*Mobula alfredi*	×	✓	×	Species or species habitat likely to occur within area	Species or species habitat known to occur within area
Dwarf sawfish, Queensland sawfish	*Pristis clavata*	Vulnerable	✓	✓	×	Species or species habitat known to occur within area
Freshwater sawfish, largetooth sawfish, river sawfish, Leichhardt's sawfish, northern sawfish	*Pristis pristis*	Vulnerable	✓	✓	Species or species habitat may occur within area	Species or species habitat may occur within area
Green sawfish, Dindagubba, narrowsnout sawfish	*Pristis zijsron*	Vulnerable	✓	✓	Species or species habitat known to occur within area	Species or species habitat known to occur within area
Narrow sawfish, knifetooth sawfish	*Anoxypristis cuspidata*	×	✓	✓	Species or species habitat may occur within area	Species or species habitat may occur within area
Longfin mako	*Isurus paucus*	×	✓	×	Species or species habitat likely to occur within area	Species or species habitat likely to occur within area
Oceanic whitetip shark	*Carcharhinus longimanus*	×	✓	×	Species or species habitat may occur within area	Species or species habitat may occur within area
Northern river shark, New Guinea river shark	*Glyphis garricki*	Endangered	×	✓	Species or species habitat may occur within area	Species or species habitat may occur within area
Scalloped hammerhead	*Sphyrna lewini*	Conservation Dependent	×	✓	Species or species habitat likely to occur within area	Species or species habitat known to occur within area
Shortfin mako, mako shark	*Isurus oxyrinchus*	×	✓	×	Species or species habitat likely to occur within area	Species or species habitat likely to occur within area
Grey nurse shark	*Carcharias taurus*	×	✓	✓	Species or species habitat may occur within area	Species or species habitat may occur within area

Common Name	Species Name	EPBC Act Listing Status		EPBC Act Management Publications	Presence Type	
		Threatened	Migratory		Activity Area	Planning Area
White shark, great white shark	*Carcharodon carcharias*	Vulnerable	✓	✓	Species or species habitat may occur within area	Species or species habitat may occur within area
Whale shark	*Rhincodon typus*	Vulnerable	✓	✓	Foraging, feeding or related behaviour known to occur within area	Foraging, feeding or related behaviour known to occur within area
Birds						
Abbott's booby	*Papasula abbotti*	Endangered	×	✓	Species or species habitat may occur within area	Species or species habitat may occur within area
Asian dowitcher	*Limnodromus semipalmatus*	Vulnerable	✓	✓	×	Species or species habitat known to occur within area
Australian lesser noddy	*Anous tenuirostris melanops*	Vulnerable	×	×	Foraging, feeding or related behaviour likely to occur within area	Breeding known to occur within area
Australian painted snipe	*Rostratula australis*	Endangered	×	✓	×	Species or species habitat may occur within area
Barn swallow	*Hirundo rustica*	×	✓	×	×	Species or species habitat known to occur within area
Bar-tailed godwit	*Limosa lapponica*	×	✓	✓	×	Species or species habitat known to occur within area
Bar-tailed godwit (northern Siberian)	*Limosa lapponica menzbieri*	Endangered	×	✓	×	Species or species habitat known to occur within area
Bridled tern	*Onychoprion anaethetus*	×	✓	✓	×	Breeding known to occur within area
Brown booby	*Sula leucogaster*	×	✓	✓	×	Breeding known to occur within area
Caspian tern	*Hydroprogne caspia*	×	✓	✓	×	Breeding known to occur within area

Common Name	Species Name	EPBC Act Listing Status		EPBC Act Management Publications	Presence Type	
		Threatened	Migratory		Activity Area	Planning Area
Christmas Island white-tailed tropicbird, golden bosunbird	*Phaethon lepturus fulvus*	Endangered	×	✓	Species or species habitat may occur within area	Foraging, feeding or related behaviour likely to occur within area
Common noddy	*Anous stolidus*	×	✓	✓	Species or species habitat likely to occur within area	Breeding known to occur within area
Common sandpiper	*Actitis hypoleucos*	×	✓	✓	Species or species habitat may occur within area	Species or species habitat known to occur within area
Curlew sandpiper	*Calidris ferruginea*	Critically Endangered	✓	✓	Species or species habitat may occur within area	Species or species habitat known to occur within area
Eastern curlew, far eastern curlew	*Numenius madagascariensis*	Critically Endangered	✓	✓	Species or species habitat may occur within area	Species or species habitat known to occur within area
Great frigatebird, greater frigatebird	*Fregata minor*	×	✓	✓	Species or species habitat likely to occur within area	Breeding known to occur within area
Greater crested tern	*Thalasseus bergii*	×	✓	×	×	Breeding known to occur within area
Greater sand plover, large sand plover	*Charadrius leschenaultii*	Vulnerable	✓	✓	×	Species or species habitat known to occur within area
Grey wagtail	*Motacilla cinerea*	×	✓	×	×	Species or species habitat known to occur within area
Lesser frigatebird, least frigatebird	*Fregata ariel*	×	✓	✓	Species or species habitat likely to occur within area	Breeding known to occur within area
Little tern	*Sternula albifrons*	×	✓	✓	×	Congregation or aggregation known to occur within area
Masked booby	*Sula dactylatra*	×	✓	✓	×	Breeding known to occur within area
Oriental cuckoo, Horsfield's cuckoo	*Cuculus optatus*	×	✓	×	×	Species or species habitat known to occur within area

Common Name	Species Name	EPBC Act Listing Status		EPBC Act Management Publications	Presence Type	
		Threatened	Migratory		Activity Area	Planning Area
Oriental reed-warbler	*Acrocephalus orientalis*	×	✓	×	×	Species or species habitat known to occur within area
Pectoral sandpiper	*Calidris melanotos*	×	✓	✓	Species or species habitat may occur within area	Species or species habitat may occur within area
Red knot, knot	*Calidris canutus*	Vulnerable	✓	✓	Species or species habitat may occur within area	Species or species habitat known to occur within area
Red-footed booby	*Sula sula*	×	✓	✓	Breeding known to occur within area	Breeding known to occur within area
Red-rumped swallow	*Cecropis daurica*	×	✓	×	×	Species or species habitat may occur within area
Red-tailed tropicbird	*Phaethon rubricauda westralis*	Endangered	✓	✓	Species or species habitat likely to occur within area	Breeding known to occur within area
Roseate tern	*Sterna dougallii*	×	✓	✓	×	Breeding known to occur within area
Sharp-tailed sandpiper	*Calidris acuminata*	Vulnerable	✓	✓	Species or species habitat may occur within area	Species or species habitat known to occur within area
Streaked shearwater	*Calonectris leucomelas*	×	✓	✓	Species or species habitat known to occur within area	Species or species habitat known to occur within area
Wedge-tailed shearwater	*Ardenna pacifica*	×	✓	✓	×	Breeding known to occur within area
White-tailed tropicbird	*Phaethon lepturus*	×	✓	✓	Species or species habitat likely to occur within area	Breeding known to occur within area
Yellow wagtail	*Motacilla flava*	×	✓	×	×	Species or species habitat known to occur within area

7.7.7.1 Marine Mammals

Marine mammals are typically widely distributed and highly mobile animals. In general, distribution patterns reflect seasonal feeding areas, characterised by high productivity, and migration routes associated with reproductive patterns.

Table 7-10 lists the EPBC Act listed threatened and migratory marine mammals that may occur within the Activity and Planning Areas. No additional species were identified within the Light or Noise Assessment Areas compared to the Activity Area. However, the inclusion of the dugong within the Activity Area and Noise Assessment Area has been incorporated based on anecdotal sightings within or in close proximity to the Activity Area (per comms Craig McPherson [JASCO] 2023).

The Activity Area (including the Light and Noise Assessment Areas) does not intersect any marine mammal BIAs. The marine mammal BIAs that may occur within the Planning Area are listed in Table 7-11 and shown in Figure 7-11 to Figure 7-13. Sections 7.7.7.1.1 to 7.7.7.1.3 describe the marine mammal values and sensitivities of the EPBC Act listed threatened and migratory species.

Table 7-11: BIAs of Marine Mammals within the Planning Area

BIA Behaviour	General Location(s)	Distance from Activity Area (~km)	Distance from the Crux Platform (~km)
Pygmy Blue Whale			
Foraging	Perth Canyon and adjacent waters, less defined and lower density along Ningaloo reef and around Scott Reef.	132	267
Migration	Deep offshore waters (500 m to 1,000 m) along the continental shelf edge off the WA coastline, extending offshore near Scott Reef and into Indonesian waters. Appear close to coast in the Exmouth-Montebello Islands area on southern migration.	77	121
Dugong			
Breeding	Ashmore Reef (far west)	150	180
Calving	Ashmore Reef (far west)	150	180
Foraging	Ashmore Reef (far west)	150	180
Foraging (high density seagrass beds)	Ashmore Reef (south on the sea reef side only not including the interior)	135	162
Nursing	Ashmore Reef (far west)	150	180

7.7.7.1.1 Whales

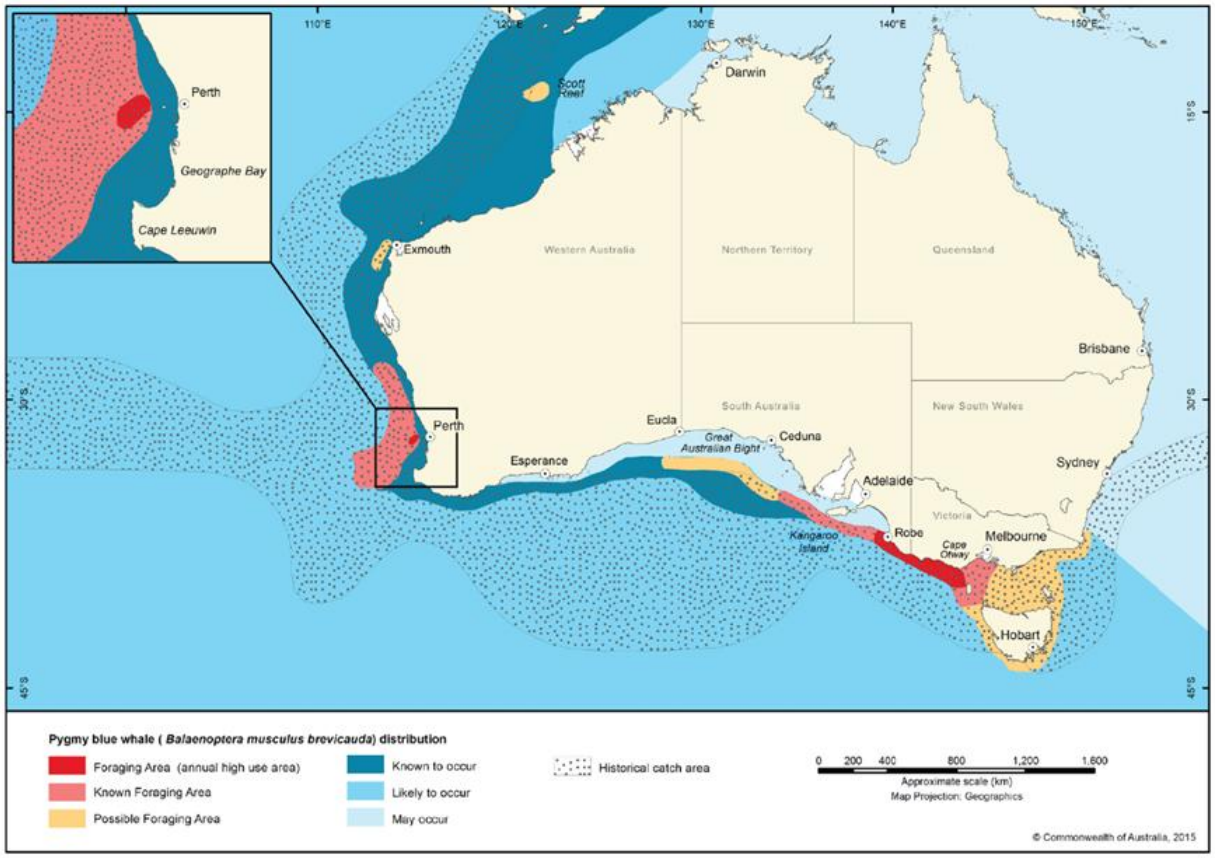
Pygmy Blue Whale

The blue whale (*Balaenoptera musculus*; endangered, migratory) has four distinct sub-species, of which two are found in the southern hemisphere; the pygmy blue whale (*B. m. brevicauda*; Indo-Australian and Tasman-Pacific populations) and the Antarctic blue whale (*B. m. intermedia*; CoA 2015a).

The pygmy blue whale is known to migrate along the WA coastline between the 500 m and 1,000 m depth contours from Geographe Bay to the NW Cape and in the deep offshore waters off northern WA (Figure 7-10; CoA 2015a). The pygmy blue whale tagging studies by Thums et al. (2022) and Ferreira et al. (2024) found that pygmy blue whales demonstrate extensive use of slope habitat off the WA coastline and limited use of WA shelf waters. These studies indicate that pygmy blue whales are predominantly present in water depths >250 m. The Planning Area overlaps part of this recognised biologically important migration corridor (Figure 7-11; IUCN-MMPATF 2023a; DCCEEW 2023u). The northerly migration toward the calving grounds near the equator occurs in March/April to June (Thums et al. 2021; CoA 2015a). Noise monitoring for the Barossa Gas Project, which is located in the Timor Sea ~713 km north-east of the Crux platform, detected the

presence of blue whales in the months of May to August during their north-bound seasonal migration (McPherson et al. 2016). The southerly migration to the feeding grounds in the high-latitudes of the southern hemisphere occurs in September/October to December (CoA 2015a). Pygmy blue whales appear to travel as individuals or in small groups when making their migrations, based on acoustic data from noise loggers deployed around Scott Reef for the Woodside Browse Project (Woodside 2014). During their migratory period along the coast of WA, the pygmy blue whales travel predominantly fast, with directed travel interspersed with relatively short periods of low move persistence in three main areas—Perth Canyon, Cape Range Canyon and Cloates Canyon. The low move persistence could indicate foraging, resting or breeding behaviours (Thums et al. 2022), supporting the 'possible' foraging areas identified in the Blue Whale Recovery Plan (CoA 2015a).

A known biologically important foraging area has been mapped at Seringapatam Reef, Scott Reef and the open waters to the west of these features, as shown in Figure 7-11. Canyons and/or steep gradient reef-features at these locations tend to stimulate upwelling and, in turn, seasonally variable increased productivity which may provide a favourable foraging area (ConocoPhillips 2018). Recent research suggested that the locations and/or relative importance of foraging areas may be dynamic and varying according to prey abundance (Thum et al. 2022).



Foraging Area (Annual high use area)	Blue whales are regularly observed feeding on a seasonal basis
Known Foraging Area	Known foraging occurs in these areas but is highly variable both between and within seasons
Possible Foraging Area	Evidence for feeding is based on limited direct observations or through indirect evidence, such as occurrence of krill in close proximity of whales, or satellite tagged whales showing circling tracks. Blue whales travel through on a seasonal basis, possibly as part of their migratory route

Known to occur	Blue whales are known to occur based on direct observations, satellite tagged whales or based on acoustic detections
Likely to occur	Blue whales are likely to occur based on occasional observations in the area and nearby areas
May occur	Evidence for the presence of blue whales through strandings or rare observations
Historical catch area	Blue whales were caught during the whaling period based on whaling data

Figure 7-10: Pygmy Blue Whale Distribution around Australia (CoA 2015a)

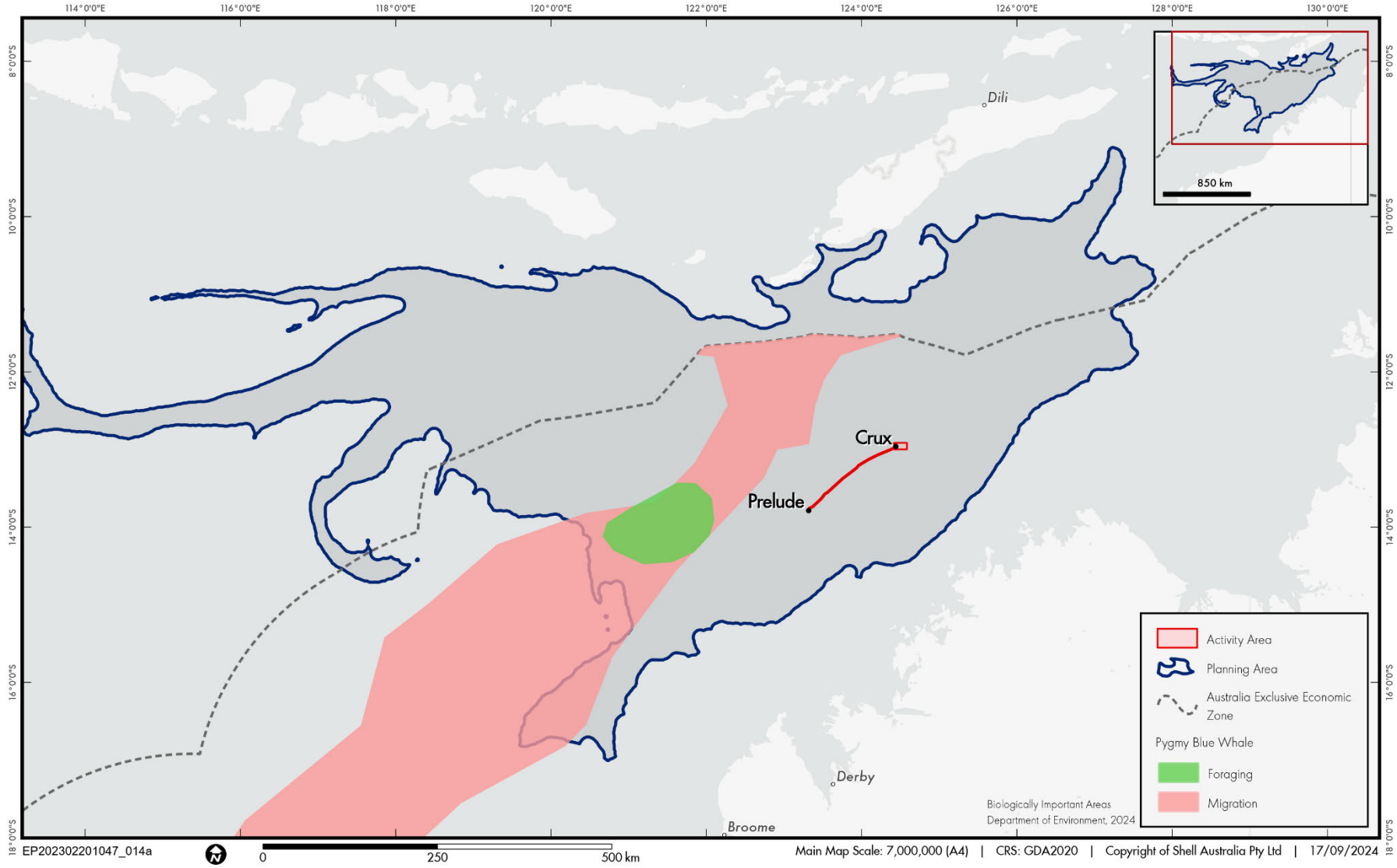


Figure 7-11: BIAs for Pygmy Blue Whales within the Planning Area

Humpback Whale

There are no known BIAs for the humpback whale within the Planning Area. The humpback whale (*Megaptera novaeangliae*; migratory) has a wide distribution, shown in Figure 7-12, with recordings throughout Australian Antarctic waters and offshore from all Australian states (Bannister et al. 1996). The species migrates between summer feeding grounds in Antarctica and winter breeding and calving grounds in the sub-tropical and tropical inshore waters of north-west Australia (Jenner et al. 2001). A BIA for humpback whale migration is recognised in nearshore waters (<100 km) along the WA coast from west of Esperance to 100 km north of Broome (DCCEEW 2023j; IUCN-MMPATF 2023b; Figure 7-12) (outside of the Planning Area). Although the exact timing of migration varies annually due to a number of factors such as water temperature (DoE 2023c), the northbound migration peaks between late July and early August, and the southbound migration peaks between late August and early September (Jenner et al. 2001). Relatively few humpback whales have been known to travel north of Camden Sound, WA (outside of the Planning Area) (Jenner et al. 2001) and noise monitoring undertaken for the Barossa Gas Project located within the North Marine Region (NMR) did not detect any humpback whale calls in the Timor Sea (McPherson et al. 2016).

Studies have generally indicated a steady recovery in the size of the humpback population that migrates along the WA coastline since the cessation of commercial whaling, and the species was removed from the EPBC Act threatened species list in 2022 (DAWE 2022).

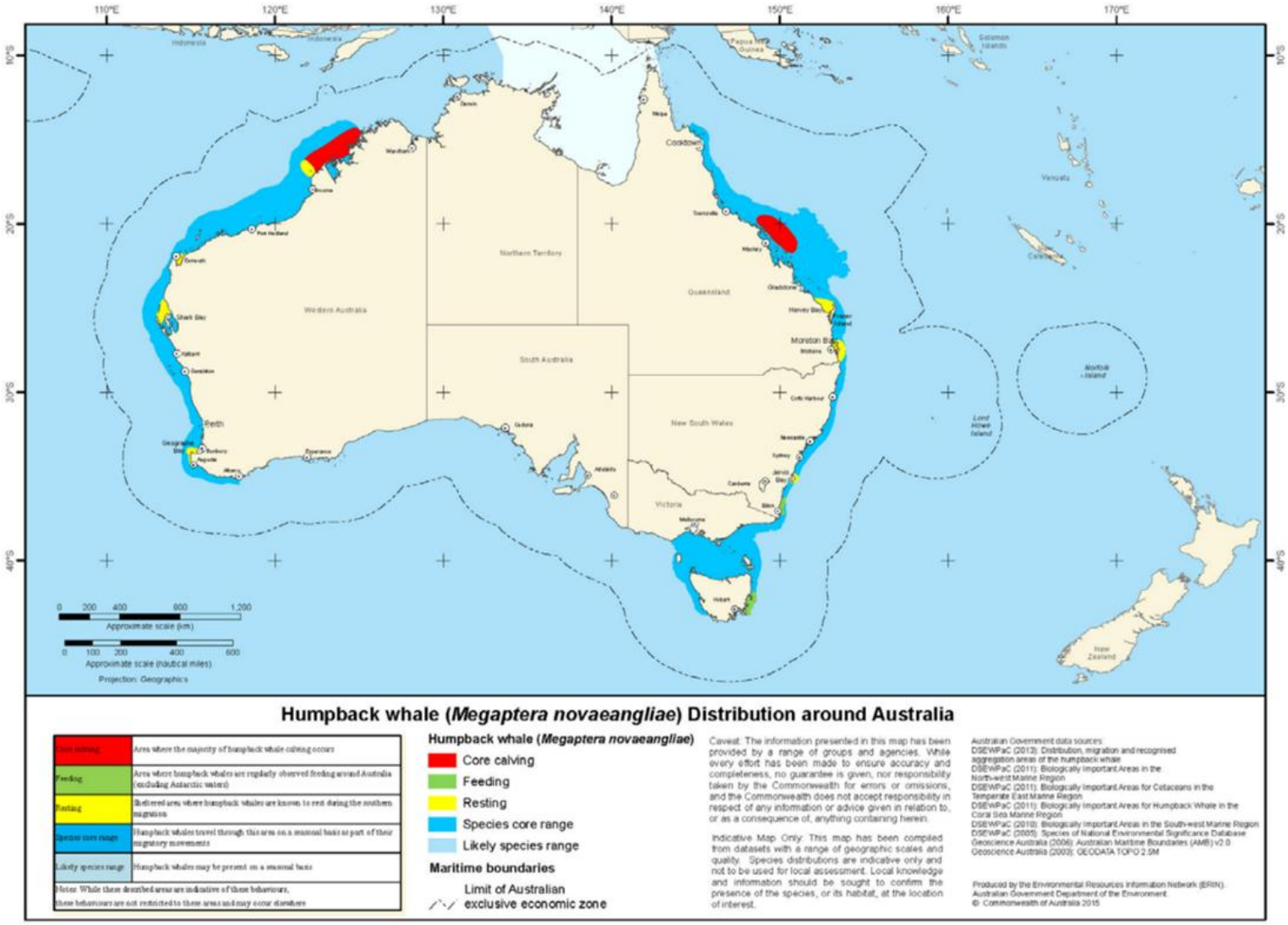


Figure 7-12: Distribution of Humpback Whales around Australia

Sei Whale

Sei whales (*Balaenoptera borealis*; vulnerable, migratory) are thought to have a wide distribution, although unclear as this species is often confused with Bryde's whales. Sightings are rare, but the species may be seen in coastal and offshore waters throughout Australia (DoE 2023d; Bannister et al. 1996). The species is able to use a diverse range of marine habitats, which has been attributed to a combination of dynamic physical and prey processes (DoE 2023d).

Sei whale migratory movements are well defined (distinctly north-south), with the species moving between polar, temperate and tropical waters for foraging and breeding. The species feeds intensively between the Antarctic and sub-tropical convergences on planktonic crustacea (DoE 2023d; Ceccarelli et al. 2011; Bannister et al. 1996). The species does not dive; instead, it sinks and tends to swim at shallower depths compared to other species (DoE 2023d). There are no known mating or calving areas in Australian waters and the species is thought to occur infrequently in the NW region (Ceccarelli et al. 2011).

Fin Whale

Fin whales (*Balaenoptera physalus*; vulnerable, migratory) are widely distributed from polar to tropical waters and have been recorded in all Australian states, other than New South Wales (NSW) and the NT (Bannister et al. 1996). Fin whales feed on planktonic crustacea, such as Antarctic krill, and primarily forage in high latitudes.

The species rarely occupies inshore waters and displays well defined migratory movements (essentially north-south) between polar, temperate and tropical waters and may migrate through the region (DoE 2023i; Ceccarelli et al. 2011; Bannister et al. 1996). Recent research by Aulich et al. (2019) found that predominately fin whales travel up the WA coast as far north as Dampier (19°S) (outside of the Planning Area).

Bryde's Whale

Bryde's whales (*Balaenoptera edeni*; migratory) distribution encompasses tropical and warm temperate waters with individuals being recorded in all Australian states (Ceccarelli et al. 2011; McPherson et al. 2016). The species typically moves between 40 °N and 40 °S, with these movements seeming to be primarily linked to prey availability (DoE 2023h). Bryde's whale are thought to be divided into offshore and onshore forms with the distinction between the two based on prey preference (DoE 2023h; Ceccarelli et al. 2011). The offshore form is found in deeper waters (500 m to 1,000 m) and is thought to migrate seasonally in favour of warmer waters in winter months. The inshore form generally inhabits waters over 200 m and displays no distinct migratory movements (DoE 2023h).

Sperm Whale

Sperm whales (*Physeter macrocephalus*; migratory) occur in deep waters in all oceans, typically remaining at depths of 300 m or greater, and are known to occur throughout Australian waters (Ceccarelli et al. 2011; Bannister et al. 1996). Migration patterns vary between sexes. Mature females and juveniles are thought to be resident in tropical and subtropical waters throughout the year, whereas mature males are thought to migrate between the tropics and Antarctic (DoE 2023i; Bannister et al. 1996; Ceccarelli et al. 2011). Sperm whales have a diverse diet, although they primarily feed on oceanic squid (Bannister et al. 1996; DoE 2023i).

Key areas for sperm whales are known to occur in WA waters between Cape Leeuwin and Esperance and along the continental shelf ~20 nm to 30 nm offshore (outside of the Planning Area) (Bannister et al. 1996).

Killer Whale

Killer whales (*Orcinus orca*; migratory) are a cosmopolitan species with a vast global distribution across a wide range of habitats. However, they appear to be primarily concentrated in coastal waters and cooler regions of high productivity as they are carnivores with a diet which varies seasonally and regionally (DoE 2023v; Bannister et al. 1996). Globally, killer whales are known to migrate; however, specific routes and seasonal movement patterns are not known in detail and are thought to relate to prey availability (Bannister et al. 1996).

Two distinct populations have been identified off the WA coast; one inhabits shallow, nearshore waters, off the Ningaloo Coast, and a second larger population occurs in temperate waters off the WA south coast (both outside the Planning Area) (Reeves et al. 2022; Totterdell et al. 2022).

7.7.7.1.2 Dugong

Dugongs (*Dugong dugon*; migratory) occur in tropical and sub-tropical coastal and island waters broadly coincident with the distribution of seagrasses, which typically occur in shallow intertidal areas to water depths

of around 25 m (DoE 2023t). Dugong feeding aggregations tend to occur in large seagrass meadows within wide shallow protected bays, shallow mangrove channels and in the lee of large inshore islands. Although the movements of most individuals are limited to within tens of kilometres of the vicinity of seagrass beds (National Oceans Office 2004), some individuals travel up to 1,000 km (Hobbs and Willshaw 2016; Whiting 2008).

Dugongs and areas of potential dugong habitat exist along the majority of the WA north from Shark Bay and NT coastline (including islands). Within the Planning Area there is a known dugong BIA located at Ashmore Reef (Figure 7-13). A small population of ~50 individuals occur at Ashmore Reef, which is considered to be genetically distinct from other nearby Australian or Indonesian populations (DoE 2014). It is possible that the range of this population extends to Cartier Island where individuals have been recorded (DoE 2014). Dugongs may also frequent other shallow shoals on the Sahul Banks; however, there has only been a single sighting of this occurrence in 1996 (Whiting and Guinea 2003).

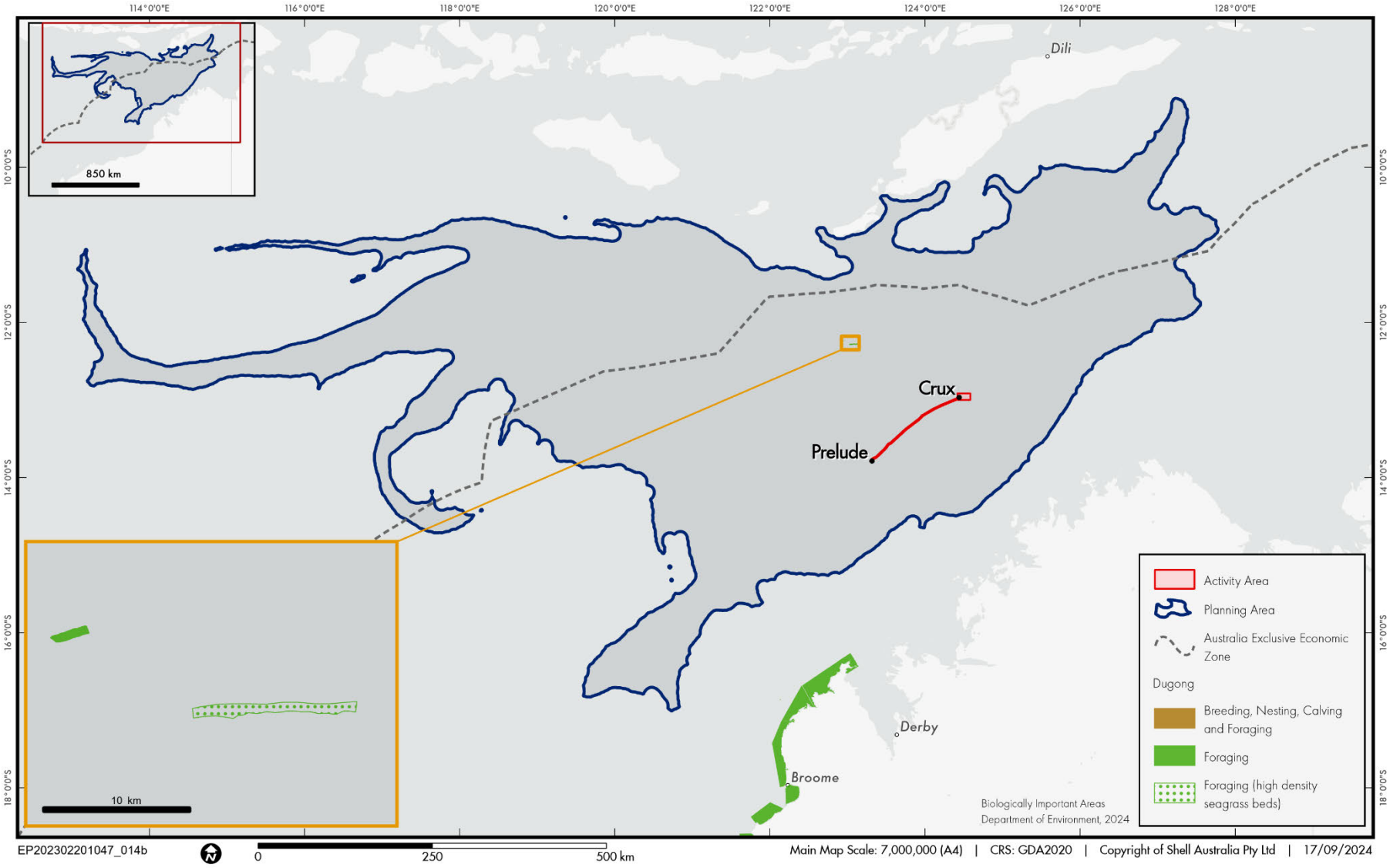


Figure 7-13: BIAs for Dugongs within the Planning Area

7.7.7.1.3 Dolphins

Spotted Bottlenose Dolphin

The spotted bottlenose dolphin (Arafura/Timor Sea populations) (*Tursiops aduncus*; migratory) occurs primarily in continental shelf waters (<200 m deep), nearshore and in areas with rocky or coral reefs, sandy or soft sediments, or seagrass beds (DSEWPaC 2012b). Small populations also occur in the inshore waters of some oceanic islands (Ceccarelli et al. 2011).

In Australia, migration patterns for the species are variable, including year-round residency in small areas, long-range movements and migration (DoE 2023f). In the NWMR, spotted bottlenose dolphins tend to aggregate near Browse Island and other island and reef complexes in offshore waters (Ceccarelli et al. 2011).

Australian Humpback Dolphin

The Australian humpback dolphin (*Sousa sahulensis*; migratory, previously/also known as the Indo-pacific humpback dolphin, *Sousa chinensis*) occur from northern Australia to Papua New Guinea (Jefferson & Rosenbaum 2014 in DoE 2023f; Beasley et al. 2016).

Although distribution, life history and habitat preferences of the Australian humpback dolphin are poorly understood (DoE 2023f; Hanf et al. 2016; Palmer et al. 2014). In Australia, humpback dolphins occur along the northern Australian coastline from Shark Bay, WA to southern Queensland (Qld) (DoE 2023f; Raudino et al. 2018; Hanf et al. 2016). In the NWMR, this species is thought to inhabit coastal waters up to the 30 m isobath (Hanf et al. 2016), but Australian humpback dolphins have been recorded up to 80 km offshore (Raudino et al. 2018).

Australian Snubfin Dolphin

The Australian snubfin dolphin (*Orcaella heinsohni*; migratory, also known as the Irrawaddy dolphin, *O. brevirostris*) is a poorly known species inhabiting shallow coastal and estuarine waters and tidal rivers typically in waters <20 m deep in the vicinity of freshwater outflows. However, this species has also been recorded up to 23 km offshore (DoE 2023g; Bouchet et al. 2021). The Australian snubfin dolphin is likely to occur in higher densities in areas of complex habitat type which provide a variety of prey types (Palmer et al. 2014; DSEWPaC 2012b). Breeding is thought to occur throughout the year for this species.

7.7.7.2 Marine Reptiles

Table 7-10 lists the threatened and migratory species or species habitat within the Planning Area and subcategories as listed from the protected matters reports (Appendix F). No additional species were identified within the Light or Noise Assessment Area compared to the Activity Area.

7.7.7.2.1 Marine Turtles

Turtles are oceanic species coming ashore only during seasonal nesting periods, which are species-dependent and vary along the north Australian coastline. While the incubation time between turtle nesting and hatchling emergence varies between species, it is generally about two months (CoA 2017b). Female turtles also exhibit an internesting phase in which they spend two–three months in shallow waters in the vicinity of the nesting beach or rookery while they produce the next clutch of eggs (Guinea 2013; CoA 2017b). The female turtles will rest on the seabed during the internesting period but are not known to feed (ConocoPhillips 2018).

There are no known marine turtle BIAs that intersect the activity, Light or Noise Assessment Areas. The marine turtle BIAs within the Planning Area and the distances to the Activity Area are listed in Table 7-12 and illustrated in Figure 7-14 to Figure 7-18. Table 7-13 lists and Figure 7-19 shows the habitat critical to the survival to marine turtles—based on geographically distinct genetic stocks—that may occur within the Planning Area.

Table 7-12: BIAs of Marine Turtles that Overlap the Planning Area

Common Name	BIA Behaviour	Distance from Activity Area (~km)	Distance from the Crux Platform (~km)
Flatback turtle	Foraging	180	200
Green turtle	Foraging	43	161
	Internesting	168	312

Common Name	BIA Behaviour	Distance from Activity Area (~km)	Distance from the Crux Platform (~km)
	Internesting buffer	83	90
	Mating	147	174
	Nesting	85	110
Hawksbill turtle	Foraging	85	106
	Internesting buffer	119	146
	Nesting	140	165
Loggerhead turtle	Foraging	180	196
Olive ridley turtle	Foraging	180	196

Table 7-13: Habitat Critical to the Survival of Marine Turtles within the Planning Area

Common Name	Genetic Stock	Nesting Location	Internesting Buffer (km)	Nesting Period	Hatching Period	Distance from Activity Area (~km)	Distance from the Crux Platform (~km)
Green turtle	Ashmore Reef	Ashmore Reef and Cartier Reef	20	All year (peak: Dec–Jan)	Sep–May	83	86
	Scott Reef – Browse Island	Scott Reef	20	Nov–Mar (peak: Jan–Feb)	Mar–Apr	138	290
		Browse Island				23	160
	North West Shelf	Mainland east of Mary Island to mainland adjacent to Murrara Island including all offshore islands	20	Nov–Mar (peak: Dec–Feb)	Jan–May (peak: Feb–Mar)	145	145
		Browse Island				23	160

Flatback Turtles

Flatback turtles are known to occur along the WA, NT, Qld coastlines, and forage widely across the Australian continental shelf and into the continental waters off Indonesia and Papua New Guinea (CoA 2017b). Flatback turtles are primarily carnivorous, feeding predominantly on soft-bodied invertebrates. Moderate to lesser density nesting in winter may occur in the North Kimberley offshore islands (Tucker et al. 2021). Flatback turtles that nest within the Pilbara region typically migrate along the continental shelf to foraging grounds as far north as Darwin at the end of the nesting season, returning to breed at varying intervals of a year or more (Thums et al. 2020; CoA 2017b). A known flatback turtle BIA for foraging intersects the Planning Area (Figure 7-14).

Green Turtles

Green turtles are predominately found off the WA, NT and Qld coastlines (CoA 2017b). The green turtle is the most common marine turtle breeding in the NWMR, with WA supporting one of the largest remaining populations worldwide (DSEWPaC 2012c). The species is primarily herbivorous and forages on algae, seagrass and mangroves, including where these habitats exist at offshore coral reef habitats across most of north-western Australia (Ferreira et al. 2021; CoA 2017b). Green turtles are also known to travel large

distances of up to 3,100 km between nesting and feeding areas (Ferreira et al. 2021; DSEWPaC 2012c). This species breeds all year around, with nesting in the Kimberley region peaking in summer. The highest density rookery was found to be the Lacepede Islands (outside of the Planning Area) for green turtles, with moderate to lesser density nesting by green turtles in the North Kimberley offshore islands (Tucker et al. 2021). Figure 7-19 shows and Table 7-13 lists the habitat critical for the survival of green turtles (nesting). Table 7-12 lists and Figure 7-15 shows the known green turtle BIAs that overlap the Planning Area.

Hawksbill Turtles

Hawksbill turtles predominately occur along the northern WA, NT and Qld coastlines, with three recognised stocks: north Qld stock located in the north Great Barrier Reef and Torres Strait; north-east Arnhem Land stock in the NT; and WA stock located on the NWS. On a global scale, WA provides one of the largest remaining hotspots for this species, and migrating hawksbill turtles traverse shallow continental-shelf waters of <200 m deep following the coastline and a migratory corridor along the Pilbara coast (Fossette et al. 2021). Hawksbill turtles are omnivorous and feed on algae, sponges, soft corals and soft- bodied invertebrates foraging in waters ranging from 1.5 m to 84 m deep (Fossette et al. 2021). Hawksbill turtles are typically associated with rocky and coral reef habitats, often returning to a small foraging area, and are expected to be found within these habitats along the WA coastline, from Shark Bay to the northern extent of the NWMR, migrating over 4,600 km from their nesting site (Crommenacker et al. 2022; Barr et al. 2021; CoA 2017b). Figure 7-16 shows and Table 7-12 lists the known BIAs for hawksbill turtles that overlap the Planning Area.

Leatherback Turtles

Leatherback turtles are known to forage and migrate throughout the open offshore waters of Australia, with foraging more common along the east coast and Bass Strait. Records of leatherback turtles nesting in Australia are sparse, and limited to Qld, NSW and NT (DoE 2023w; CoA 2017b). There have been no confirmed accounts of nesting on WA beaches (Tucker et al. 2021), although they have been recorded in coastal waters of south-western WA. Leatherback turtles are pelagic throughout their life and feed almost exclusively on jellyfish (DoE 2023w; CoA 2017b). There are no known leatherback BIAs within the Planning Area.

Loggerhead Turtles

Loggerhead turtles occur along most of the Australian coastline and throughout the NWMR (CoA 2017b). Capable of large migrations, individual loggerhead turtles from eastern Australian have been recorded foraging in the NT and further afield in Indonesia and Papua New Guinea (Perez et al. 2022). In the Kimberley region, loggerhead turtles are thought to be transient or end-of-migration foragers with no documented nesting sites in the area (Tucker et al. 2021). This species is carnivorous and mainly feeds on benthic invertebrates in a wide range of habitats from nearshore to waters 55 m deep (CoA 2017b). A known loggerhead turtle BIA for foraging intersects the Planning Area (Figure 7-17).

Olive Ridley Turtles

Olive ridley turtles are known to nest in the NT and on western Cape York (Qld), with low density nesting recorded on the Kimberley coast, in the Dampier Peninsula and along Camden Sound (outside of the Planning Area) (Tucker et al. 2021; CoA 2017b). This species is primarily carnivorous and feeds on soft-bodied invertebrates in waters between 15 m and 200 m in depth. Olive ridley turtles can migrate through oceanic waters and have been recorded travelling up to 1,130 km between their nesting and foraging grounds (Cáceres-Farias et al. 2022; CoA 2017b; Whiting et al. 2005). A known olive ridley turtle BIA for foraging intersects the Planning Area (Figure 7-17).

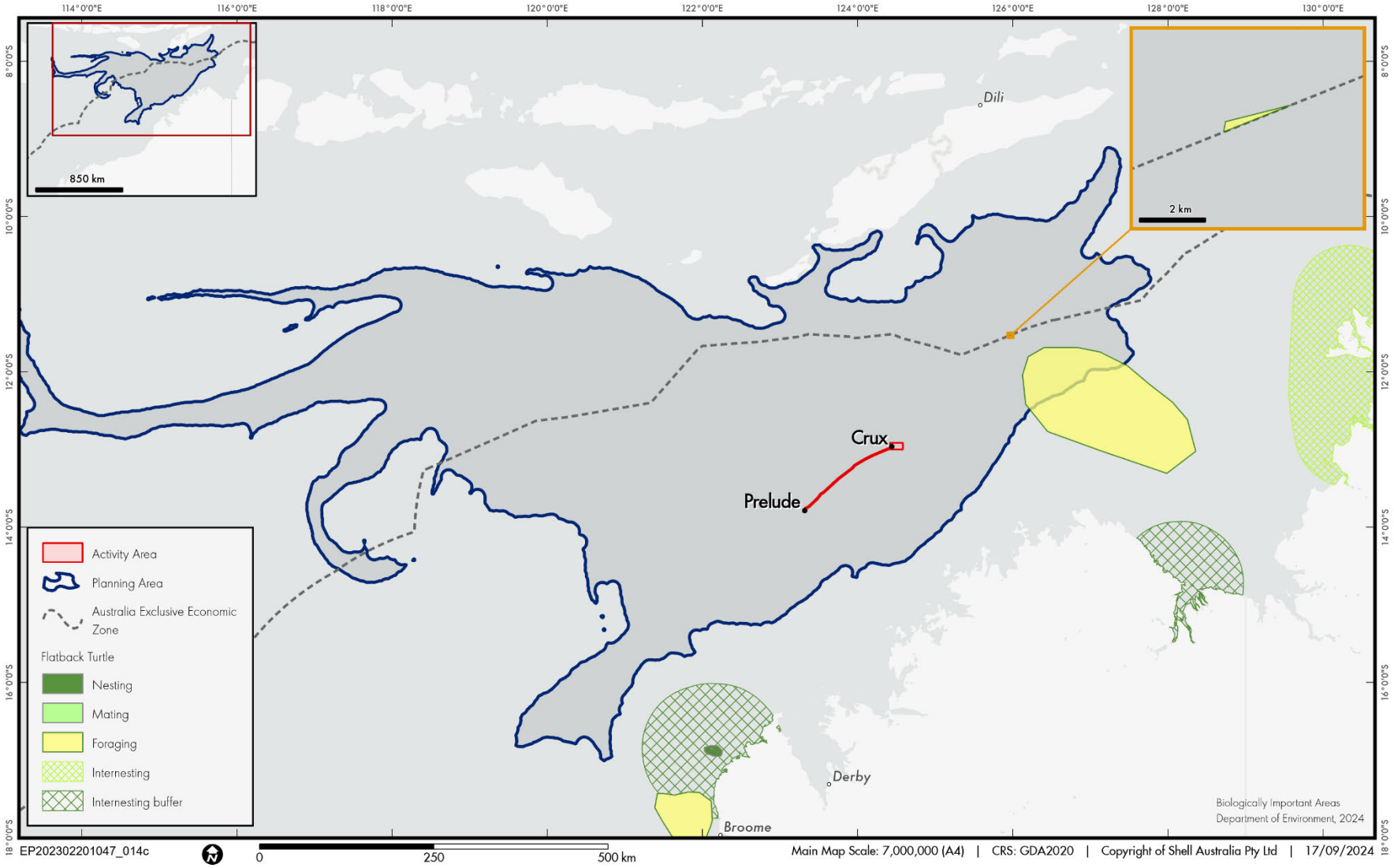


Figure 7-14: BIAs for Flatback Turtles within the Planning Area

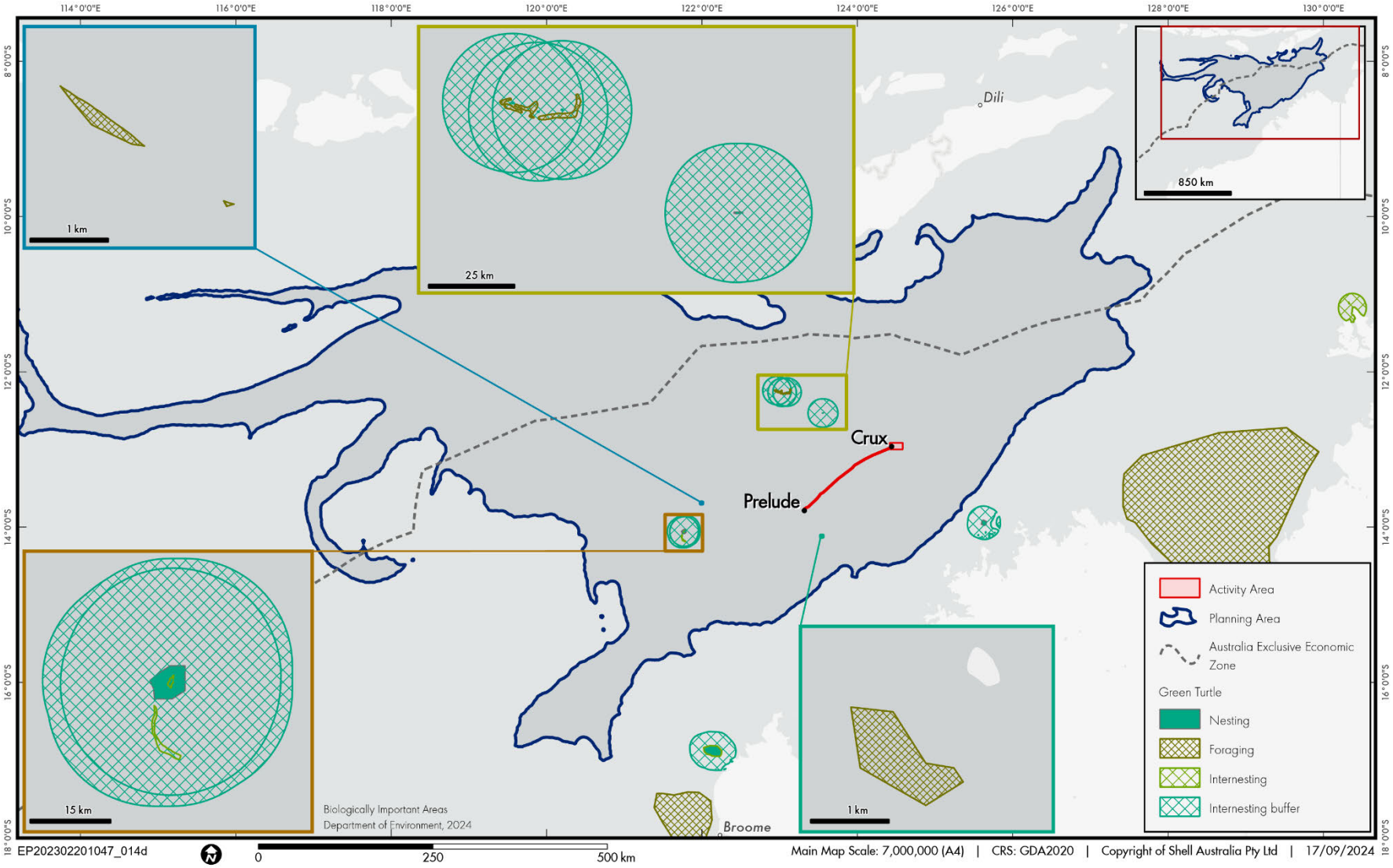


Figure 7-15: BIAs for Green Turtles within the Planning Area

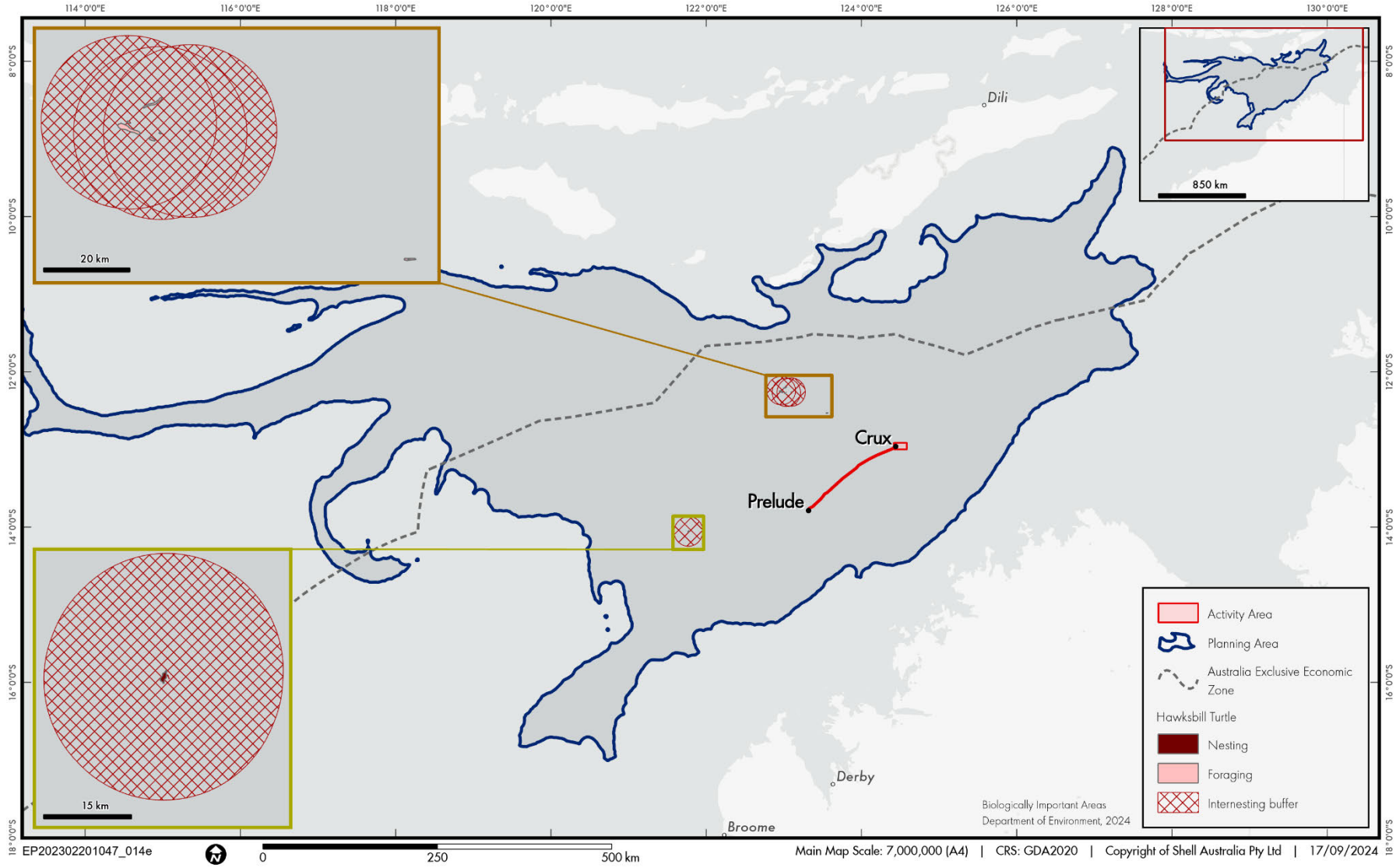


Figure 7-16: BIAs for Hawksbill Turtles within the Planning Area

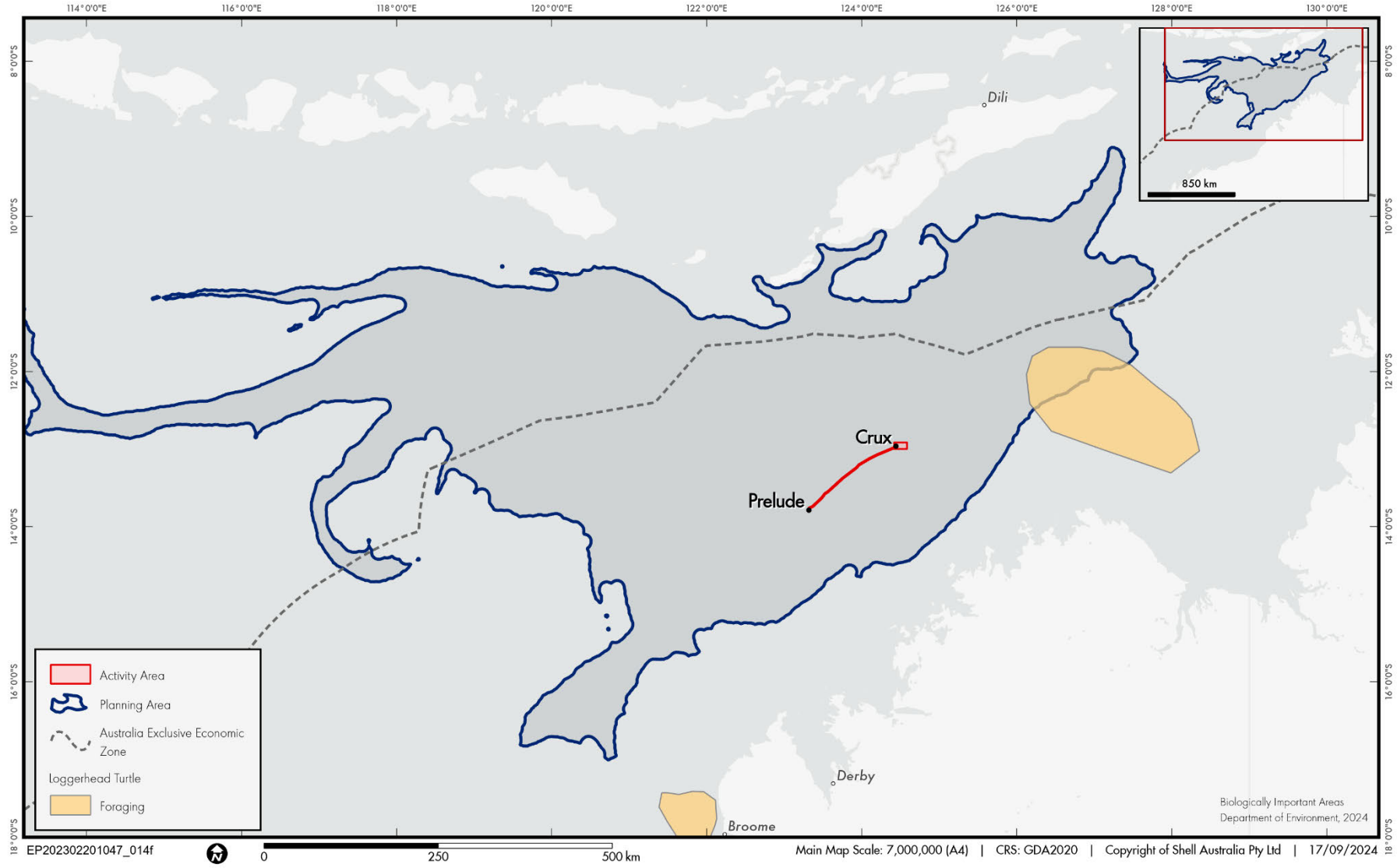


Figure 7-17: BIAs for Loggerhead Turtles within the Planning Area

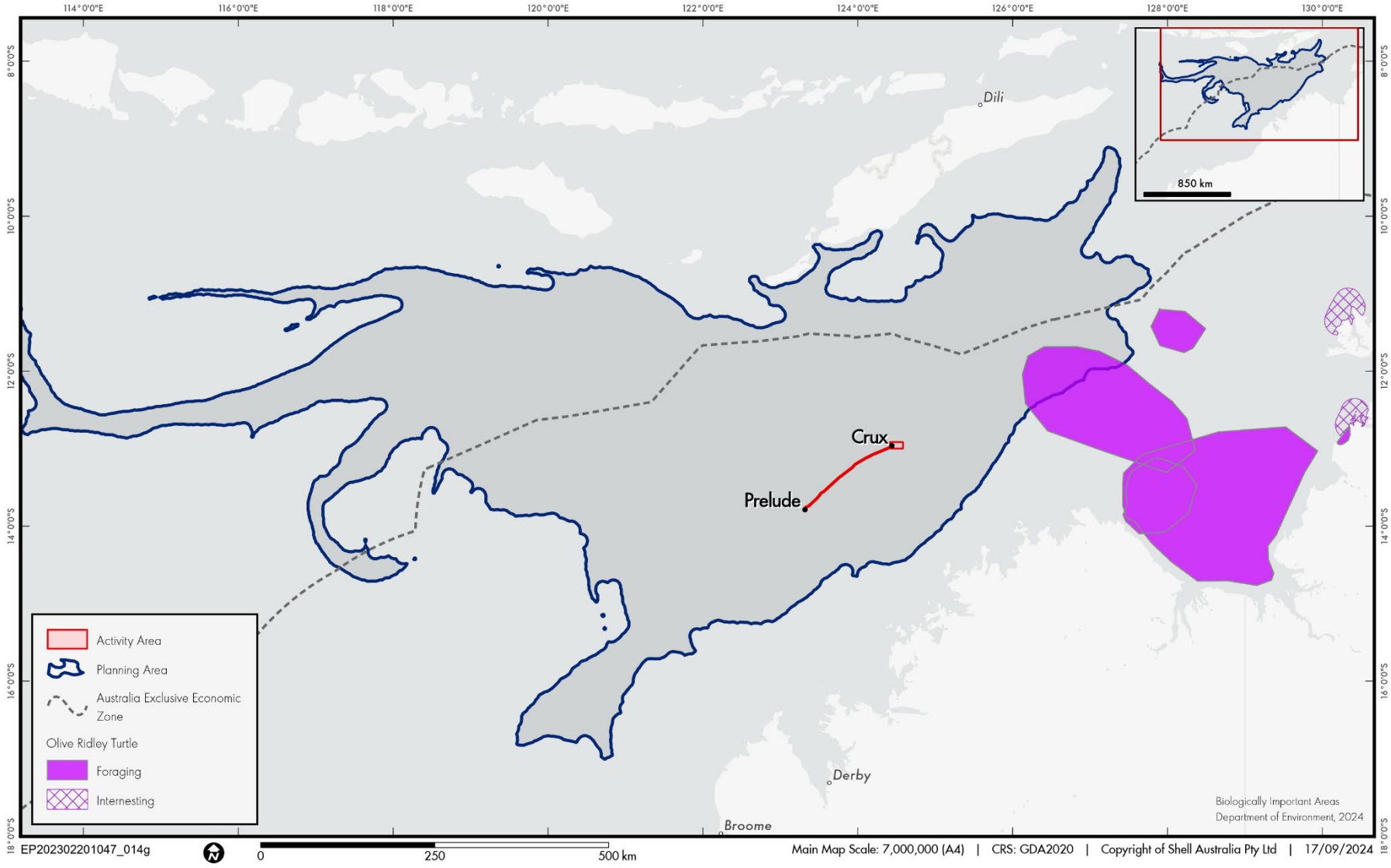


Figure 7-18: BIAs for Olive Ridley Turtles within the Planning Area

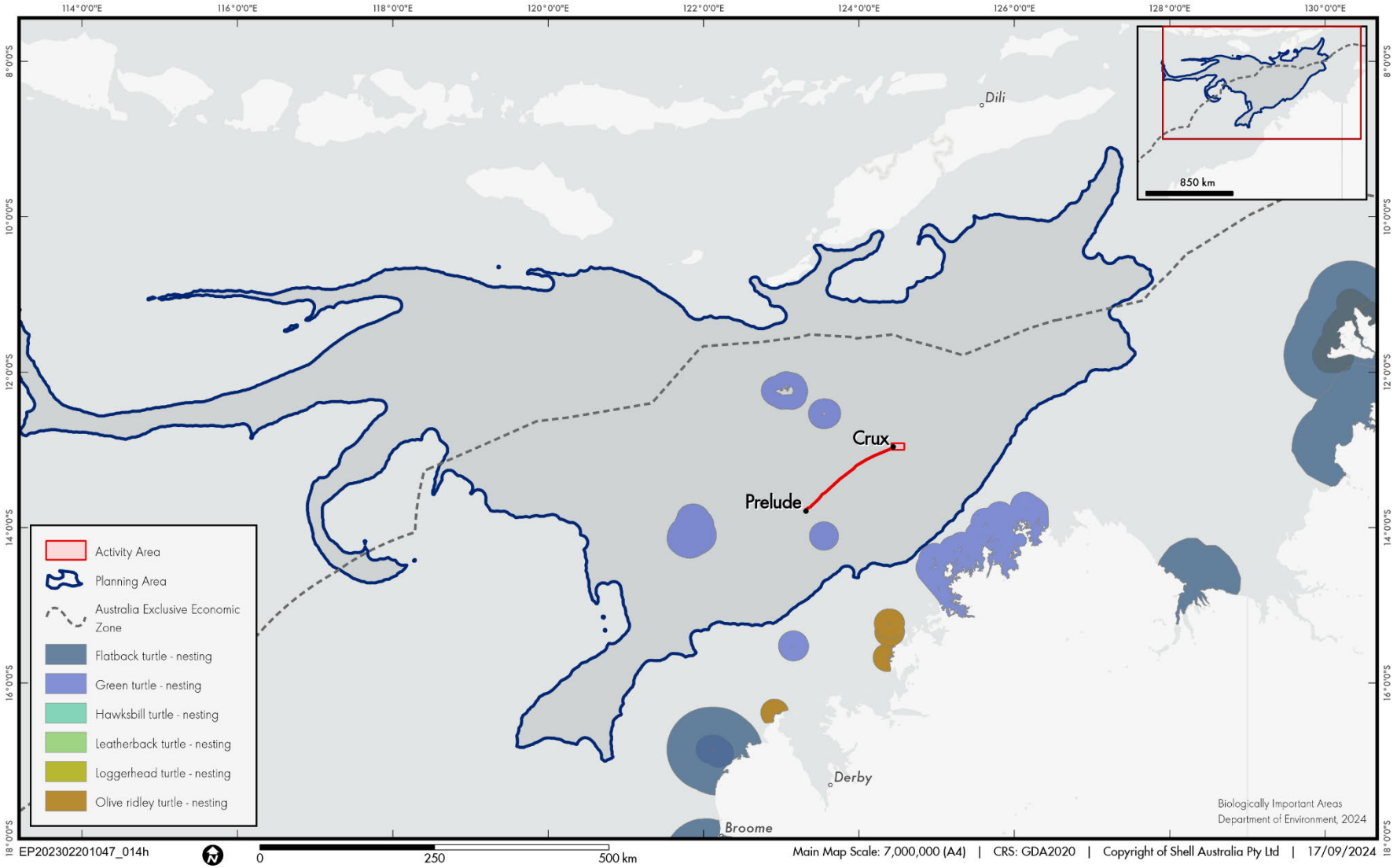


Figure 7-19: Habitat Critical for the Survival of Marine Turtles within the Planning Area

7.7.7.2.2 Sea snakes

There are three EPBC Act listed threatened sea snake species—dusky (*Aipysurus fuscus; vulnerable*), leaf-scaled (*Aipysurus foliosquama; critically endangered)* and short-nosed (*Aipysurus apraefrontalis;* critically endangered)—that are likely to occur within the Planning Area. These species are thought to be short-range endemic species and within the Planning Area are likely to be restricted to the Sahul Shelf within 0-20 m water depth (Lukoschek et al. 2013; Udyawer et al. 2020 as cited in DCCEEW 2024h). The leaf-scaled and short-nosed sea snakes have been recorded at Ashmore and Hibernia reefs, located ~155 km and 105 km north-west of the Crux platform, respectively (TSSC 2010a, 2010b). In addition to these reefs, the dusky sea snake has been recorded at the Scott Reef complex and nearby Seringapatam Reef, Heywood Shoal and Cartier Island, located ~300 km, ~276 km, ~67 km and ~105 km from the Crux platform (DCCEEW 2024h). The short-nosed and leaf-scaled sea snakes have been sighted at Ningaloo Reef, some 1,500 km south-south-west of the Planning Area (D'Anastasi 2016). A leaf-scaled sea snake was also observed in seagrass meadows in Shark Bay (D'Anastasi 2016). These species prefer reef flats or shallow waters along the outer reef edge, in water depths up to 10 m (TSSC 2010a, 2010b). While once relatively common at Ashmore and Hibernia reefs, these sea snakes have not been recorded at these locations since the late 1990s/2001, despite an increase in survey effort (TSSC 2010a, 2010b; Speed et al. 2020, as cited in DCCEEW 2024h; Somaweera et al. 2021, as cited in DCCEEW 2024h). The decline of sea snakes at Ashmore Reef is likely due to a number of factors, with a variety of explanations being investigated including disease, increased predation from reduced shark fishing, higher water temperature, and more marine vessel traffic (Lukoschek et al. 2013; Somaweera et al. 2021; Speed et al. 2022; Guinea 2022, as cited in DCCEEW 2024h).

7.7.7.2.3 Crocodiles

The salt-water crocodile (*Crocodylus porosus*; migratory) was listed under the EPBC Act to regulate commercial hunting which caused a significant decline in the population (DCCEEW 2024j). Salt-water crocodiles are found across northern Australia and occur within the nearshore marine and estuarine waters of the Kimberley coast (DCCEEW 2024j). Larger populations within the major river systems of the Kimberley occur in the rivers draining into the Cambridge Gulf, the Prince Regent and Roe River systems of the east and northwest Kimberley (all outside the Planning Area) (DCCEEW 2024j). There is limited availability of nesting habitat for this species within its distribution, with only the Ord, King and Roe River systems (outside the Planning Area) typically providing suitable nesting vegetation for the species (DCCEEW 2024j). There are no BIAs for the salt-water crocodile within the Planning Area, but given their widespread distribution, they are likely to be present within the Planning Area.

7.7.7.3 Sharks, Rays and Other Fish

The Planning Area supports a variety of fish, shark and ray species of high conservation value, as well as fisheries of commercial and recreational importance. The current state of knowledge of fishing activities within the Planning Area in a socioeconomic context is discussed further in Sections 7.8.2 and 7.9.1. Table 7-10 lists the EPBC Act listed threatened and migratory sharks, rays and other fish that may occur within the Planning Area. No additional species were identified within the Light or Noise Assessment Areas compared to the Activity Area. A foraging BIA for the whale shark intersects the Activity Area (see Figure 7-20).

7.7.7.3.1 Fish

Fish Communities at Shoals

Fish communities found at the submerged shoals within the Planning Area are described in Section 7.7.3. In summary, the pelagic biota of the shoals was found to be similar to those on coral reefs and biologically rich. Of the species recorded, 97% were teleost fish with the remainder consisting predominantly of sharks and rays.

7.7.7.3.2 Sharks and Rays

Whale Shark

The whale shark (*Rhincodon typus*; vulnerable, migratory) is globally distributed in tropical and warm temperate seas, with the exception of the Mediterranean. There are two distinct subpopulations, with ~75% of the global population in the Indo-Pacific, and the remaining 25% in the Atlantic Ocean (Vignaud et al. 2014 in FRDC 2019). A known whale shark aggregation and congregation site are located at Ningaloo Reef (WA) and near Christmas Island (WA) respectively (both outside of the Planning Area). These aggregations are thought to be linked to seasonal prey fluctuations (DoE 2015e). The species is an epipelagic filter-feeder with a diet of

planktonic and nektonic species, including small crustaceans and smaller schooling fish species (DoE 2023). Whale sharks are known to be highly migratory with migrations of over 20,000 km recorded (Guzman et al. 2018). Migration along the northern WA coastline broadly follows the 200 m isobath and typically occurs between July and November (DoE 2015e).

A known foraging BIA for whale sharks is located in northern WA, offshore of the Pilbara and Kimberley coastline, and broadly follows the 200 m isobath (Figure 7-20; DoE 2024a). The BIA is listed as a foraging habitat, however, the Conservation Advice (DoE 2015e) for this species indicates this BIA up the north west coast represents a migration corridor rather than significant foraging habitat, consistent with tagging studies. Meekan and Radford (2010) showed that whale sharks migrated up the coast from Ningaloo Reef and individually dispersed over a broad area; either north-west into the open Indian Ocean, northward towards Sumatra and Java, or north-east towards the Timor Sea. Thomson et al. (2021) more recently recorded whale sharks tagged in Ningaloo Reef travelling to the NWS.

Grey Nurse Shark

The grey nurse shark (*Carcharias taurus*; migratory) has a wide but patchy tropical and temperate distribution in the Indo-West Pacific and Atlantic oceans. There are two distinct Australian subpopulations: east coast and west coast. The west coast population inhabits coastal and continental shelf waters from SW WA (Albany) up to the NW shelf (DoE 2024b; FRDC 2019) and although one aggregation site has been documented, data on spatial temporal distribution along the WA coastline is lacking (Hoschke et al. 2023). Grey nurse sharks undertake large-scale movements to potentially capitalise on seasonal prey aggregations, with individuals migrating 1,294 km along the WA coast from SW WA to Ningaloo (Jakobs and Braccini 2019; DoE 2024b). Grey nurse sharks are thought to move further north along the coast with lower sea temperatures from May to December, and individuals have been caught near Browse Island and off Bali, Indonesia (Hoschke et al. 2023).

White Shark

The white shark (*Carcharodon carcharias*; vulnerable, migratory) is a rare, primarily temperate species with a wide Australian range and two subpopulations; eastern Australasia (from Papua New Guinea along Australia's east coast and Macquarie Island to the south-western Pacific, including waters off New Caledonia, Vanuatu and Tonga) and the southern-western population (from western Victoria across southern Australia and up the WA coast) (DSEWPaC 2013; FRDC 2019; Kyne et al. 2021a). Although the species has been recorded up to Ningaloo Reef (WA) and may occur further north (McAuley et al. 2017), white sharks are not known to aggregate within the NWMR or NMR and are most likely to be found south of NW Cape (DSEWPaC 2012, 2012h). Ongoing research into the movements of this species suggests that female white sharks travel further offshore than males, cover a broader longitudinal range and dive deeper (Bradford et al. 2020). Off the WA coast, the direction and timing of the movement of individual sharks are highly variable, with white sharks travelling along the coast in both directions at most times of the year. The reasons for movements to north-western WA are unknown and little information is available on their reproduction in Australian waters (McAuley et al. 2016; DSEWPaC 2012e).

Shortfin Mako Shark and Longfin Mako Shark

Shortfin mako (*Isurus oxyrinchus*; migratory) and longfin mako (*Isurus paucus*; migratory) sharks are both highly migratory epipelagic species. The shortfin mako is a common shark widespread in tropical and temperate waters with temperatures >16° C (Groeneveld et al. 2014). This species is widespread throughout Australian waters except for the Torres Strait, Arafura Sea and Gulf of Carpentaria (FRDC 2019; Birkmanis et al. 2020; Kyne et al. 2021a). Shortfin mako sharks exhibit sexual and developmental segregation; juveniles spend 90% of their time near the surface whereas adults dive much deeper (Groeneveld et al. 2014). In contrast, the wide but patchy distribution and biology of the rarely encountered longfin mako is less well documented (Kyne et al. 2021a). This epipelagic shark also inhabits tropical and warm-temperature waters (Reardon et al. 2006) and longfin mako sharks are found in Australia from Geraldton (WA) across the NT and QLD down to Port Stevens in NSW (FRDC 2019).

Oceanic Whitetip Shark

The Oceanic Whitetip Shark (*Carcharhinus longimanus*; migratory) is a highly mobile globally distributed pelagic species found in tropical and warm temperate waters 30°N to 35°S (DoE 2023n; Kyne et al. 2021a). This species is found from surface waters to at least 150 m deep and may venture close inshore where the continental shelf is narrow.

In Australia, this rarely encountered species is found in warmer waters from Cape Leeuwin (WA) across northern Australia down to Sydney (NSW). The southern distribution limit is unclear with a single specimen

recorded in South Australia. Oceanic whitetip sharks have been globally assessed as Critically Endangered by the IUCN, Overfished by Status of Australian Fish Stocks (Cth) and listed on Convention on International Trade in Endangered Species of Wild Fauna and Flora Appendix II (FRDC 2019).

Scalloped Hammerhead

The Scalloped hammerhead shark (*Sphyrna lewini*; conservation dependent) is a coastal and semi-oceanic species with a wide tropical and warm-temperate global distribution from the intertidal zone to at least 275 m water depth, with newborns found in coastal zones (Kyne et al. 2021a; FRDC 2019). Recent studies suggest that the Indo-Pacific population (including Australia) is genetically distinct from the Atlantic and Caribbean populations. There is likely to be two subpopulations in Australian waters (WA and the rest of Australia), with the non-WA subpopulation connected to Papua New Guinea and Indonesia by shallow water habitats along northern Australia (Green et al. 2022). This mobile species has a broad Australian range from NSW and Qld across the NT to WA (DoE 2023o; Bartes et al. 2021; Kyne et al. 2021a; FRDC 2019).

Northern River Shark

Northern river sharks (*Glyphis garricki*; endangered) are rare and although their distribution is uncertain, they are known to occur in the Ord and King Rivers, King Sound and Joseph Bonaparte Gulf in WA along with the South and East Alligator Rivers and the Wessel islands in NT (FRDC 2019; TSSC 2014a; DSEWPaC 2010). It is thought that this species exhibits segregation during developmental stages and similarly occupies rivers, estuarine systems, macrotidal embayments, as well as inshore marine habitats (Kyne et al. 2021b; FRDC 2019; DSEWPaC 2010). Although the northern river shark has been recorded in offshore waters, the frequency of this occurrence is unknown.

Remaining populations throughout Australia are considered isolated and their viability is therefore questionable. Both species were listed as threatened in 2001 due to their limited geographical distribution and low population estimates, and the population decline is likely to continue (TSSC 2014a; DSEWPaC 2010).

Sawfish

Three listed threatened (vulnerable, migratory) sawfish species—dwarf sawfish (*Pristis clavata*), green sawfish (*Pristis zijsron*) and largetooth sawfish (*Pristis pristis*)—occur within the Planning Area. Adults of both green and largetooth sawfish are thought to use deepwater habitats, but this has not been confirmed for dwarf sawfish (CoA 2015b). Considering declining global populations of these sawfishes, northern and north-west Australia may contain the last significant populations of these species (Yan et al. 2021; CoA 2015b; DSEWPaC 2012e).

The dwarf sawfish is primarily found in shallow coastal and estuarine areas, from Cairns (QLD) around the north of Australia to the Pilbara coastline in WA, with juveniles thought to remain in estuarine waters (FRDC 2019; TSSC 2009).

The green sawfish does not occupy freshwater habitats and although most common in shallow coastal and estuarine areas, this species has been recorded in depths of up to 70 m from Cairns (Qld) across to Broome (WA) (FRDC 2019; TSSC 2008b).

The largetooth sawfish inhabits the sandy or muddy bottoms of river, estuarine and marine environments within north-west Australia and has a patchy distribution, including the Fitzroy, Durack, Robinson and Ord rivers in WA. Newborns and juveniles occur primarily in the freshwater areas of rivers and in estuaries, while adults mostly occupy marine and estuarine environments (FRDC 2019; CoA 2015b; DSEWPaC 2012e; TSSC 2014b).

A fourth sawfish species, the narrow sawfish (*Anoxypristis cuspidate*; migratory), is being assessed for EPBC Act threatened species listing (DoE 2023k). Narrow sawfish are a bentho-pelagic species found throughout the Indo-West Pacific and are still found throughout much of its historic range, albeit in substantially reduced numbers (FRDC 2019). Narrow sawfish occur across northern Australia from the Pilbara Coast (WA) to Broad Sound (Qld) in waters up to 40 m deep on the continental shelf and in estuaries (Kyne et al. 2021a; FRDC 2019). Juveniles and pupping females require inshore and estuarine habitats, while adults predominantly occur offshore (FRDC 2019).

There are no known foraging or breeding aggregation areas for these species within the Planning Area.

Manta Rays

The giant manta ray (*Mobula birostris*; migratory) and reef manta ray (*Mobula alfredi*; migratory) are globally distributed in both tropical and temperate waters. Giant manta rays are considered to be the more migratory

and oceanic species of the two, and individuals of this highly-mobile species are not expected to be resident in Australian waters (Kyne et al. 2021a; Couturier et al. 2015). While considered more solitary and less frequently sighted than reef mantas, giant manta rays can be found in large numbers engaging in foraging, mating or cleaning activities and exhibit seasonal habitat preferences frequenting offshore seamounts and islands (Marshall et al. 2022a).

The reef manta ray typically uses productive nearshore habitats, including island groups, atolls and continental coastlines (Marshall et al. 2022b), and is coastally distributed across the north of Australia to ~30°S on both coasts (Armstrong et al. 2020). While reef mantas demonstrate a high degree of site fidelity in tropical and subtropical waters, this species has also been shown to travel up to 700 km, undertake seasonal migrations and traverse international waters (Couturier et al. 2015). Reef mantas are also often sighted in high numbers, predominately when undertaking foraging activities or migrating. There are no known foraging or breeding aggregation areas for these species within the Planning Area.

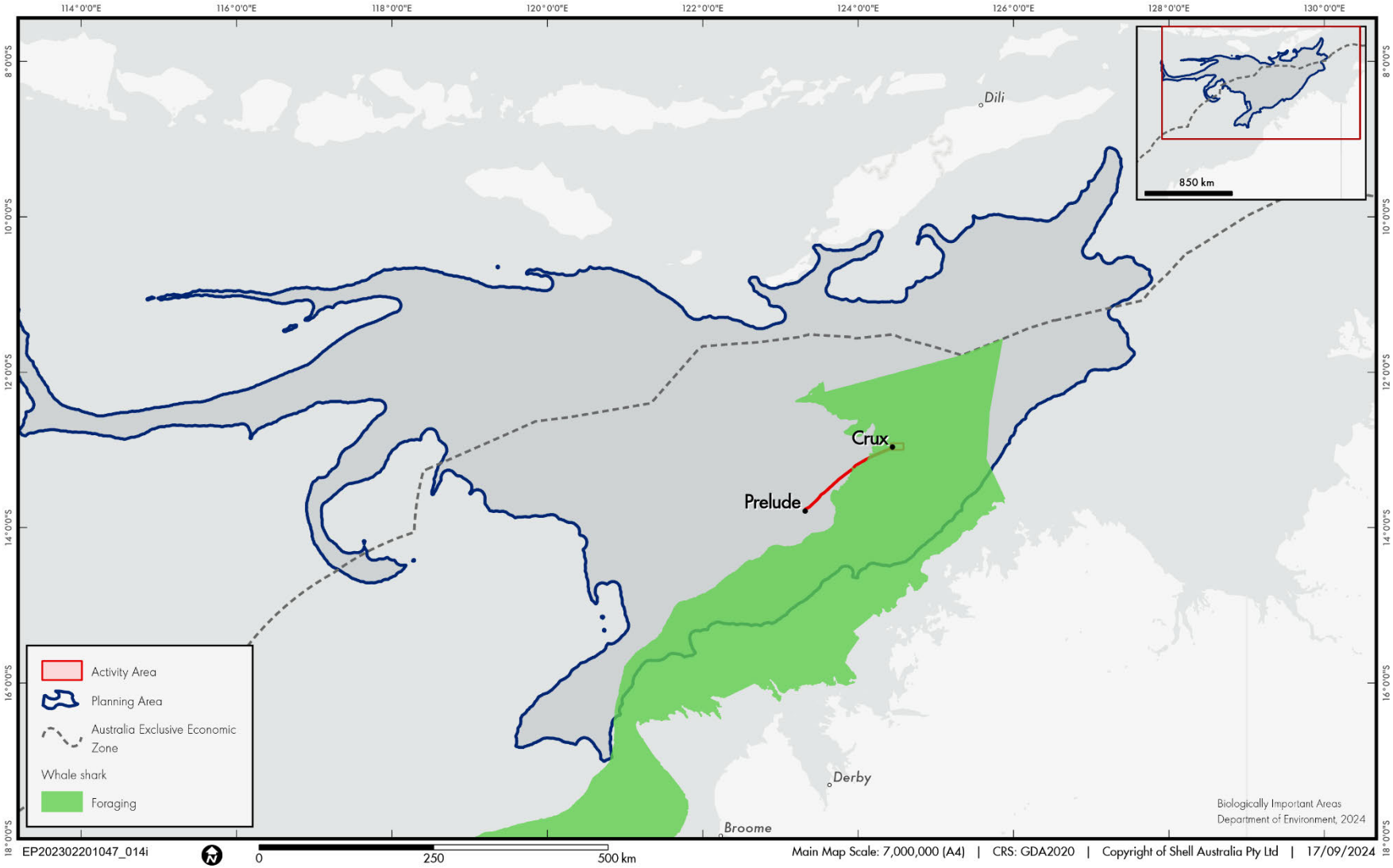


Figure 7-20: BIAs for Whale Sharks within the Planning Area

7.7.7.4 Birds

Table 7-10 lists the EPBC Act listed threatened and migratory birds that may occur within the Activity Area and Planning Area. A number of marine bird species are known to occur within the Planning Area as they forage large distances over the open ocean (DCCEEW 2024). Many migratory shorebird and wetland species are also expected to fly over the Planning Area as part of their large-scale transitory movements.

Most migratory birds are unlikely to land on the sea for significant periods of time (ConocoPhillips 2018). Whilst seabirds spend much of their lives at sea, migratory shorebirds overfly offshore areas during migratory periods and typically do not interact with the sea surface (DCCEEW 2024; ConocoPhillips 2018). Migratory wetland species also do not interact with open offshore waters. However, these species may land on offshore oil and gas infrastructure, especially during inclement weather, while flying between land masses (ConocoPhillips 2018).

No emergent land exists within the Activity Area that could support breeding populations of seabirds or migratory shorebirds. The nearest shorelines are Cartier Island and Ashmore Reef. Scott Reef and Browse Island may provide additional connectivity for shorebirds of the NWMR (DCCEEW 2024).

Table 7-14 lists and Figure 7-21 shows the bird BIAs that may occur within the Planning Area. No additional bird species were identified within the Light or Noise Assessment Area compared to the Activity Area. No bird BIAs intersect the activity, Light or Noise Assessment Area.

Table 7-14: Bird BIAs within the Planning Area

Common Name	BIA Behaviour	BIA Description	Distance from Activity Area (~km)	Distance from Crux Platform (~km)
Brown booby	Breeding	Breeding at Ashmore Reef. Breeding may occur from Feb–Oct.	90	119
Greater frigatebird	Breeding	Islands off the Kimberley (WA) coastline including Ashmore Reef and Adele Island (outside of the Planning Area). Breeding may occur in May–Jun and Aug.	30	57
Lesser crested tern	Breeding	Breeding along NT coastline and Ashmore Reef. Breeding may occur from Mar–Jun.	113	141
Lesser frigatebird	Breeding	Islands off the Kimberley (WA) coastline including Ashmore Reef and Adele (outside of the Planning Area) and Lacepede (outside of the Planning Area) Islands.	33	62
Little tern	Resting	Islands off the Kimberley (WA) coastline including Ashmore Reef.	125	154
Red-footed booby	Breeding	Islands off the Kimberley (WA,) coastline including Ashmore Reef and Adele Island (outside of the Planning Area). Breeding may occur in May–Jun.	30	57
Roseate tern	Breeding	Breeding along NT coastline and Ashmore Reef. Breeding may occur from Mar–Jul.	113	141
Wedge-tailed shearwater	Breeding	Breeding at Ashmore Reef. Breeding may occur from Aug–Apr.	33	62
White-tailed tropicbird	Breeding	Breeding at Ashmore Reef. Breeding may occur from May–Oct.	40	65

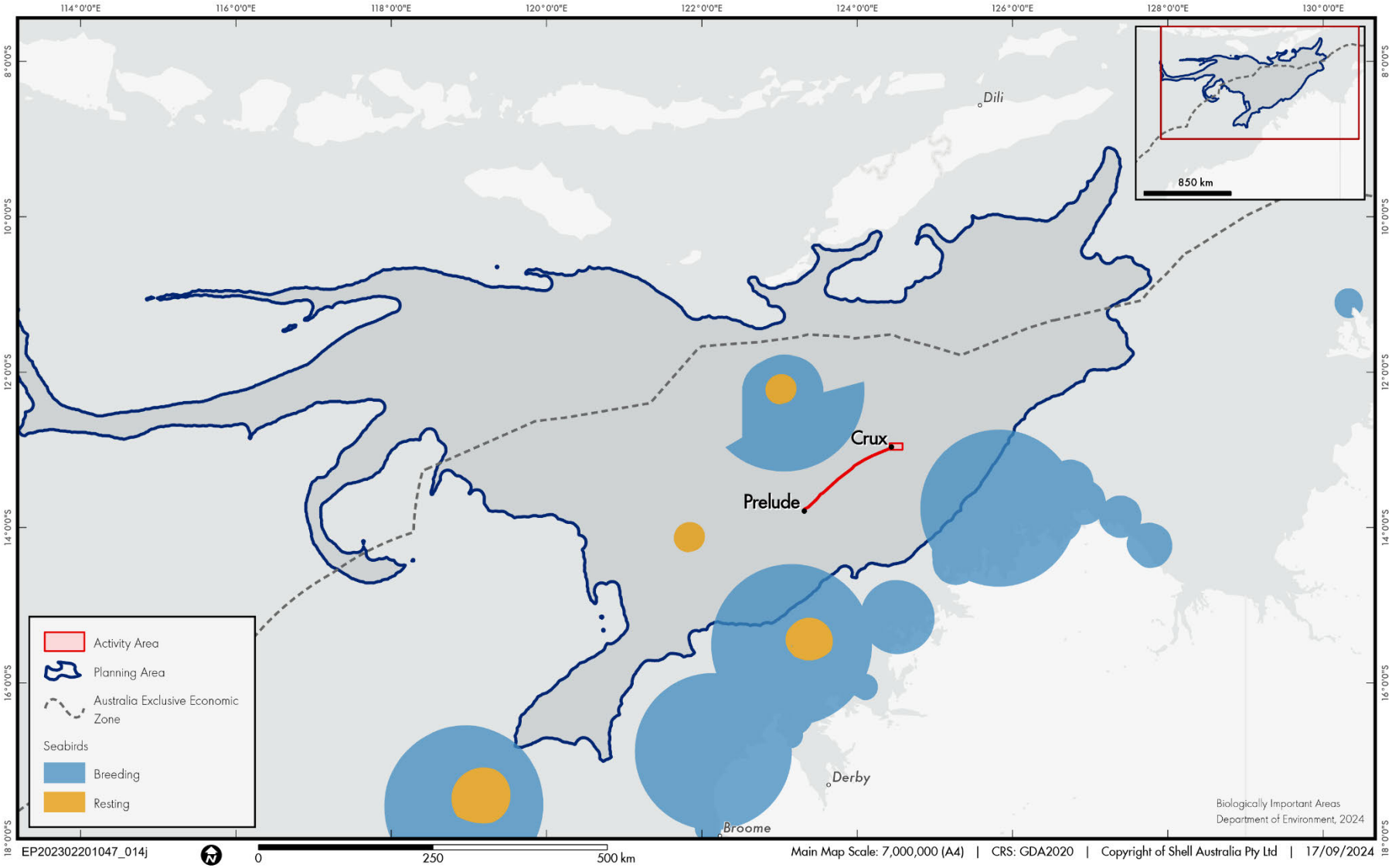


Figure 7-21: BIAs for Birds within or Proximal to the Planning Area

Abbott's Booby

The Abbott's booby (*Papasula abbotti*; endangered) spends the majority of its life at sea, generally only coming ashore to breed. Within Australia, this species breeds exclusively on Christmas Island (outside of the Planning Area), nesting in the forests on the island and foraging in the surrounding waters and south-east Asia (TSSC 2020b). Recent population estimates on Christmas Island are of 2,500 breeding pairs (Menkhorst et al. 2017). The restricted geographical location of Abbott's booby is thought to be attributed to areas of upwelling in the waters surrounding Christmas Island, possibly providing seasonal prey items necessary for raising offspring.

Asian Dowitcher

The Asian dowitcher (*Limnodromus semipalmatus*; vulnerable under the EPBC Act, migratory) is a large, distinctive wader with a long neck, long legs, and a long, straight, snipe-like bill (DCCEEW 2024e). In Australia, this bird is only a regular visitor to coastal areas between Broome and Port Hedland and the Port McArthur tidal wetlands in the Gulf of Carpentaria, arriving from August (DCCEEW 2024e). It roosts in sheltered coastal environments such as estuarine and intertidal mudflats, lagoons, creeks and saltworks, and feeds on inter-tidal mudflats (DCCEEW 2024e). Only a small proportion of the non-breeding population arrive in Australia, occasionally recorded in the NT and rarely in western and eastern Australia (DCCEEW 2024e). In the NT, the Asian dowitcher is found in Darwin and Arnhem Land (DCCEEW 2024e). No sites of international significance are listed in the NT for this species (Birdlife Australia 2020). The Asian dowitcher typically leaves north-west Australia by the end of April to return to northern hemisphere breeding grounds (DCCEEW 2024e). Given the areas historically observed to be inhabited by this species, individuals may seasonally occur within the Planning Area.

Australian Lesser Noddy

The Australian lesser noddy (*Anous tenuirostris melanops*; vulnerable) is a tropical species of tern endemic to Australia (DoE 2023ab; TSSC 2015a). Whilst the Australian lesser noddy has a large range, the species primarily uses a small area in Houtman Abrolhos for breeding (DoE 2023ab; Surman et al. 2018; TSSC 2015a). The Australian lesser noddy is also known to breed in small numbers at Ashmore Reef (Menkhorst et al. 2017) and individuals generally remain in close proximity to the breeding islands throughout the year (Surman et al. 2018). Although the EPBC Act protected matters report states that breeding is known to occur within the area, Australian lesser noddies are likely to remain in the general vicinity or to the south of the Houtman Abrolhos Islands and are not expected to occur in significant numbers throughout the Planning Area.

Australian Painted Snipe

The Australian painted snipe (*Rostratula australis*; endangered) is a wading bird that has been recorded in wetlands of all Australian states, although in smaller numbers and less frequently at scattered locations in WA (DoE 2023ac; DCCEEW 2022). This species generally inhabits shallow terrestrial freshwater and occasionally brackish wetlands and other waterlogged areas, requiring shallow wetlands with areas of bare wet mud and canopy cover nearby for breeding (DoE 2023ac; DCCEEW 2022). The most northerly breeding records are from near Derby and Taylor's Lagoon, near Broome, although this species is only occasionally recorded in northern WA (DoE 2023ac; Trainor et al. 2017; Knuckey et al. 2013). The EPBC Act protected matters report states that this species or habitat may occur within the area, however, as the Australian painted snipe inhabits freshwater wetlands, it is unlikely to occur in the Planning Area.

Barn Swallow

The barn swallow (*Hirundo rustica*; migratory) usually occur in northern Australia, on Cocos-Keeling Island and Christmas Island (both outside of the Planning Area) (Stokes et al. 1984; Stokes 1988), Ashmore Reef (Higgins et al. 2006), and patchily along the north coast of the mainland from the Pilbara region (WA) to Fraser Island (Qld).

Red-rumped Swallow

The red-rumped swallow (*Cecropis daurica;* migratory) is a widespread Eurasian migratory bird with irregular occurrences within northern Australia. The red-rumped swallow migrates to Australia during its non-breeding season between October and April (Jackson and Kyne 2013).

Bar-tailed Godwit

Northern Siberian bar-tailed godwit (*Limosa lapponica menzbieri*; critically endangered) and Alaskan bar-tailed godwit (*Limosa lapponica baueri;* migratory) are large migratory shorebirds that predominantly occur in the

north and north-west of WA. The species has been recorded in the coastal areas of all Australian states and is widespread in the Torres Strait. The bar-tailed godwit is found in coastal habitats, sandy ocean beaches, coral reef-flats and rock platforms, foraging near the water's edge or in shallow water. This species feeds on worms, molluscs, crustaceans, insects and some plant material (Chan et al. 2022; DoE 2023al; DCCEEW 2024c, DCCEEW 2024d).

Christmas Island White-tailed Tropicbird

The Christmas Island white-tailed tropicbird (*Phaethon lepturus fulvus*; endangered) is a subspecies of *Phaethon lepturus*, however, there is dissent as to whether this species is merely a 'golden morph' of the white-tailed tropicbird (DoE 2023af; TSSC 2014c; Humeau et al. 2020). Christmas Island white-tailed tropicbirds disperse widely to roost and forage over the Indian Ocean and have been recorded south and south-east of Christmas Island. The subspecies mostly occurs north of 18°S, but may occur up to 1,500 km from Christmas Island at the edge of the continental shelf off WA (at 21°S). The species preys on cephalopods and fish captured by vertically plunging into water from up to 20 m and swooping along the surface of the water (TSSC 2014c).

Red-tailed Tropicbird

The red-tailed tropicbird (*Phaethon rubricauda;* endangered; migratory) is a seabird native to tropical parts of the Indian and Pacific Oceans. The red-tailed tropicbird is predominately a plunge diver, diving from an above-water height ranging from ~6 to 50 m and to a depth of ~4.5 m, although this may change seasonally. The species prey on mainly squid and flying fish (BirdLife International 2020).

White-tailed Tropicbird

White-tailed tropicbird (*Phaethon lepturus*; migratory) is a medium sized seabird. The white-tailed tropicbird usually feeds alone or in pairs (Marchant and Higgins 1990) and is less often associated with flocks of seabirds and subsurface predators (e.g. tuna) than do other tropical seabirds (DoE 2023ad). Figure 7-21 shows the breeding BIAs for the white-tailed tropicbird that overlap the Planning Area. There are three breeding populations—Rowley Shoals (outside the Planning Area), North Keeling Island (outside the Planning Area) and Ashmore Reef (DoE 2023ad).

Common Sandpiper

The common sandpiper (*Actitis hypoleucos*; migratory) is a shorebird found along Australian coastlines and mostly found around muddy margins or rocky shores and rarely on mudflats. The common sandpiper is typically carnivorous such as molluscs, crustaceans and insects (Higgins and Davies 1996). The common sandpiper breeds in Europe and Asia during April to August (DoE 2023ae).

Curlew Sandpiper

The curlew sandpiper (*Calidris ferruginea*; critically endangered, migratory) has a broad distribution and has been recorded along the coasts of all Australian states and territories (DoE 2023ag). In WA, curlew sandpipers are widespread around coastal and subcoastal plains from Cape Arid to south-west Kimberley, and more sparsely distributed between Carnarvon and Dampier Archipelago. Although occurring in large numbers at Port Hedland Saltworks, 80 Mile Beach, Roebuck Bay and Lake Macleod, this species is rarely recorded in the north-west Kimberley. In the NT, curlew sandpipers mostly occur around Darwin, north to Melville Island and Cobourg Peninsula, and east and south-east to Gove Peninsula, Groote Eylandt and Sir Edward Pellew Island (DoE 2023ag; DCCEEW 2023f). Although the species' preferred habitat is intertidal mudflats in sheltered coastal areas where they forage in nearshore waters or mud at the edge of wetlands, they are also widespread inland in smaller numbers (DoE 2023ag). The curlew sandpiper migrates along the East Asian-Australasian Flyway from their breeding grounds in Siberia to Australia, generally arriving in Australia around late August/early September and departing by mid-April. Some non-breeding individuals may not undertake the migration northward but stay in Australia (DoE 2023ag). The EPBC Act protected matters report states that this species or habitat is known to occur within the area. Based on the known distribution, preferred feeding and roosting habitats, it is considered highly unlikely that individuals will interact with the Planning Area.

Pectoral Sandpiper

Pectoral sandpiper (*Calidris melanotos*; migratory) is a small–medium wader bird found throughout Australia, preferring prefers shallow fresh to saline wetlands. The common sandpiper is typically omnivorous, consuming algae, seeds, crustaceans, arachnids and insects (Higgins and Davies 1996). The common sandpiper breeds in Russia and Northern America (DoE 2024j).

Sharp-tailed Sandpiper

The sharp-tailed sandpiper (*Calidris acuminata*; vulnerable; migratory) is a small-medium wader found throughout Australia (freshwater and saline habitats). The common sandpiper is typically omnivorous, consuming seeds, crustaceans, worms, molluscs and insects. The common sandpiper breeds in Siberia (Higgins and Davies 1996).

Eastern Curlew

The eastern curlew (*Numenius madagascariensis*; critically endangered, migratory) is the world's largest species of shorebird (DoE 2023ah; Menkhorst et al. 2017). The species is restricted to the East Asian-Australasian Flyway, migrating annually to breeding grounds in Russia and north-eastern China before returning to Australia in August to forage, primarily in intertidal mudflats on larger prey items such as crab (DoE 2023ah; Menkhorst et al. 2017; Bamford et al. 2008). In Australia, the species has a continuous distribution from Barrow Island and Dampier Archipelago in WA through the Kimberley and along the NT, Qld, NSW coasts and the islands of Torres Strait (DCCEEW 2023e). There are two internationally important non-breeding sites in northern WA; Roebuck Bay and Eighty Mile Beach (Bamford et al. 2008).

Greater Sand Plover

Greater sand plovers (*Charadrius leschenaultia*; vulnerable, migratory) are shorebirds that migrate from breeding areas in Mongolia, Siberia and China to coastal areas in all Australian states. This species occurs in the greatest numbers in north-western Australia and is especially widespread between North West Cape and Roebuck Bay in WA, with scattered records between Roebuck Bay and Darwin. Greater sand plovers are often recorded in the Top End of the NT including on Groote Eylandt, and is widespread from the Torres Strait, Ashmore Reef, Cocos-Keeling and Christmas Islands (DoE 2023aj; DCCEEW 2023g). In Australia, greater sand plovers are almost entirely coastal, inhabiting littoral and estuarine habitats on sheltered muddy, sandy or shelly beaches, large intertidal mudflats, salt-marshes, estuaries, sandbanks, coral reefs, rocky islands rock platforms, tidal lagoons and coastal dunes. Greater sand plovers feed on molluscs, worms, crustaceans and insects they find in wet sand or mud on open intertidal flats of sheltered embayments, lagoons or estuaries (DoE 2023aj; DCCEEW 2023g).

Red Knot

The red knot (*Calidris canutus*; endangered) is an omnivorous wading bird which uses the intertidal mudflats, sandflats and sandy beaches of sheltered coastal areas, estuaries, bays and other similar marine habitats. The red knot is present throughout coastal and offshore Australia, including Christmas and Cocos Keeling Islands. Notably, large numbers of red knots are regularly recorded in the north-west of Australia (specifically at 80 Mile Beach and Roebuck Bay) and the species is present along the Ningaloo coast and at Lake Macleod (DCCEEW 2024b; Bamford et al. 2008). At the end of the breeding season the species returns south, arriving in northern Australia in late August to early September to take up residence, as well as settling in other areas primarily in eastern Australia and New Zealand (DCCEEW 2024b; Watkins 1993).

Lesser Frigatebird

The lesser frigatebird (*Fregata aerial*; migratory) occurs throughout the tropical and warmer waters of northern and eastern Australia (DCCEEW 2024), breeding on islands such as Ashmore Reef and North Keeling, as well as a number of other islands located off the north coast of WA (Menkhorst et al. 2017; Mott 2016). The lesser frigatebird feeds on prey items such as flying fish by catching their prey at or just above the ocean surface (DCCEEW 2024). This species also occasionally feeds on squid, octopus and the chick of other bird species, and typically does not forage far from the breeding colony (DCCEEW 2024; Birdlife International 2017b). Figure 7-21 shows the known breeding BIAs for the lesser frigatebird that overlap the Planning Area.

Greater Frigatebird

The greater frigatebird (*Fregata minor*; migratory) is widespread and breeds on a number of small and remote tropical and sub-tropical islands (DCCEEW 2024; Birdlife International 2017a). Whilst the species typically nests in mangroves or bushes, it may also nest on the bare ground (Birdlife International 2017a). The greater frigatebird forages both inland and along coastlines, potentially straying up to 200 km from the colony to forage during the early breeding season (Birdlife International 2018b; DCCEEW 2024). The species' diet consists largely of fish, squid and the chicks of other bird species (Birdlife International 2017a; DCCEEW 2024). There are large breeding populations of this species in the tropical waters of the Pacific and Indian Oceans (Birdlife International 2017a). Within WA, the greater frigatebird has a small breeding colony at Ashmore Reef and is found throughout the north and eastern coastal and offshore areas of Australia (Mott 2016; DCCEEW 2024).

The species also breeds on Christmas and North Keeling Islands, located outside the Planning Area (Menkhorst et al. 2017). Figure 7-21 shows the known breeding BIAs for the greater frigatebird that overlap the Planning Area.

Red-footed Booby

The red-footed booby (*Sula sula*; migratory) has an extensive distribution in tropical regions of the Indian, Pacific and Atlantic oceans. In Australia, this species is not known to travel far from breeding colonies, however juveniles emigrate to other islands. The species has not been recorded from WA or the NT coasts, but breeding occurs on Ashmore Reef. The red-footed booby forages in deep water up to 150 km from the nearest breeding island on fish, especially flying fish, and cephalopods by plunge diving to small depths (DoE 2023ap). Figure 7-21 shows the known breeding BIAs for the red-footed booby that overlap the Planning Area.

Brown Booby

The brown booby (*Sula leucogaster*; migratory) occurs from Bedout Island in WA, around the NT coast to Queensland. Off north-west WA, this species is most abundant 18–36 km from land and is often concentrated where wavelets are about 2 m high. The brown booby breeds on tropical and continental islands, sand cays and atolls. This species feeds in both shallow and deep inshore waters on mullet, flying-fish, squid and cephalopods, caught by plunge-diving (2023as). Figure 7-21 shows the breeding BIAs for the brown booby that overlap the Planning Area.

Masked Booby

The masked booby (*Sula dactylatra;* migratory) is the largest and heaviest of the booby family. The masked booby ranges from the north eastern to north western coastline of Australia, including offshore islands (Marchant and Higgins 1990). In Australia, there is a breeding population on Lord Howe, NSW (Priddel et al. 2005).

Streaked Shearwater

The streaked shearwater (*Calonectris leucomelas*; migratory) is a pelagic species but also found in inshore waters. The streaked shearwater breeds on the coast and islands of Japan, Russia, China, North Korea and South Korea. The streaked shearwater feeds mainly on fish and squid (BirdLife International 2018).

Wedge-tailed Shearwater

The wedge-tail shearwater (*Ardenna pacifica*; migratory) is a pelagic seabird widespread across the Indian ocean and forages across waters of the continental shelf. Wedge-tail Shearwaters breed on islands off the coast of WA, and on Cocos-Keeling Island.

Although movement patterns of this species are not well documented, populations in the northern and southern extremities of its range are known to be migratory. Populations in WA migrate north from April to May, and the species has been recorded at Ashmore Reef from August to November. Wedge-tailed shearwaters dive to a depth of two to three metres when feeding to catch deeper prey inaccessible to most other tropical seabirds (DoE 2023aq). Figure 7-21 shows the breeding BIA for the wedge-tail shearwater that overlap the Planning Area.

Bridled Tern

Bridled terns (*Onychoprion anaethetus;* migratory) occur in warm tropical waters worldwide and are widespread in Australia, breeding on offshore islands from Cape Leeuwin in the south-west around the north to Qld. At sea, distribution extends from SW WA to Barrow Island and the Dampier Archipelago, and off the Kimberley coast west of the Dampier Peninsula to Ashmore Reef and Joseph Bonaparte Gulf. Breeding is widespread in the Pilbara and Kimberley Regions. In the NT, the main colonies are off north-eastern Arnhem Land, on south-eastern Groote Eylandt and the Sir Edward Pellew Group. This species spends a large portion of its life offshore and is rarely seen near land except when breeding. Bridled terns breeding seasons vary geographically, occurring in the spring and summer in WA, with most birds returning to their breeding grounds between late September/October and departing in April (DoE 2023at).

Caspian Tern

Caspian terns (*Hydroprogne caspia*; migratory) are widespread in Australia in both coastal and inland areas. In WA, the species is widespread in coastal regions from the Great Australian Bight to the Dampier Peninsula and are known to breed in the Pilbara region from Point Cloates to North Turtle Island, and more rarely in the Kimberley Region. In the NT, records are scattered but in the non-breeding season are more common on the

eastern and western coasts. Caspian terns are known to breed on Sandy Island off Cobourg Peninsula, and on offshore islands including the Sir Edward Pellew Group. In Australia, this species is resident where breeding occurs year round, but also where breeding is protracted (e.g. Darwin and WA). This species inhabits sheltered coastal embayments with sandy or muddy margins and prefers sheltered areas near offshore islands, but is rarely seen beyond reefs. Caspian terns forage in sheltered shallow water and open coastal waters for small fish, carrion and invertebrates (DoE 2023av).

Greater Crested Tern

The crested tern (*Thalasseus bergii*; migratory) is a widely distributed species recorded from almost all Australian coastlines. Adults forage up to 40 km daily to catch fish, cephalopods, crustaceans and insects (DoE 2023ar).

Lesser Crested Terns

The lesser crested tern (*Thalasseus bengalensis*) is not listed as an EPBC Act listed threatened or migratory species. The lesser crested tern is a strictly coastal species usually found on beaches and estuaries. This species is known to breed on Ashmore Reef and other WA islands located outside of the Planning Area such as Adele Island, Lacepede Island and Lowendal Islands (DoE 2023aw; Nicholson 1998). Figure 7-21 shows the known breeding BIA for the lesser crested tern within the Planning Area.

Little Tern

The Australian breeding population of little terns (*Sternula albifrons*; migratory) are divided into two major subpopulations; a northern subpopulation breeding across northern Australia from Broome to the Cape York Peninsula most of the year, and an eastern subpopulation which breeds on the eastern and south-eastern coast Australian coast. There is an additional non-breeding population present in austral spring-autumn (DoE 2023az; TSSC 2002). Little terns are widespread in Australia, with breeding sites widely distributed across north-western Australia. This species inhabits exposed ocean beaches and sheltered coastal environments with exposed sandbanks or sand-spits. Little Terns are widespread on islands off the NT coast and forage in shallow waters of estuaries and coastal lagoons over channels often close to breeding colonies. They also forage along open coasts within 50 m of shore and less often at sea. Little terns feed on small fish, crustaceans, molluscs and insects (DoE 2023az; TSSC 2002). Figure 7-21 shows the known resting BIAs for the little tern that overlap the Planning Area.

Roseate Tern

Roseate terns (*Sterna dougallii*; migratory) are a marine migratory bird species recorded from south-west WA to south-east Qld. In WA, roseate terns regularly occur from Mandurah to Eighty Mile Beach in the Pilbara Region, and at scattered sites north to at least the Bonaparte Archipelago in the Kimberley Region. In the NT, this species mainly occurs from Darwin to Gove Peninsula, west to North Peron Island and east to the Sir Edward Pellow Islands. Breeding mainly occurs off the WA and NT coasts during two distinctive periods either in spring-summer or autumn-winter, with April to November the peak laying periods. Roseate Tern migration varies geographically and is not well documented. This species inhabits coral reefs, rocky and sandy beaches, sand cays and offshore islands, feeding by plunge-diving for fish in the ocean (DoE 2023ao). Figure 7-21 shows the known breeding BIA for the roseate tern within the Planning Area.

Grey Wagtail

The grey wagtail (*Motacilla cinerea*; migratory) is widely distributed, with several populations breeding in Europe and Siberia. In Australia, the grey wagtail is widely distributed throughout Australia and several offshore islands. The grey wagtail feed on a variety of aquatic invertebrates including adult flies, mayflies, beetles, crustacea and molluscs (Birdlife International 2017).

Yellow Wagtail

The yellow wagtail (*Motacilla flava*; migratory) is widely distributed, with several populations breeding in Europe and Asia. In Australia, the yellow wagtail is widely distributed throughout Australia and several offshore islands. It feeds on a variety of terrestrial and aquatic invertebrates and some plant material, particularly seeds (Birdlife International 2019).

Oriental Cuckoo

The oriental cuckoo (*Cuculus optatus*; migratory) is mostly found in northern and eastern Australia, inhabiting predominately forests. Several populations breed on northern Europe and Asia. The oriental cuckoo feeds mainly on insects and their larvae (Birdlife International 2016b).

Oriental Reed-Warbler

The oriental reed-warbler (*Acrocephalus orientalis*; migratory) is distributed in northern and eastern Australia and Asia. It breeds in northern Asia and forages for insects and other invertebrates (Birdlife International 2016a).

Common Noddy

The common noddy (*Anous stolidus*; migratory) is most commonly found over the ocean and offshore of WA's north-west and central coasts and occurs on Christmas and Cocos (Keeling) Islands. The species is rarely encountered off the NT coast. The preferred habitat for the common noddy includes shoals or cays of coral or sand rocky islets and stacks with precipitous cliffs. The species mainly eats fish caught on or just below the surface of the water while flying. The common noddy forages far from shore and has been recorded at sea hundreds of kilometres from breeding islands. Although migration patterns of the species are not well known, during the non-breeding period from March to August the common noddy are known to migrate 700 km to shelf waters around the Montebello Islands (DoE 2023au; Surman et al. 2018).

7.7.7.5 Seasonal Sensitivities of Threatened and Migratory Species

Table 7-15 lists the months that coincide with key environmental sensitivities (aggregation, breeding, foraging or migration) for the EPBC Act listed threatened and migratory species potentially occurring within the Planning Area.

Table 7-15: Key Environmental Sensitivities and Indicative Timings for Migratory Fauna within the Planning Area

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mammals												
Blue whale – northern migration (Exmouth, Montebello, Scott Reef)[1]												
Blue whale – southern migration (Exmouth, Montebello, Scott Reef)[2]												
Sharks, Rays and Other Fish												
Whale shark – foraging/aggregation near Ningaloo[3]												
Reptiles												
Green turtle[4]	N,H	N,H	H	H	H	N	N	H	H	H	H	N,H
Hawksbill turtle[4]	N,H	H						N,H	H	N,H	N,H	N,H
Olive ridley turtle[4]				N	N	N,H	N,H	H				
Flatback turtle[4]	N,H	H	H	H	H	N,H	N,H	N,H	N,H	N,H	N,H	N,H
Leatherback turtle[4]	N,H	H										N
Loggerhead turtle[4]	N,H	H	H	H	H							
Birds												
Migratory shorebirds[6]												

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Key and notes

	Species likely to be present
	Peak period. Presence of animals reliable and predictable each year
N	Peak Turtle Nesting
H	Peak Turtle Hatching

1 – DSEWPaC 2012; McCauley and Jenner 2010
2 – DSEWPaC 2012; McCauley and Jenner 2010
3 – TSSC 2015a; Wilson et al. 2006
4 – CoA 2017b

7.7.7.6 EPBC Act Management Publications

The Commonwealth government publishes management plans, recovery plans and Conservation Advice. These publications provide guidance on threats and management measures to prevent species decline and support species recovery. To determine the relevance of each publication, the spatial extent of the species' presence, habitat, and threats were examined, within the Planning Area to identify applicable aspects for the impact and risk assessment (Section 9). The activities under this EP are not inconsistent with any of the publications. Table 7-16 summarises relevant EPBC Act listed species and associated publications relevant to the activity.

Table 7-16: Summary of Relevant EPBC Act Management Publications

Species/ Sensitivity	EPBC Act Management Publication	Key Threats Identified in the RP/CA	Relevant Conservation Actions
All Vertebrate Fauna			
All vertebrate fauna	Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (CoA 2018)	Marine debris	No explicit conservation actions for non-fisheries related industries (Note: management actions in the plan relate largely to managing fishing waste and state and Commonwealth fisheries management through regulation)
Mammals			
Cetaceans and other marine megafauna	National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (CoA 2017)	Vessel disturbance	No explicit relevant conservation actions
Sei whale	Approved conservation advice *Balaenoptera borealis* (sei whale) (DoE 2015c)	Noise interference	Assess and manage acoustic disturbance
		Vessel disturbance	Assess and manage physical disturbance and development activities
		Climate change	No explicit relevant conservation actions
Blue whale		Noise interference	Assess and address anthropogenic noise

Species/ Sensitivity	EPBC Act Management Publication	Key Threats Identified in the RP/CA	Relevant Conservation Actions
	Conservation management plan for the blue whale: A recovery plan under the *Environment Protection and Biodiversity Conservation Act 1999* 2015–2025 (CoA 2015a)	Vessel disturbance	Minimise vessel collisions
		Climate change	No explicit relevant conservation actions
Fin whale	Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC 2015b)	Noise interference	Assess and address anthropogenic noise
		Vessel disturbance	Minimise vessel collisions
		Climate change	No explicit relevant conservation actions
Reptiles			
Loggerhead turtle, green turtle, leatherback turtle, hawksbill turtle, flatback turtle, olive ridley turtle	National Light Pollution Guidelines for Wildlife (DCCEEW 2023b)	Light pollution	Minimise light pollution
	Recovery plan for marine turtles in Australia 2017–2027 (CoA 2017@b)	Light pollution	Minimise light pollution
		Chemical and terrestrial discharge (oil pollution)	Ensure that spill risk strategies and response programs include management for turtles and their habitats
		Climate change	No explicit relevant conservation actions
		Vessel disturbance	No explicit relevant conservation actions
		Marine debris	Support the implementation of the Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (CoA 2018)
		Noise interference	No explicit relevant conservation actions
Leatherback turtle	Approved Conservation Advice for *Dermochelys coriacea* (leatherback turtle) (TSSC 2008a)	Vessel disturbance	No explicit relevant conservation actions
		Climate change	No explicit relevant conservation actions
Dusky sea snake	Conservation advice for *Aipysurus fuscus* (dusky sea snake) (DCCEEW 2024h)	Climate change and severe weather	
		Frequent and severe marine heatwaves (acute)	*Shell considers the listed climate change impact actions related to implementing regulatory mechanisms and international diplomacy to reduce greenhouse gas emissions, which are, therefore, not explicitly relevant conservation actions for the activity described within this EP.*
		High average water temperature (persistent)	
		Severe cyclones and storms	

Species/ Sensitivity	EPBC Act Management Publication	Key Threats Identified in the RP/CA	Relevant Conservation Actions
			Use scientifically informed planning and regulation to avoid impacts across the known and likely distribution of the dusky sea snake, including for development of the Torosa gas field and elsewhere across the Browse basin. This includes (but is not limited to) eliminating: • Net-positive carbon emissions that contribute to climate change. • The risk of discharged cooling water, or other heat sources, increasing water temperature for the dusky sea snake and its habitat. *Although Shell considers this conservation action as not relevant to the activity as there are no dusky sea snake known or likely distributions (including areas where the species may occur) within the Activity Area, a conservative approach was applied to consider the potential impacts of transiting vessels to nearby shoals.*
		Fossil fuel exploration and extraction	
		Oil Pollution	• It is essential that gas and oil exploration, extraction, production and decommissioning activities are adequately and effectively regulated and enforced to avoid negative impacts to the dusky sea snake at all stages of each project. This includes the use of a precautionary approach to avoid potential threats until further information is available from targeted research. Monitoring for compliance is essential in this remote area. • Use scientifically informed planning and regulation to avoid impacts across the known and likely distribution of the dusky sea snake, including for development of the Torosa gas field and elsewhere across the Browse basin. This includes (but is not limited to) eliminating: ○ The risk of oil spill affecting the dusky sea snake and its habitat. • Ensure there is an effective strategy and adequate local resources and knowledge in place to rapidly respond to a large unintentional oil spill from gas and oil projects in the Browse Basin. • Prioritise local storage of green dispersants which are non-toxic, non-volatile, and naturally available or renewable – and local capacity for

Species/ Sensitivity	EPBC Act Management Publication	Key Threats Identified in the RP/CA	Relevant Conservation Actions
			their use. *Shell considers this conservation action as not relevant to this EP as dispersant application is not planned for an oil spill response. Shell applies an acceptable dispersant application zone that includes buffers around shoals (e.g., within 20 km) and in waters <30 m. The acceptable dispersant application zone encompasses the Crux platform location. However, for operational reasons—such as facilitating platform access by oil spill response personnel—Shell may determine, through the operational Spill Impact Mitigation Assessment (SIMA) process, that dispersant application is necessary to support an oil spill response.* • Should an oil spill occur that may impact the known or likely distribution of the dusky sea snake: ○ Urgently use herding agents, bioremediation agents and mechanical means to contain and break down the oil. See Australian Maritime Safety Authority: oil spill control agents. ○ Urgently cap or otherwise isolate the source of the oil to prevent further contamination. ○ Immediately resource and mobilise multiple expert wildlife care teams to search for, and rehabilitate, ill dusky sea snakes (and other threatened and priority taxa). Ensure there is sufficient expertise within the care team to assess the condition of sea snakes at sea for release or rehabilitation, effectively collect samples from live individuals for toxicology and pathology assessments, and safely collect and freeze deceased individuals for necropsy, pathology, and toxicology assessment.
		Excessive Marine Noise	Use scientifically informed planning and regulation to avoid impacts across the known and likely distribution of the dusky sea snake, including for development of

Species/ Sensitivity	EPBC Act Management Publication	Key Threats Identified in the RP/CA	Relevant Conservation Actions
			the Torosa gas field and elsewhere across the Browse basin. This includes (but is not limited to) eliminating: • All sources of excessive or constant marine noise that may impact the dusky sea snake: • Use knowledge about barotrauma in oral gulping fish as a surrogate for assessing and avoiding barotrauma in the dusky sea snake until further information is available from targeted research; noting that reef-dependent sea snakes, including the dusky sea snake, have little to no capacity to relocate to avoid noise. • Ensure all other sources of excessive or constant marine noise that may impact the dusky sea snake are eliminated, including from drilling and shipping. *Although Shell considers this conservation action as not relevant to the activity—as there are no dusky sea snake known or likely distributions within the Noise Assessment Area—a conservative approach has been applied to consider potential noise impacts to areas where the dusky sea snake may occur.*
		Pollution from heavy metals and other toxins	Use scientifically informed planning and regulation to avoid impacts across the known and likely distribution of the dusky sea snake, including for development of the Torosa gas field and elsewhere across the Browse basin. This includes (but is not limited to) eliminating: • The risk of other pollutants affecting the dusky sea snake and its habitat, including produce water and heavy metals.
		Sedimentation and coral smothering	No actions which relate to the activities described within this EP.
		Marine vessels	
		Constant Marine Noise	• Develop, implement and enforce regulations that require marine vessels that are operating in areas where the dusky sea snake is known or likely to occur to have adequate noise-quieting technology installed. *Shell considers this conservation action as not a relevant as it relates to the development of regulation, implementation and enforcement of*

Species/ Sensitivity	EPBC Act Management Publication	Key Threats Identified in the RP/CA	Relevant Conservation Actions
			regulation, which is a function of relevant regulatory authorities. • Develop minimal-noise operating guidelines that address constant noise exposure and distribute these to captains of vessels operating in waters where the dusky sea snake is known or likely to occur. Ensure vessels are operating under minimal-noise guidelines in these areas. *Although Shell considers this conservation action as not relevant to the activity—as there are no dusky sea snake known or likely distributions within the Noise Assessment Area—a conservative approach has been applied to consider potential noise impacts to areas where the dusky sea snake may occur.*
		Small and fragmented population	
		Low genetic diversity	No explicit relevant conservation actions
		Hybridisation	No explicit relevant conservation actions
Short-nosed sea snake	Approved Conservation Advice for *Aipysurus apraefrontalis* (short-nosed sea snake) (TSSC 2010a)	No additional threats identified (ex. marine debris)	None applicable
Leaf-scaled sea snake	Approved Conservation Advice for *Aipysurus foliosquama* (leaf-scaled sea snake) (TSSC 2010b)	No additional threats identified (ex. marine debris)	None applicable
Sharks and Rays			
Grey nurse shark	Recovery plan for the grey nurse shark (*Carcharias taurus*) (DOE 2014)	Climate change	No explicit relevant conservation actions
White shark	Recovery plan for the white shark (*Carcharodon carcharias*) (DSEWPaC 2013)	No additional threats identified (ex. marine debris)	No explicit relevant conservation actions
		Climate change	
Northern river shark	Approved Conservation Advice for *Glyphis garricki* (northern	Habitat degradation/modification	Implement measures to reduce adverse impacts of habitat degradation and/or modification

Species/ Sensitivity	EPBC Act Management Publication	Key Threats Identified in the RP/CA	Relevant Conservation Actions
	river shark) (TSSC 2014a)		
	Sawfish and river shark multispecies recovery plan (CoA 2015b)		Identify risks to important sawfish and river shark habitat and measures need to reduce those risks
Green sawfish	Approved Conservation Advice for green sawfish (TSSC 2008b)	Habitat degradation/modification	No explicit relevant conservation actions
	Sawfish and river shark multispecies recovery plan (CoA 2015b)		Identify risks to important sawfish and river shark habitat and measures need to reduce those risks
Whale shark	Approved Conservation Advice on *Rhincodon typus* (whale shark) (DoE 2015e)	Vessel disturbance	Minimise offshore developments and transit time of large vessels in areas close to marine features likely to correlate with whale shark aggregations and along the northward migration route that follows the northern WA coastline along the 200 m isobath
		Habitat disruption from mineral exploration, production and transportation	Minimise offshore developments and transit time for large vessels
		Marine debris	No explicit relevant conservation actions
		Climate change	
Dwarf sawfish	Approved Conservation Advice for P*ristis clavata* (dwarf sawfish) (TSSC 2009)	Habitat degradation/modification	No explicit relevant conservation actions
	Sawfish and river shark multispecies recovery plan (CoA 2015b)		Identify risks to important sawfish and river shark habitat and measures need to reduce those risks
Freshwater sawfish	Approved Conservation Advice for P*ristis pristis* (largetooth sawfish) (TSSC 2014b)	Habitat degradation/modification	No explicit relevant conservation actions
	Sawfish and river shark multispecies recovery plan (CoA 2015b)		Identify risks to important sawfish and river shark habitat and measures need to reduce those risks

Species/ Sensitivity	EPBC Act Management Publication	Key Threats Identified in the RP/CA	Relevant Conservation Actions
Birds			
All seabirds and shorebirds	National Light Pollution Guidelines for Wildlife (DCCEEW 2023b)	Light pollution	Implement best practice light design principles and provide a suite of lighting design/lighting controls to mitigate the effect of light for projects relevant to seabirds
Migratory shorebirds[11]	Wildlife conservation plan for migratory shorebirds (DoE 2015a)	Habitat degradation/modification	Ensure all areas important to migratory shorebirds in Australia continue to be considered in development assessment processes
		Climate Change	No explicit relevant conservation actions.
Seabirds[12]	Wildlife conservation plan for seabirds (CoA 2020)	Anthropogenic disturbance	Identify, protect, and manage seabirds and their habitats in Australia
		Pollution (marine debris, light, acute, chronic)	No explicit relevant conservation actions.
		Climate Change	No explicit relevant conservation actions.
Abbott's booby	Conservation advice for Abbott's booby – *Papasula abbotti* (TSSC 2020b)	Climate Change	No explicit relevant conservation actions.
		Marine debris – plastics	
Asian dowitcher	Conservation advice for *Limnodromus semipalmatus* (Asian dowitcher) (DCCEEW 2024e)	Pollution	No explicit relevant conservation actions.
		Climate Change	
Australian lesser noddy	Conservation advice A*nous tenuirostris melanops* (Australian lesser noddy) (TSSC 2015a)	Habitat degradation/modification	No explicit relevant conservation actions.
		Pollution/contamination	
Australian painted snipe	Approved conservation advice on R*ostratula australis* (Australian painted snipe) (TSSC 2013)	Habitat degradation/modification	No explicit relevant conservation actions
	National Recovery Plan for the Australian painted snipe (*Rostratula*	Climate Change	No explicit relevant conservation actions

[11] Includes Asian dowitcher, bar-tailed godwit, common sandpiper, curlew sandpiper, eastern curlew, greater sand plover, pectoral sandpiper, red knot, sharp-tailed sandpipe and streaked shearwater.

[12] Includes bridled tern, brown booby, Caspian tern, Christmas Island white-tailed tropicbird, common noddy, great frigatebird, greater crested tern, greater crested tern, lesser frigatebird, little tern, masked booby, red-footed booby, red-tailed tropicbird, roseate tern, streaked shearwater, wedge-tailed shearwater and white-tailed shearwater.

Species/ Sensitivity	EPBC Act Management Publication	Key Threats Identified in the RP/CA	Relevant Conservation Actions
	australis) (DCCEEW 2022)		
Bar-tailed godwit (northern Siberian)	Approved conservation advice for *Limosa lapponica menzbieri* (yakutian bar-tailed godwit) (DCCEEW 2024d)	Habitat degradation/modification Climate Change	No explicit relevant conservation actions
Bar-tailed godwit (western Alaskan)	Conservation advice *Limosa lapponica baueri* (Alaskan bar-tailed godwit) (DCCEEW 2024c)	Habitat degradation/modification Climate Change	No explicit relevant conservation actions
Christmas Island white-tailed tropicbird	Conservation advice P*haethon lepturus fulvus* (white-tailed tropicbird-Christmas Island) (TSSC 2014c)	Marine debris – plastics Pollution/contamination (oil spills)	No explicit relevant conservation actions No explicit relevant conservation actions
Curlew sandpiper	Conservation Advice C*alidris ferruginea* curlew sandpiper (DCCEEW 2023f)	Pollution/contamination Climate Change	No explicit relevant conservation actions
Eastern curlew	Conservation Advice *Numenius madagascariensis* eastern curlew (DCCEEW 2023e)	Pollution/contamination Climate Change	No explicit relevant conservation actions
Greater sand plover	Conservation advice for *Charadrius leschenaultii* (greater sand plover) (DCCEEW 2023g)	Habitat degradation/modification Climate Change	No explicit relevant conservation actions
Red knot, knot	Approved Conservation Advice for *Calidris canutus* (red knot) (DCCEEW 2024b)	Pollution/contamination Climate Change	No explicit relevant conservation actions
Red-tailed tropicbird	Conservation advice for *Phaethon rubricauda westralis* (indian ocean red-tailed tropicbird) (DCCEEW 2023h)	Climate Change	No explicit relevant conservation actions
		Pollution	No explicit relevant conservation actions

Species/ Sensitivity	EPBC Act Management Publication	Key Threats Identified in the RP/CA	Relevant Conservation Actions
Sharp-tailed sandpiper	Conservation advice for *Calidris acuminata* (sharp-tailed sandpiper) (DCCEEW 2024a)	Climate Change	

7.8 Socioeconomic Features

7.8.1 People and Communities

People residing in these coastal areas of the northern region of Australia tend to concentrate in a relatively small number of remote population centres, often separated by large expanses of pastoral and/or undeveloped land. Figure 7-22 shows and Table 7-17 summarises the main coastal towns and communities within the north-western region of Australia. Sections 7.8.1 to 7.8.7 describes the socioeconomic features and Section 7.9 describes the associated values and sensitivities within or proximal to the Planning Area. Sections 7.10 and 7.11 detail the heritage and cultural features and values within or proximal to the Planning Area.

Table 7-17: Overview of Key Population Centres Adjacent

Community	Population			Employment	
	Size	Avg/Median Age	% Aboriginal	Most People Employed	% Fishing, Forestry, Agriculture
Karratha	22,199[13]	33[14]	13.3[14]	Mining[13]	0.2[14]
Broome	16,959[15]	33[16]	32.3[15]	Health Care and Social Assistance[15]	3.0[15]
Derby	7,075[17]	33[16]	70.4[16]	Education and Training[17]	5.5[16]
Darwin	140,000[18]	33[18]	8.7[18]	Government and Community Services[19]	1.1[19]

[13] Karratha region (Pilbara Development Commission [PDC] 2023)
[14] Pilbara region (PDC 2023)
[15] Broome region (Kimberley Development Commission [KDC] 2023)
[16] Kimberley region (KDC 2023)
[17] Derby-West Kimberley (KDC 2023)
[18] ABS 2022
[19] NT Gov 2023c

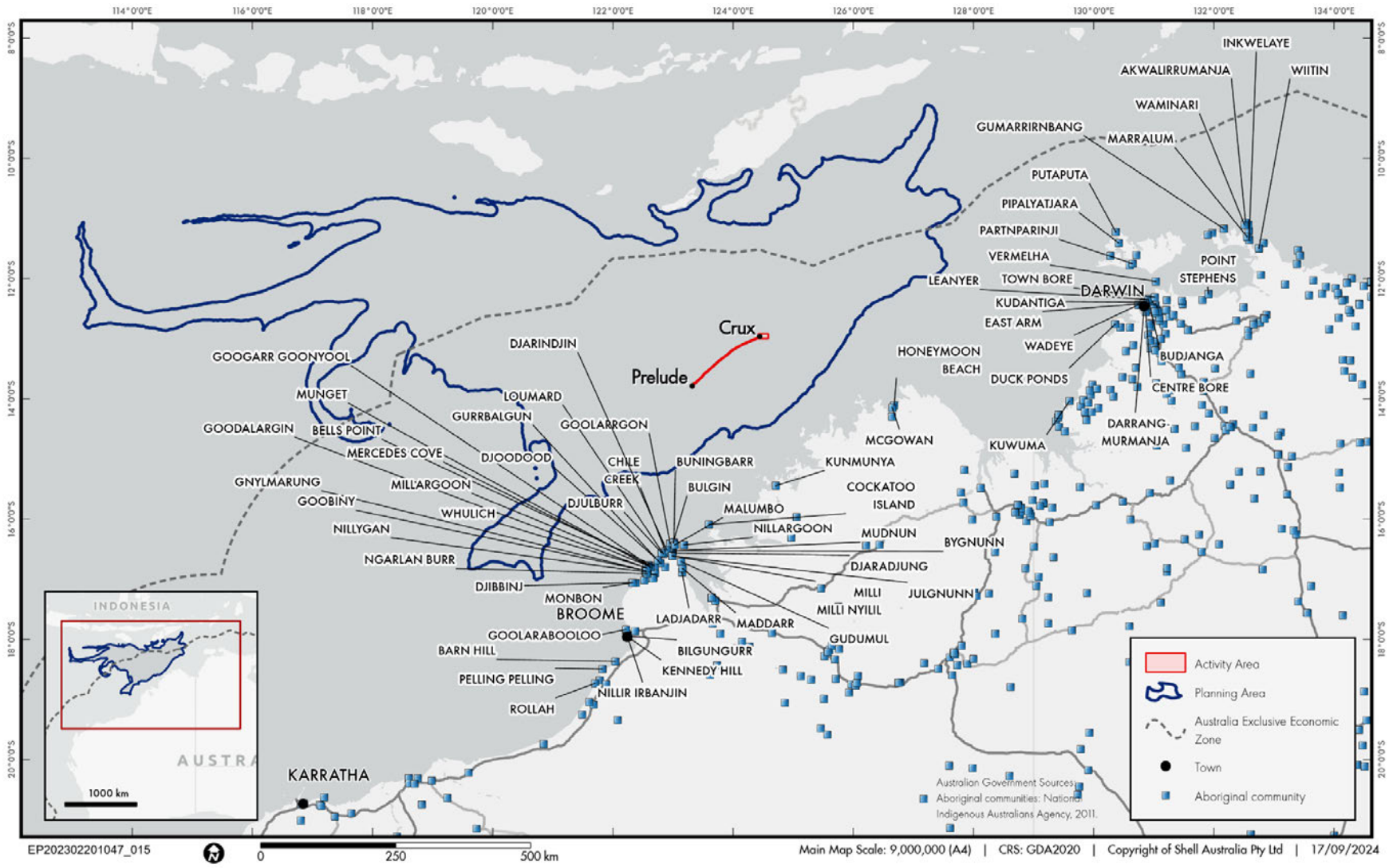


Figure 7-22: Regional Population Centres and Communities

7.8.2 Fishing Industry

The NWMR supports Commonwealth and WA–managed commercial fisheries that target various shark, demersal and pelagic finfish, molluscs, oyster pearls and crustacean species of commercial importance. The commercial fisheries within or proximal to the Activity and Planning Areas are shown in Figure 7-23, Figure 7-24, Figure 7-25, Figure 7-26 and Figure 7-27. Section 7.9.1 describes the tourism and recreational values and sensitivities within or proximal to the Planning Area. Refer to section 7.5.3.1 for details of baseline fish mercury levels.

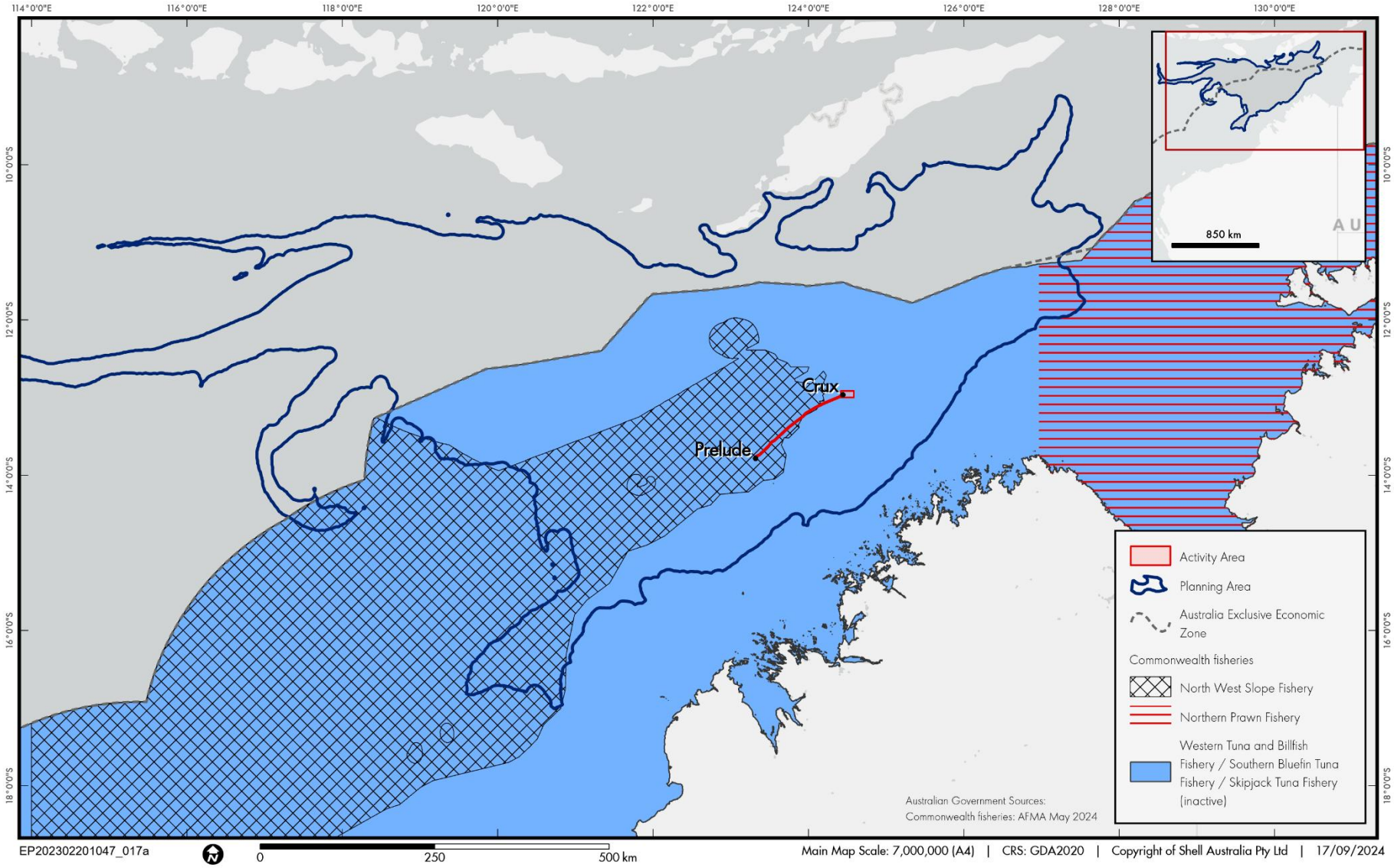


Figure 7-23: Commonwealth-Managed Fisheries Management Areas within the Planning Area

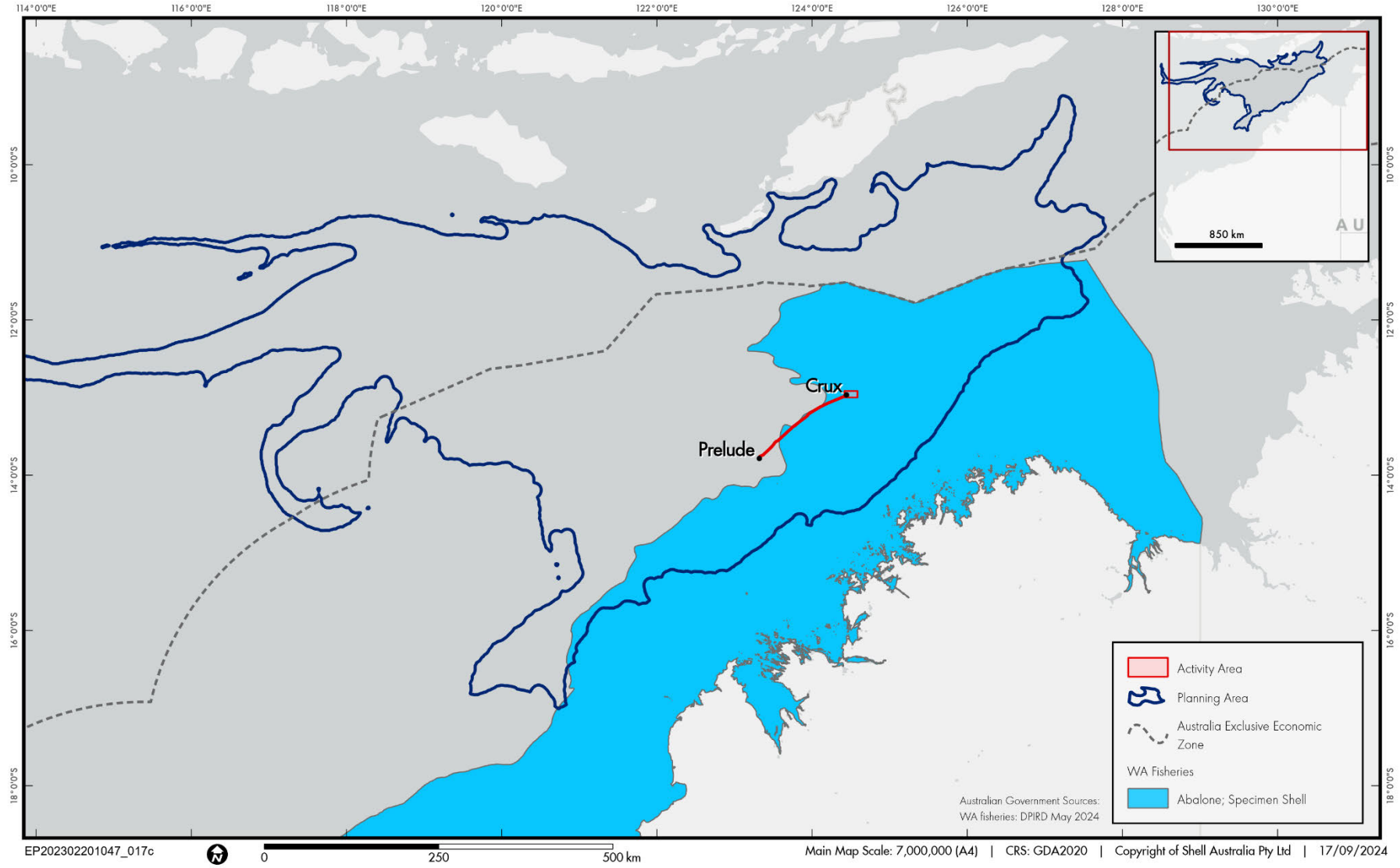


Figure 7-24: WA-Managed Fisheries Management Areas within the Planning Area (1)

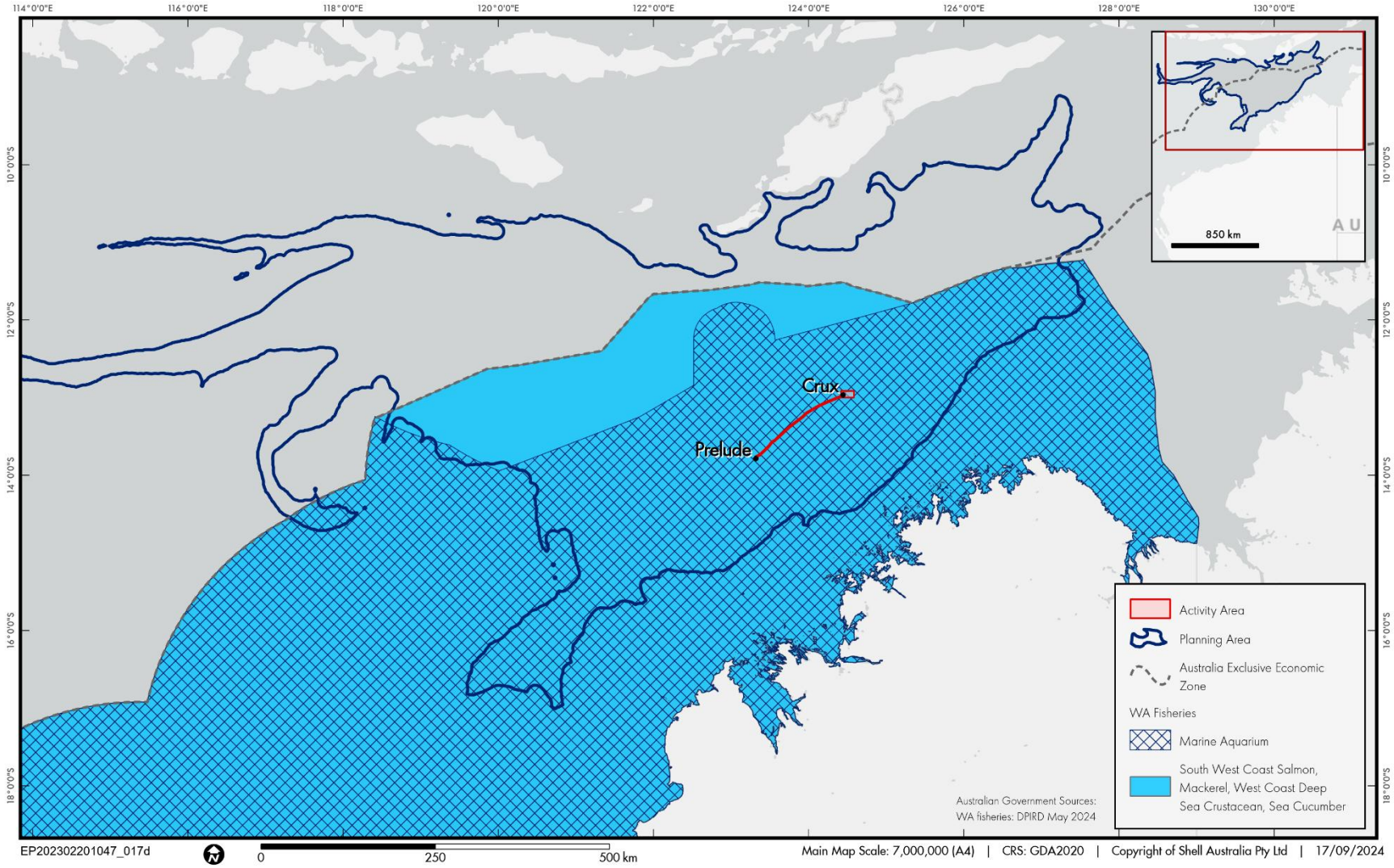


Figure 7-25: WA-Managed Fisheries Management Areas within the Planning Area (2)

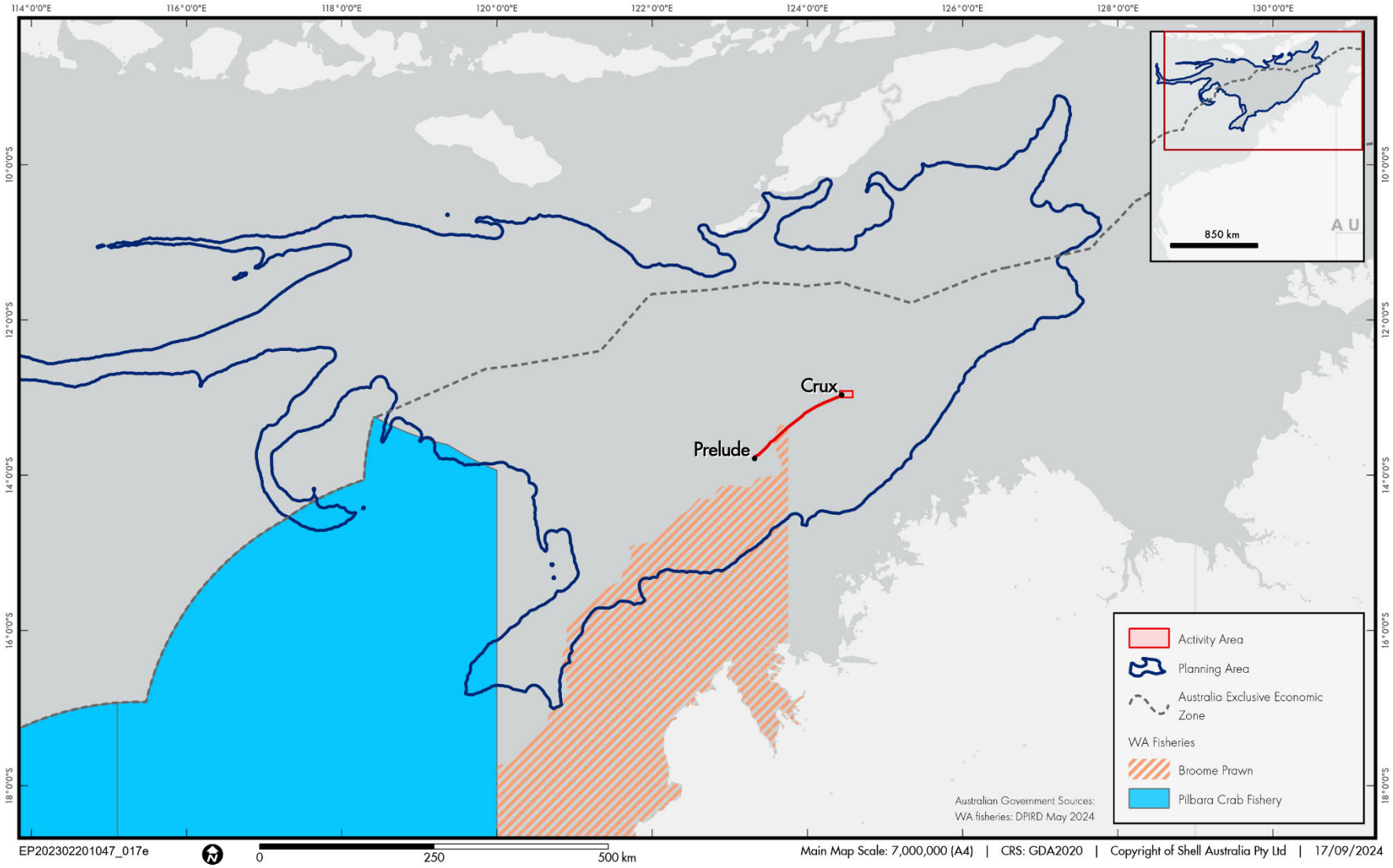


Figure 7-26: WA-Managed Fisheries Management Areas within the Planning Area (3)

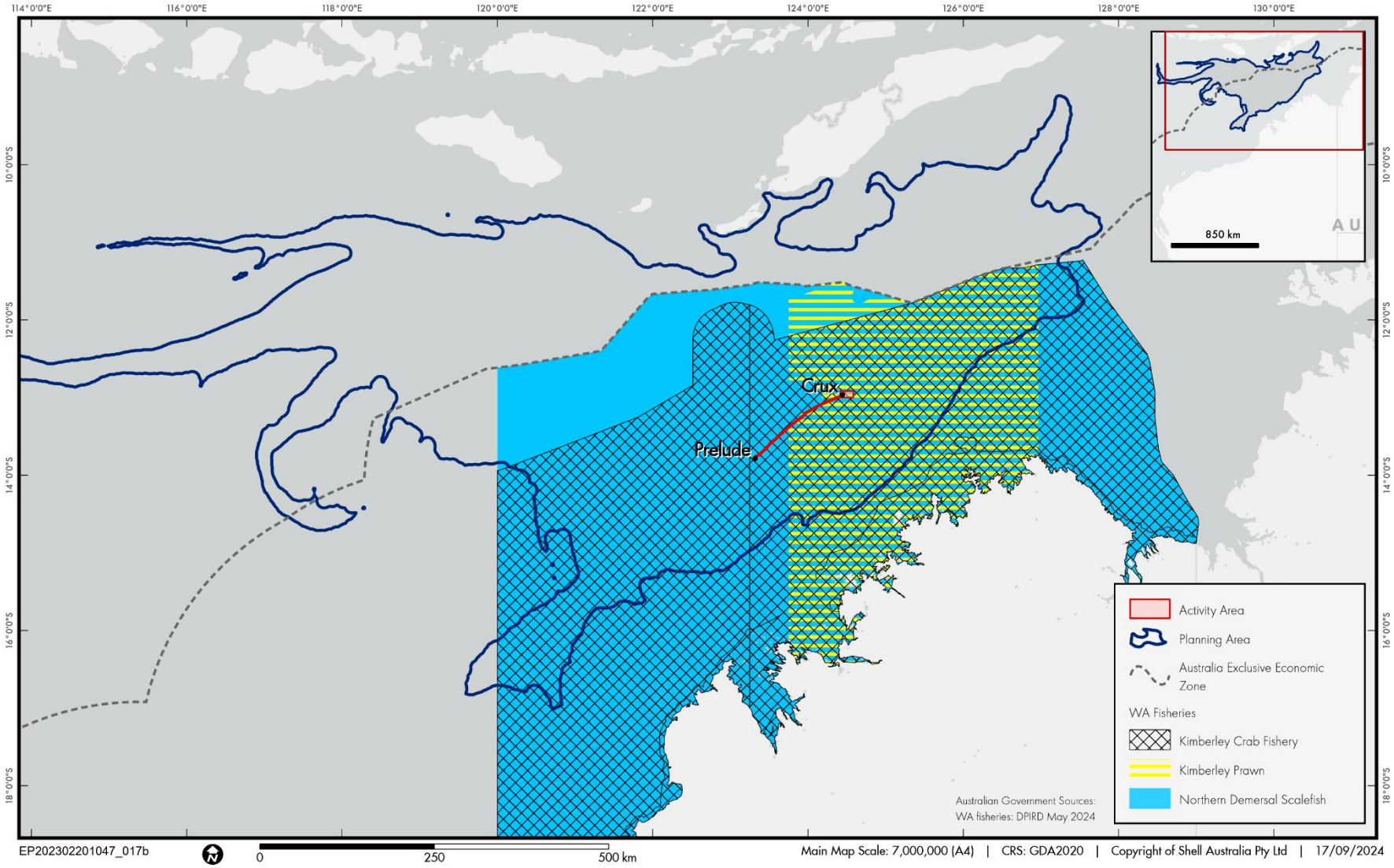


Figure 7-27: WA-Managed Fisheries Management Areas within the Planning Area (4)

7.8.3 Tourism and Recreation

The northern and north-western regions of Australia are considered important visitor destinations for Australian and international tourists. Water-based tourism and recreational activities such as recreational and charter fishing, swimming, snorkelling/diving, wildlife watching and boating could occur within the Planning Area. However, these activities are generally concentrated in coastal waters and around inshore islands near population centres along the mainland coast. There are no known regular recreational fishing activities that occur within the Activity Area due to the distance from shore (e.g. access to the Activity Area would take >15 hours (assuming high vessel speeds of 30 km/h) from the nearest port (Broome, WA), however there is a potential for transiting tourism vessels. Section 7.9.2 describes the tourism and recreational values and sensitivities within or proximal to the Planning Area.

7.8.4 Defence

Maritime Border Command (MBC) is enabled by Australian Border Force (ABF) and the Australian Defence Force (ADF). The MBC undertakes civil and maritime surveillance (and enforcement) within the activity and Planning Areas (Department of Home Affairs [DHA] 2018a, 2018b). There are no Defence exercise areas within the Activity Area, however, defence activities may occur within the Planning Area (Figure 7-28). Section 7.9.3 describes the Defence values and sensitivities within or proximal to the Planning Area.

7.8.5 Shipping

Most shipping movements in the Activity Area are associated with the operation of the Prelude FLNG facility and Ichthys facilities (e.g. offtake tankers, vessels etc.). Figure 7-29 summarises the regional shipping movements and port areas within the Planning Area. Section 7.9.4 describes the shipping values and sensitivities within or proximal to the Planning Area.

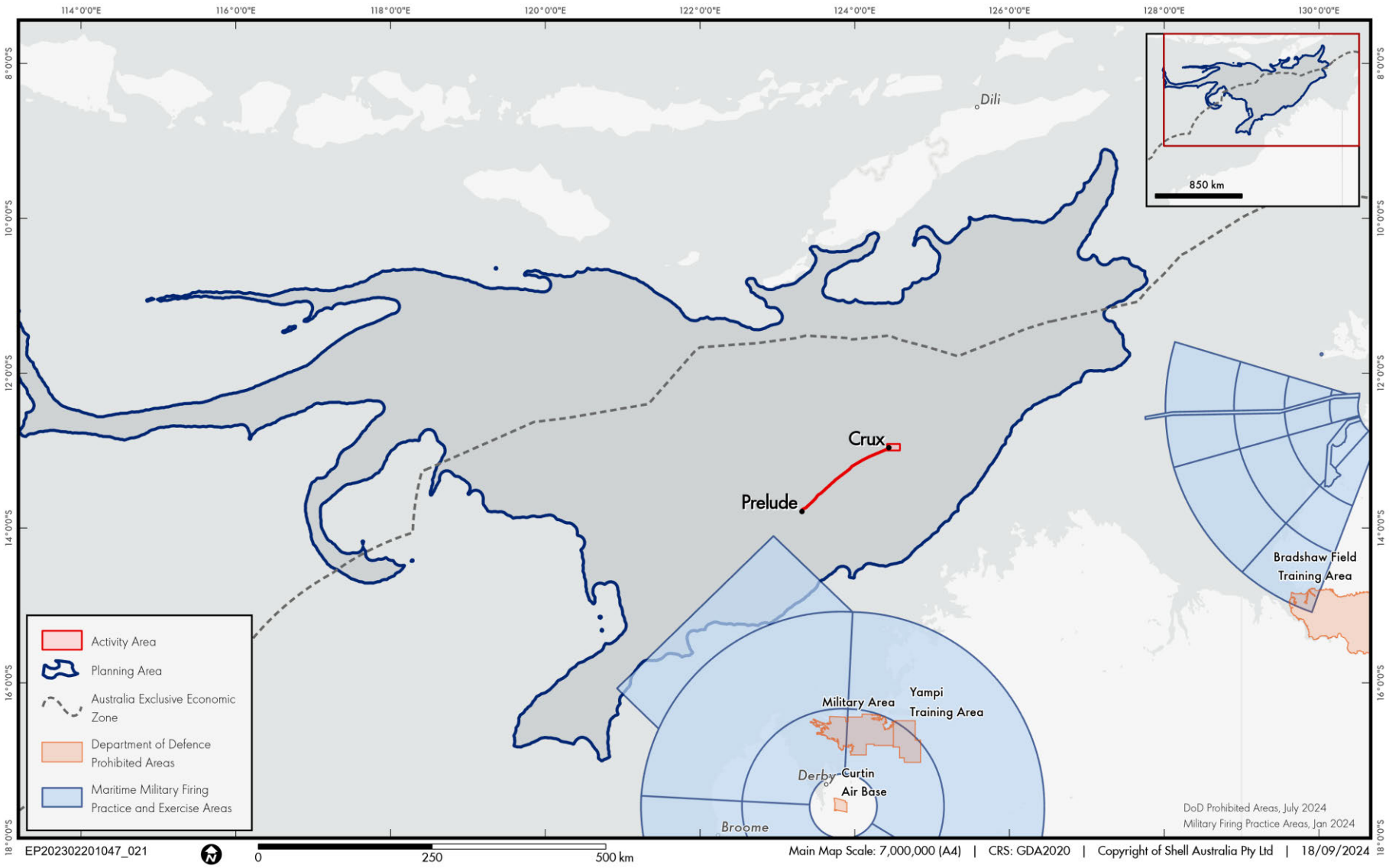


Figure 7-28: Defence Practice and Exercise Areas within or Proximal to the Planning Area

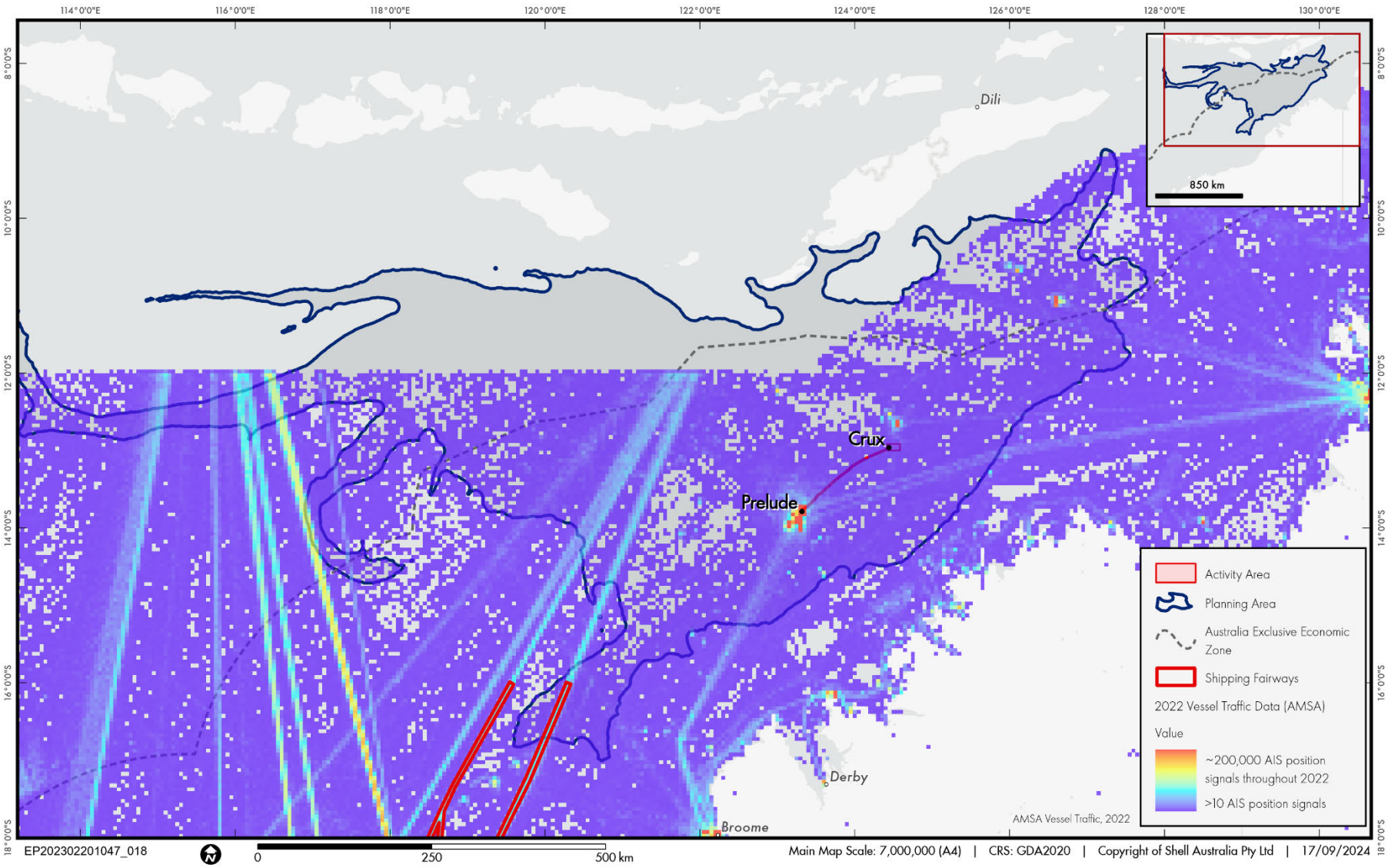


Figure 7-29: Shipping Levels within the Activity Area and Planning Area

7.8.6 Scientific Research and Restoration

The Planning Area encompasses the sites for some long-term marine research and restoration programs in the north-west shelf conducted by the Australian Institute of Marine Science (AIMS), various universities and industry. Some petroleum activities, such as seismic, may interrupt nearby research activities and unplanned releases have the potential to adversely affect long term programs. Further detail is provided in Section 7.9.5.

7.8.7 Oil and Gas Industry

Oil exploration activities in the Timor Sea commenced in the late 1960s. Since this time numerous wells have been drilled throughout the region. Petroleum exploration has been active in the Browse Basin since the 1980s, with several commercial discoveries since that time. It is expected that petroleum exploration and development activities will continue in the region into the future.

The Prelude FLNG facility is interconnected to the activity and the next closest facilities are Ichthys FPSO (~20 km south of the Activity Area and ~164 km southwest of the Crux platform) and Montara FPSO (~30 km and 36 km north of the Activity Area and Crux Platform respectively).

7.8.8 Indonesian and Timor-Leste Coastlines

The Planning Area intersects the Indonesian and Timor-Leste waters and coastlines (RPS 2024b) and is ~310 km north from the Crux platform (see Section 7.9.5). The spill modelling predicted a low (2%) probability of accumulating on shorelines above the low threshold for shoreline concentrations and no floating oil for coastal waters for a worst-case credible spill scenario.

7.9 Socioeconomic Values and Sensitivities

7.9.1 Fishing Industry

Commercial fishing within the Planning Area is an important contributor to regional income and employment in the coastal towns of north-western Australia.

Commonwealth fisheries are managed by the AFMA under the *Fisheries Management Act 1991* (Cth). Commonwealth fisheries operate in Commonwealth waters within the 200 nm Australian Fishing Zone and in some cases, by agreement with a State or Territory, to the low water mark. The Commonwealth–managed commercial fisheries that occur within the Planning Area are shown in Figure 7-23. Table 7-18 summarises the current status of the Commonwealth–managed fishery, based on information in the Fishery Status Reports 2023 (DAFF 2023a).

WA–managed fisheries are managed by DPIRD through a range of regulatory arrangements under the *Fish Resources Management Act 1994* (WA). The WA–managed commercial fisheries that occur within the Planning Area are shown in Figure 7-24 to Figure 7-27. Table 7-18 summarises the current status of the WA–managed fishery, based on information in the WA State of the Fisheries 2022–23 (Newman et al. 2023).

Section 5 describes the consultation undertaken with AFMA, DPIRD and appropriate fishery associations and licence holders. Table 7-18 lists and assesses the potential for interaction—informed through consultation—between the commercial fisheries and the activity.

Refer to section 7.5.3.1 for details of baseline fish mercury levels.

Table 7-18: Fishing Industry within the Planning Area

Fishery Industry	Activity Area	Planning Area	Description	Potential for interaction within the Activity Area
Commonwealth–Managed Fisheries				
North West Slope Trawl Fishery	✓	✓	The fishery operates within the 200 m isobath between 114 E and 125 E. Target species is scampi, including Australian scampi, velvet scampi and Boschma's scampi. Total catch in 2021–2022 was 85.8 t with three active vessels using primarily demersal trawl methods (DAFF 2023a).	The fished area overlaps the Activity Area; therefore there is potential for interaction with the fishery.
Western Tuna and Billfish Fishery	✓	✓	The fishery management area is within the Australian EEZ and the high seas of the Indian Ocean. Key species in the fishery are swordfish, striped marlin, yellowfin tuna and bigeye tuna. Main method is pelagic longline with some minor-line fishing. The total catch was 139 t in the 2022 season with five active vessels (DAFF 2023a).	Shell considers there is no potential for interaction with this fishery within the Activity Area.
Southern Bluefin Tuna Fishery	✓	✓	Fishery management area includes all Australian waters, out to 200 nm from the coast. No current effort in north-western Australia, fishing activity is concentrated in the Great Australian Bight (DAFF 2023a).	Shell considers there is no potential for interaction with this fishery within the Activity Area.
Northern Prawn Fishery	×	✓	The fishery extends from the NT high tide mark out to 200 nm. Target species include a number of tropical prawn species including white banana prawn, brown tiger prawn, and grooved tiger prawn, which comprise 80% of catch. Otter trawl gear is used. Total landed catch in 2022 was 5,526 t, comprising 5,404 t of prawns and 122 t of byproduct species (predominantly squid, bugs and scampi). Fifty-two permits were all used with 52 licensed vessels active in this season (DAFF 2023a). Notably, seasonal fishing effort fluctuates naturally with variability in banana prawn availability. A substantial portion of fishing effort occurs within inshore coastal areas of the Gulf of Carpentaria (outside the Planning Area).	The fishery management area does not overlap with the Activity Area; therefore, Shell considers there is no potential for interaction with this fishery within the Activity Area.

Fishery Industry	Activity Area	Planning Area	Description	Potential for interaction within the Activity Area
WA–Managed Fisheries				
Abalone Fishery	✓	✓	No commercial fishing for abalone north of Moore River (Area 8 of the managed fishery) has occurred since 2011–2012 (Strain et al. 2023).	There is no potential for interaction with the fishery within the Activity Area.
Broome Prawn	✓	✓	The Broome Prawn managed fishery primarily targets western king prawns. No fishing effort occurred as no boats undertook trial fishing activities in 2022, therefore no landings were recorded (Newman et al. 2023).	Although the Activity Area intersects a small section of the Broome Prawn licence, interaction with this fishery is highly unlikely as commercial fishing is prohibited across most of the licence area, including the Activity Area (Kangas et al. 2023).
Kimberley Crab Fishery	✓	✓	The Kimberley Crab Fishery operates off the north-west coast of WA in WA waters. Fishing effort is concentrated in nearshore waters and targets brown mud crab species between April and September (Johnson et al. 2023). The total catch in 2022–2023 was 2.4 t (Johnson et al. 2023).	Interaction with this fishery is highly unlikely, given the very low fishing effort concentrated in nearshore waters.
Kimberley Prawn	✓	✓	The Kimberley Prawn managed fishery primarily targets banana prawns with a total catch of ~239 t in 2022–2023 (Newman et al. 2023). There are two fishing periods for the season (April to mid-June; August to end of November).	Although the Activity Area intersects a small section of the Kimberley Prawn licence, no fishing effort occurs within or near the Activity Area, hence there is no potential for interaction with this fishery within the Activity Area.
Mackerel Fishery	✓	✓	The Mackerel Fishery fishing effort is typically concentrated in the North Coast Bioregion, which encompasses the Pilbara and Kimberley coastline (Lewis and Rynvis 2023). Dominant fishing method is trolling, also with jigging methods also used to catch grey mackerel in some areas (Mackie et al. 2010). Catch effort in the 2022–2023 was 137 t in the Pilbara region. Sixteen boats fished during the 2020 season, with <3 active vessels within the 60 nm Catch and Effort System (CAES) block (12240) that overlaps the Activity Area (Lewis and Rynvis 2023).	Shell considers there to be limited potential for interaction with this fishery within the Activity Area.
Marine Aquarium Fish Managed Fishery	✓	✓	The fishery encompasses all WA State waters, but most effort occurs south of Broome. The fishery has the capacity to target 1500 marine aquarium fish species (Newman et al. 2023). Primarily dive based using hand-held nets (DPIRD 2023). Catch effort in the 2022–2023 was 19,710 individuals with 13 licences (Newman et al. 2023)	Given the nature of this fishery, effort is expected to be largely restricted to coastal waters <30 m deep. Therefore, no fishing effort occurs within or near the Activity Area, and there is no potential for interaction with this fishery within the Activity Area.

Fishery Industry	Activity Area	Planning Area	Description	Potential for interaction within the Activity Area
Northern Demersal Scalefish Fishery	✓	✓	The fishery includes all waters of the Indian Ocean and Timor Sea off the Kimberley coast of WA that are east of 120°00.079′ and north of 19°59.917′. There are some restricted areas within the fishery. The fishery is divided into two fishing areas; • Area 1 – inshore • Area 2 – offshore. Area 2 is further divided into Zone A, B and C. Offshore fishing method uses traps. Fishing effort for 2022–2023 was 1,458 t. Seven vessels fished in the 2020 fishing season (Newman et al. 2023).	Shell considers that there is potential for interaction with this fishery within the Activity Area.
Pearl Oyster Fishery	✓	✓	This fishery targets only the silver lipped pearl oyster (*Pinctada maxima*) and operates from Exmouth to the NT border. Effort is predominately focused along the shallow coastal waters of the NWS (Hart et al. 2023), from the Lacepede Islands north of Broome to Exmouth Gulf (WAFIC 2023b). Dive based fishery with oysters collected individually as divers are towed behind the fishing vessel, using surface supplied air (Fletcher et al. 2006). Catch effort for 2022–2023 was 756,531 oysters and six vessels were active (Hart et al. 2023).	The Activity Area overlaps within management zone 3, but it is much deeper than safe diving depths in which pearl oyster fishing occurs. Most pearl fishing occurs in inner continental shelf waters (<30 m deep) along the Kimberley and Pilbara coastlines. Since 2011, no vessels were active within the 60 nm CAES block (12240) overlapping the Activity Area. Because this fishery is diver-based (i.e. restricted to safe diving depths), Shell considers that there is no potential for interaction with the fishery within the Activity Area.
South West Coast Salmon	✓	✓	The South West Coast Salmon Managed Fishery licence expands across WA waters and therefore overlaps the Activity Area. Total catch for West Coast Nearshore and Estuarine and Finfish (includes South West Coast Salmon Managed Fishery) in the 2022-2023 season was 30.25 t (Duffy et al. 2023).	Fishing effort is concentrated in the south-west coast of WA; therefore, there is no potential for interaction with this fishery within the Activity Area.
Specimen Shell Managed Fishery	×	✓	Fishery encompasses the entire WA coastline between the high water mark and the 200 m isobath, with concentration of effort in areas adjacent to Broome, Exmouth, Shark Bay, Geraldton, Perth, Mandurah, the Capes area, Albany and Esperance. Hand based collection (diving, wading and ROVs) (Newman et al. 2023) Of the 30 licences in the fishery, 16 vessels were active with a total catch in 2022–2023 was 5,074 shells (Bruce et al. 2023).	Shell considers that it is unlikely for interaction with this fishery within the Activity Area.

Fishery Industry	Activity Area	Planning Area	Description	Potential for interaction within the Activity Area
West Coast Deep Sea Crustacean Fishery	✓	✓	The fishery operates off the WA coast from 34°2′S to the NT border, from the 150 m isobath out to the Australian EEZ (Tuffey et al. 2023). Fishery uses baited pots operated in a long-line formation in shelf edge waters (>150 m) of the West Coast and Gascoyne Bioregions (Newman et al. 2023). Most catch is in waters 500–800 m deep (WAFIC 2023a) and landed primarily in ports between Carnarvon and Fremantle. Catch effort for the 2022–2023 season totalled 123.2 t of crystal crab and 10 t of champagne crab with five active vessels (Tuffey et al. 2023)	Fishing effort is concentrated outside of the Activity Area; therefore, there is no potential for interaction with this fishery.

7.9.2 Tourism and Recreation

No tourism activities are known to occur within the Activity Area, but they do occur widely in the Planning Area. Most tourism within the Planning Area is nature-based and is typically associated with outstanding natural features such as the Kimberley coastline and the offshore reefs and islands (such as Ashmore Reef). Due to the remoteness of the Planning Area, most offshore tourism activities are organised expeditions, which use larger vessels.

Tours, charters and luxury cruises provide annual expeditions to Scott Reef, Seringapatam Reef, Ashmore Reef and Cartier Island (Newman et al. 2023) to provide fishing, wildlife watching, snorkelling and diving activities. Offshore islands, coral reef systems and continental shelf waters are increasingly targeted by fishing-based charter vessels (Newman et al. 2023). Recreational anglers typically target demersal and pelagic fish species for consumption and sport. Seasonal aggregations of marine megafauna, such as whale sharks, manta rays, sea turtles and whales, support nature-based tourism. The winter humpback whale migrations off the WA coastline provide vessel-based whale watching opportunities for charter operators.

7.9.3 Defence

Section 7.8.4 describes the Defence features. The Planning Area is within a maritime military firing practice and exercise area extending offshore administered by Department of Defence. The maritime military firing practice and exercise area extends from the Curtin Air Base, near Derby, WA (see Figure 7-28). ABF MBC undertakes civil and maritime surveillance (and enforcement) in and around the Activity Area (DHA 2018a, 2018b). Their primary purpose is to monitor the passage of suspected illegal entry vessels and illegal foreign fishing activity within and beyond Australia's EEZ, which extends to ~200 nm from the mainland (DHA 2018a). A search of the Department of Defence's UXO map indicated that no UXOs are known to occur within the Activity Area (Department of Defence n.d.) with the nearest known UXO >220 km from the Activity Area.

7.9.4 Shipping

Shipping activity in the vicinity of the Activity Area is considered high. However, most shipping movements in the Activity Area are associated with the operation of the Prelude FLNG facility and Ichthys facilities (e.g. offtake tankers, vessels etc.). Coastal ships may potentially traverse the Activity Area from the major state and territory ports (Broome, Derby, Wyndham, Darwin), and MBC may conduct civil and maritime surveillance in and around the Activity Area to monitor the passage of illegal entry vessels and illegal foreign fishing activity (DHA 2018b).

Figure 7-29 summarises the regional shipping movements and port areas within the Planning Area.

7.9.5 Scientific Research and Restoration

Long-term scientific research and restoration in the Planning Area included:

- AIMS studying the Scott Reef and Ashmore Reef systems for over 20 years.
- As part of the North-west Shoals to Shore Research Program, AIMS has been conducting habitat mapping, examining the impacts of seismic surveys on fish communities and oysters, as well as looking at whale and turtle distribution on the northwest shelf.
- The Marine Biodiversity Hub a collaborative partnership supported through funding from the Australian Government's National Environmental Research Program runs a number of programs including a decade of research on river sharks and sawfishes in the region. They also focus on AMPs, sustainable resource use, threatened and migratory species and coastal habitat restoration and developed mapping and predictive tools for shallow-reef biodiversity, wastewater discharges, and the effects of ship noise and vessel strikes on large marine animals.

7.9.6 Oil and Gas Industry

Section 7.8.7 describes the offshore oil and gas development in the Planning Area. The offshore exploration and production of oil and gas was the largest contributor ($376 million) to economic output of the marine industry in 2020–2021 with the economic output attributable to WA ($275 million) (AIMS 2023).

7.9.7 Indonesian and East Timor Coastlines

East Nusa Tenggara is considered important to marine mammals that has the potential to be delineated and managed for conservation. The East Nusa Tenggara coastal area has numerous seagrass meadows supporting a large number of dugongs and seaweed harvesting (IUCN-MMPATF 2022).

7.10 Heritage and Cultural Features

In addition to the Commonwealth Heritage Places (see Section 7.3.1.4), there are maritime and Indigenous heritage features within the Planning Area that also have heritage and cultural importance.

7.10.1 Underwater Cultural Heritage

The waters within the Planning Area contain the remains of numerous vessels, aircraft and other underwater sites/artefacts that have, or may have, cultural heritage value. Section 7.11.1 describes the values associated with the historic shipwrecks and associated articles, sunken aircraft and associated articles, and other underwater heritage protected under Commonwealth and State/Territory legislation.

7.10.2 Traditional Indonesian Fishing

Traditional Indonesian fishing has occurred in the waters of the Planning Area, including the islands and reefs off the northern coast of Australia, for centuries, focused on trepang (holothurians or sea cucumbers) but also targeting turtle shell, trochus shell, shark fin and reef fish (Environment Australia 2002). Section 7.11.2 describes the values associated with traditional fishing.

7.10.3 Indigenous Cultural Connections

The Planning Area potentially overlaps or is adjacent to sea Country of the Indigenous Peoples of Australia[20]. Shell acknowledges the decision of the Federal Court in Munkara v Santos NA Barossa Pty Ltd (No 3) [2024] FCA 9 and its interpretation of 'cultural features' – specifically, that:

- Beliefs and values (characterised as intangible cultural features of a place) must be communally held by the relevant people such that they are representative of shared cultural beliefs.
- There must be a 'sufficient cogent or coherent belief that is sufficiently accepted so that it can be described as having normative content for the people or community' in order to constitute a 'cultural feature'.
- The question of whether a sufficient cogent or coherent belief (that is sufficiently accepted) exists can be answered by reference to the customs and practices of the relevant people.

Section 7.11.3 describes consideration of the Indigenous cultural and social values that intersect the Planning Area.

7.10.3.1 Indigenous People and Communities

Indigenous Peoples have the oldest living cultural history in the world (NARVIS 2021). The presence of Indigenous Peoples in northern Australia dates back more than 60,000 years and is evidenced in the rich Indigenous cultural records that include some of the oldest cultural sites in Australia (Section 7.11.3.2.4) (NLC 2023a).

Country is an important concept to Indigenous Peoples. The term Country is often used by Indigenous Peoples to describe family origins and associations with particular parts of Australia, both land and sea. The expressions Country and sea Country are used by Indigenous Peoples to refer to the land and waters *which constitute Aboriginal traditional areas as ancestrally distinct and linguistically bounded geographic areas (*Kearney et al. 2023 p106*).* Country is inclusive of many environments that *are ecologically, geographically, ancestrally and socially configured* (Kearney et al. 2023). For Indigenous Peoples Country is a combination of the land, sea, rivers and islands and all that they contain and sustain.

Country is described further in Section 7.11.3.2.

Although many Indigenous Peoples do not live permanently on traditional Country, families and individuals retain close personal connections with their Country and visit regularly for extended trips, to care for Country, find traditional foods and connect with important sites. Regular connection to Country is of significant importance for Indigenous Peoples.

Numerous different Indigenous groups have connections to different parts of Country within the Planning Area. These family groups are representative of many different Indigenous language groups, the languages of which have been spoken for millennia.

[20] The term Indigenous People includes all people of Aboriginal and Torres Strait Islander descent.

7.10.3.2 Land and Sea Tenure and Ownership

Both traditional and contemporary systems of land and sea ownership are present within the Planning Area, as described in Sections 7.10.3.2.1 and 7.10.3.2.2 respectively. The Planning Area does not overlap Aboriginal freehold land boundary under ALRA or any ILUAs (see Figure 7-33), IPAs (see Figure 7-34) or Native Title determinations (see Figure 7-32).

7.10.3.2.1 Traditional Land and Sea Ownership

The marine areas located within/adjacent the Planning Area have been cared for and managed by many Indigenous Peoples for thousands of years. There are complex systems of rules, rights, customs and traditional knowledge that govern Indigenous Peoples interactions with each other and their land and sea estates within the Planning Area.

For Indigenous People, Country is not bound by state and territorial borders or maritime boundaries distinguished by international conventions or economic jurisdiction. An example of this is evident in the answer provided by Mary Yarmirr, under cross-examination to the question of the extent of her traditional sea Country in the 1998 Federal Court hearing of the Croker Island Native Title claim[21]:

> '*As far as my eyes can carry me'* (Mary Yarmirr 1998, cited in AHRC 2001).

Culture and ancestral features provide the necessary political distinction of traditional Country. Customary law, passed from generation to generation informs traditional land and sea ownership (NLC 2023b).

7.10.3.2.2 Contemporary Land and Sea Ownership

Native Title determinations provide formal recognition under Australian law of the complex cultural system of Indigenous Peoples ongoing relationships, interests, rights, and responsibilities in relation to land and sea. Native Title can be non-exclusive or exclusive, and can co-exist with other property rights (e.g. pastoral stations). Native Title can exist over both land and sea estates. Indigenous Peoples and their relationship and custodianship of their Country is protected by the *Native Title Act 1993* (Cth) and any determinations made by the NNTT.

The Planning Area does not intersect any Native Title determinations (see Figure 7-32). Whilst traditional ownership of sea Country in some areas has been formally recognised through native title and Aboriginal freehold land tenure, many other Indigenous Peoples claim use of and connection to sea Country.

7.10.3.3 Ancient Landscapes

Past coastal environments and climate played a central role in the development of early human communities (Erlandson and Fitzpatrick 2006; Rick and Fitzpatrick 2012 in Lebrec et al. 2022). There is evidence indicating that land areas that were once inhabited by humans are now submerged (O'Leary et al. 2020). Post glacial sea level rise resulted in the inundation and submergence of cultural sites covering the period from first arrival to Australia, an estimated 60,000 years ago, to the present sea level elevations that occurred around 7,500 years ago (O'Leary et al. 2020). The Ancient coastline at 125 m depth contour KEF (see Table 7-9) in the North West region (see Figure 7-9) represents the lowest sea level during Indigenous occupation (O'Leary et al. 2020; Williams et al. 2018). In 2020 researchers associated with the Deep History of Sea Country Project (Benjamin et al. 2020) reported the first confirmed ancient underwater archaeological site from the continental shelf, located off the Murujuga coastline in north-western Australia.

Shell commissioned an independent specialist consultant to undertake a desktop assessment of the potential presence of First Nations underwater cultural and social values within the Activity Area (Cosmos Archaeology 2023). First Nations UCH was defined as all tangible and intangible cultural expressions that are associated with and claimed by Indigenous groups within Australia (past and present) and which occurs in and is attributable to contexts that are now submerged by waters.

Tangible cultural heritage refers to the physical manifestation of human cultural behaviour. It is most commonly described as archaeological evidence but is inclusive of all other physical forms and material traces that are significant to a cultural group, community, a nation, and/or humanity. As the location of the study area is some distance from the current shoreline the archaeological remains would be that associated with submerged terrestrial sites – that is First Nations sites that were inundated during last interglacial sea level rise.

[21] In 1998 the Federal Court of Australia found that native title existed in relation to the sea and sea-bed around Croker Island (refer Mary Yarmirr & Ors v NT of Australia & Ors [1998] FCA 1185 (4 September 1998)).

Intangible heritage referred to cultural associations and imprints on the landscape that involve practices, oral traditions, ancestral narratives, performing arts, local knowledges and practices concerning nature, the environment and the universe, laws and other socio-political skills. Intangible cultural heritage exists through enactments by members of a cultural group and introduces a clear cultural right to safeguarding, instruction on which is provided for by the UNESCO Convention for the Safeguarding of Intangible Cultural Heritage. Safeguarding is oriented towards recognition of the wealth of knowledge and skills that are transmitted intergenerationally.

Cosmos Archaeology (2023) concluded:

- The eastern half of the infield zone (outside of the Activity Area) was at one time above sea level since the continent of Australia was occupied by humans (see Figure 7-30). In the northeastern quadrant (approximately) where the marine geophysical data was of sufficient quality three distinct landforms were identified—savannah type landscape, a block field type area and a limestone mesa like plateau. All three landforms would be host to a variety of archaeological sites in varying condition with potential cave sites in the escarpments of the limestone mesa formation being more likely to contain relatively intact archaeological deposits. These landforms could have held strong cultural connections with the ancestors of the Gambere, Wunambul (Wunambal Gambera), Worora (Dambimangari), Umida (Wanjina Wunggurr), Unggarangi (Maylaya), Jawi and Bardi (Bardi Jawi Niimidman). Consultation with the cultural groups was recommended to confirm whether these connections still exist.
- The southeastern quadrant (outside of the Activity Area) could not be assessed due to the poor quality of the publicly available marine geophysical data.
- The western half of the infield zone is below 130 m LAT (includes all infrastructure locations covered under this EP) which is the maximum extent of exposed land since humans have occupied the continent (see Figure 7-31). As such, there will not be any impacts to the tangible First Nations UCH. The impact with intangible UCH will need to be assessed through consultation with the Gambere, Wunambul (Wunambal Gambera), Worora (Dambimangari), Umida (Wanjina Wunggurr), Unggarangi (Maylaya), Jawi and Bardi (Bardi Jawi Niimidman).

During targeted consultation, Indigenous groups did not confirm that cultural connections still exist with landforms to the north-east of Crux or within the Planning Area.

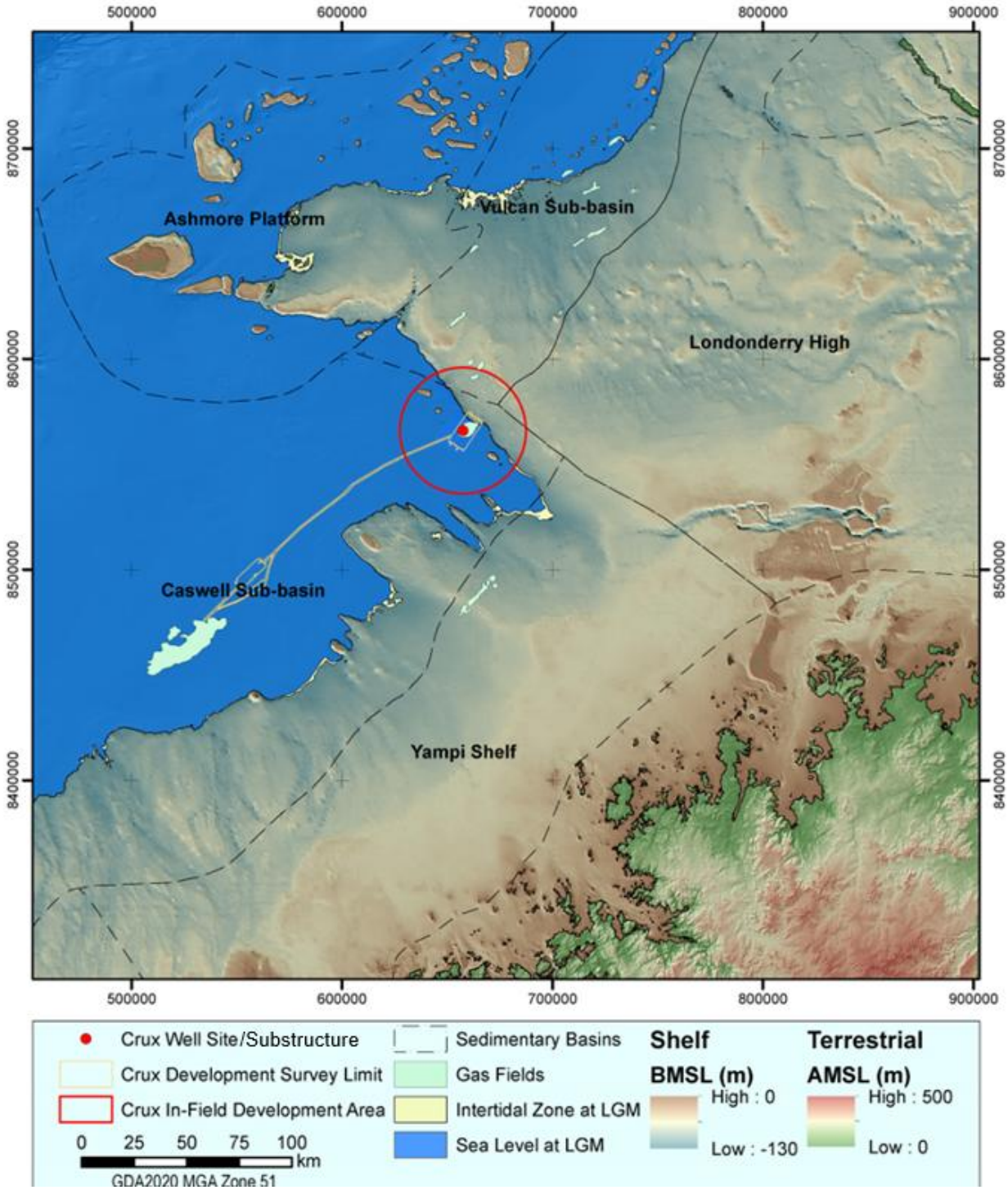


Figure 7-30: Submerged Landforms Proximal to the Activity Area

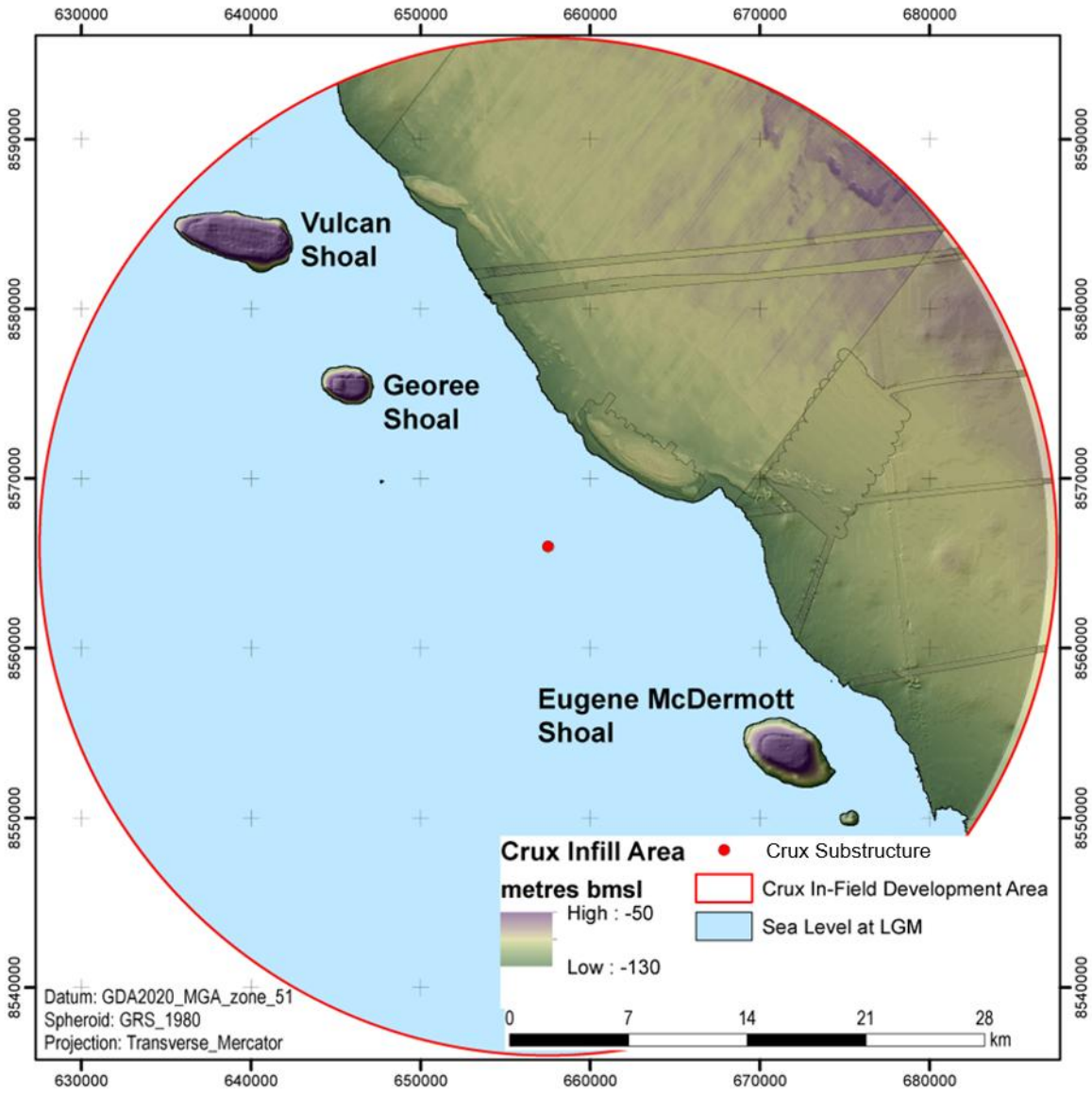


Figure 7-31: Submerged Landforms Elevations around the Crux Topsides During the Lowest Glacial Maximum

7.10.3.4 Indigenous Protected Areas

IPAs are land and/or sea areas managed by Indigenous groups as protected areas for biodiversity conservation through voluntary agreements with the Australian Government. IPAs form a component of Australia's National Reserve System. For Indigenous Peoples, IPAs support the realisation of custodianship and stewardship obligations for Country. The boundaries of IPAs can be aligned with native title boundaries or wholly contained within. In 2022, the Commonwealth government announced a program (the Sea Country IPA Program) to expand the IPA network to include coastal and marine areas. Through the Sea County IPA Program, the Australian Government is seeking to strengthen the conservation and protection of the marine and coastal environments while creating employment and economic opportunities for Indigenous Peoples (NIAA 2023). Section 7.3.1.2 describes the marine parks (IUCN Categories V and VI) within the Planning Area that coexist with IPAs and native title (Figure 7-2), which promote a balance between conservation and other sustainable uses to deliver social, cultural and economic benefits for local Indigenous communities (DCCEEW 2023c). Indigenous Peoples are active participants in the management of IPAs through land and sea ranger programs (Section 7.11.3.2.4) and other custodian and management activities.

The Planning Area does not overlap any IPAs (see Figure 7-34).

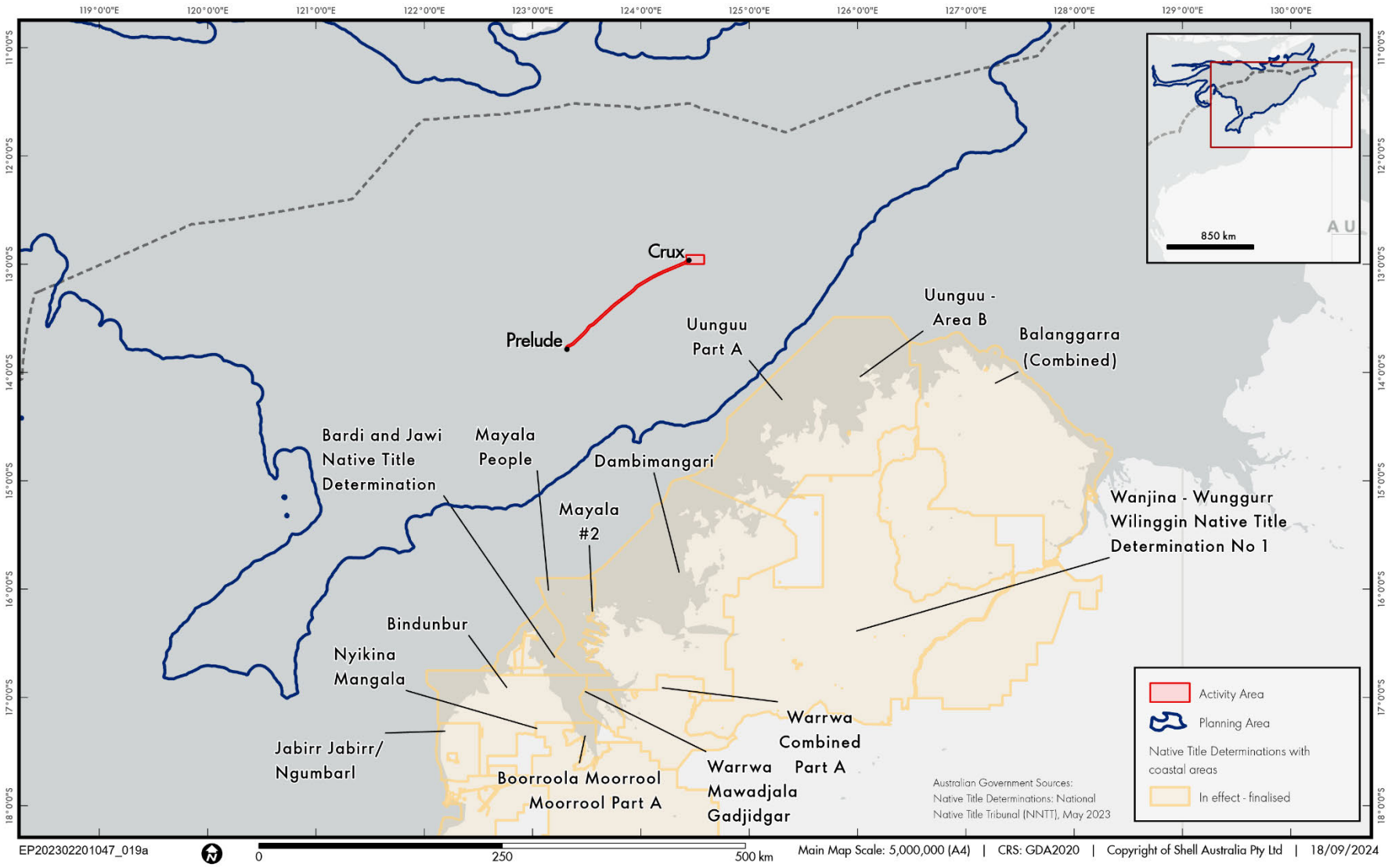


Figure 7-32: Native Title Proximal to the Planning Area

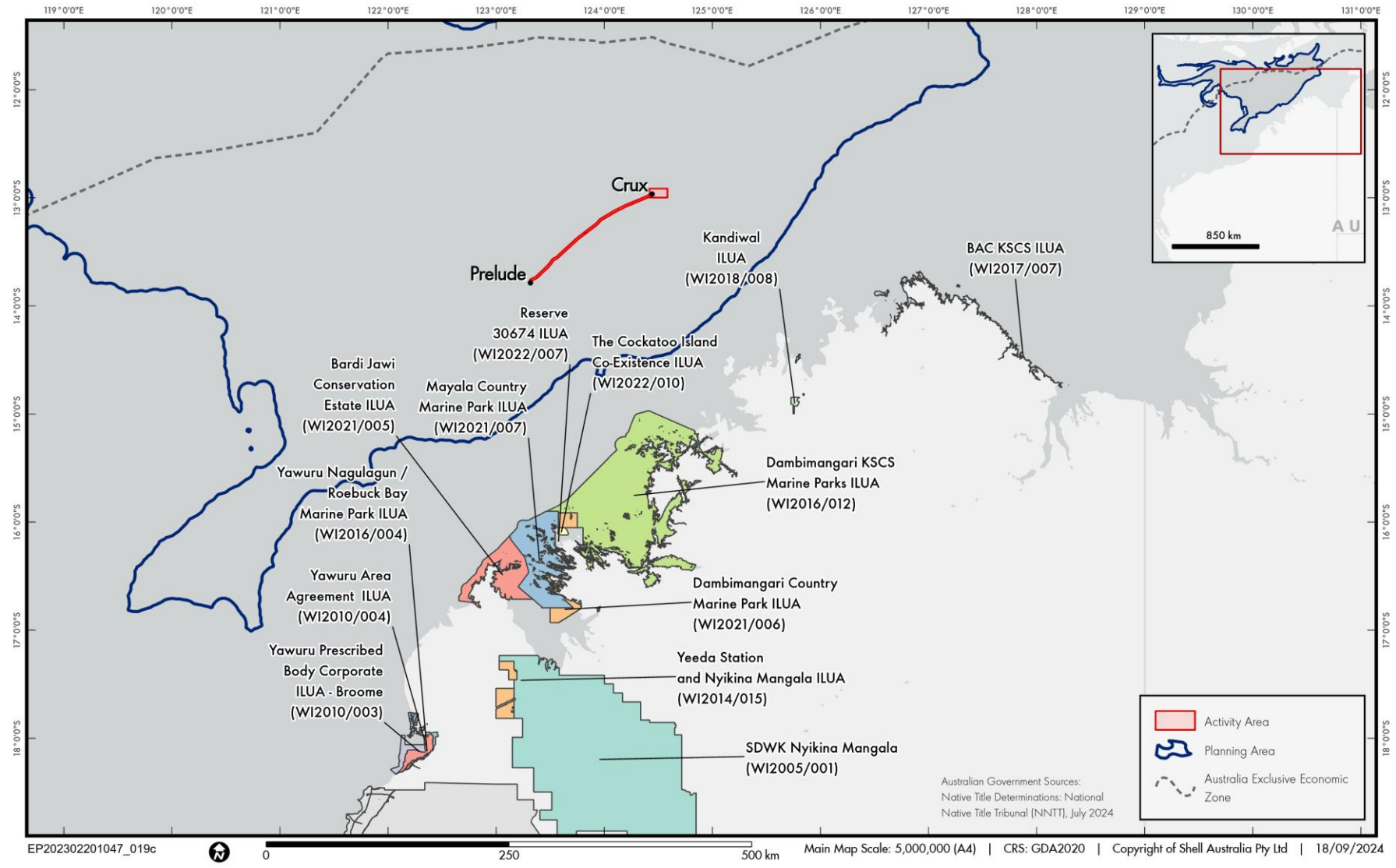


Figure 7-33: Indigenous Land Use Agreements

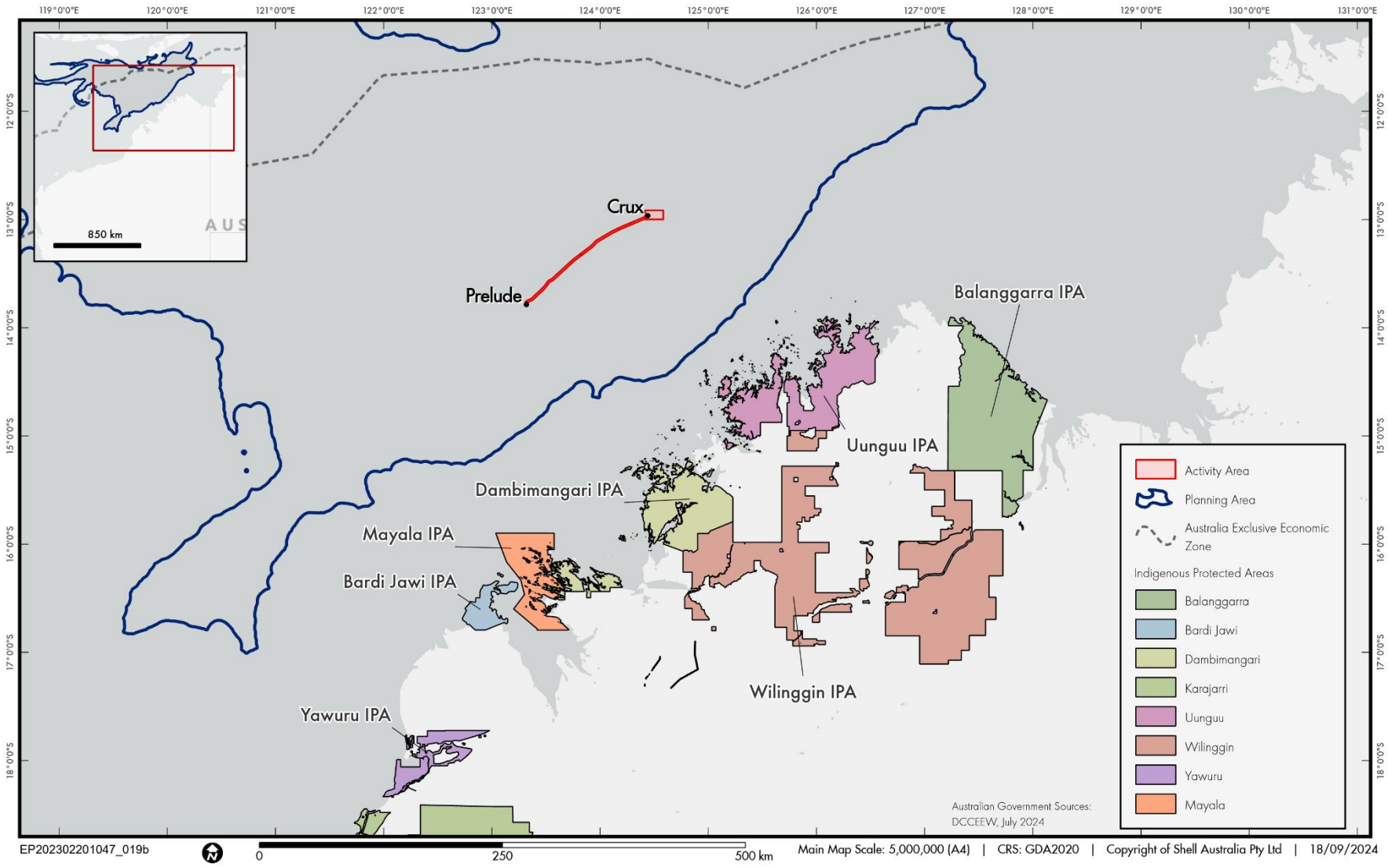


Figure 7-34: Indigenous Protected Areas

7.11 Heritage and Cultural Values and Sensitivities

7.11.1 Underwater Cultural Heritage

Under the UCH Act, all (known and undiscovered) shipwrecks and sunken aircraft, and associated artefacts, older than 75 years are protected. Shipwrecks and sunken aircraft that have been underwater for less than 75 years, and other types of UCH, can be protected through an individual declaration by DCCEEW based on an assessment of heritage significance. In addition, some UCH sites may have an underwater protection zone applied under the UCH Act (DCCEEW 2023i). Shipwrecks in WA waters dating from before 1900 are protected by the *Maritime Archaeology Act 1973* (WA).

There are no declared protected UCH sites within the Activity Area. Multiple known shipwrecks, sunken aircraft, and historic (more than 75 years old) aircraft and shipwrecks and other sites occur within the Planning Area (see Figure 7-35). The closest shipwreck to the Activity Area is the *Runnymede* (wrecked in 1878), ~19 km from the Activity Area. Near Ashmore Reef and Cartier Island are unnamed Indonesian fishing vessels and the *Sinar Bonerate* (wrecked in 1999), and near Browse Island are the *Browse Island Unident* (wrecked in 1880) and *Selina* (wrecked in 1901) (DCCEEW n.d.).

Under the UCH Act, if an Indigenous Peoples (referred to as First Nations) UCH site is discovered in Commonwealth waters, it may be declared as protected under Section 19 of the UCH Act (DCCEEW 2024g). The location of the proposed infrastructure is below 130 m LAT which is the maximum extent of exposed land since humans have occupied the continent; hence there will not be any impacts to the tangible First Nations UCH (see Section 7.10.3.3) (Cosmos 2023).

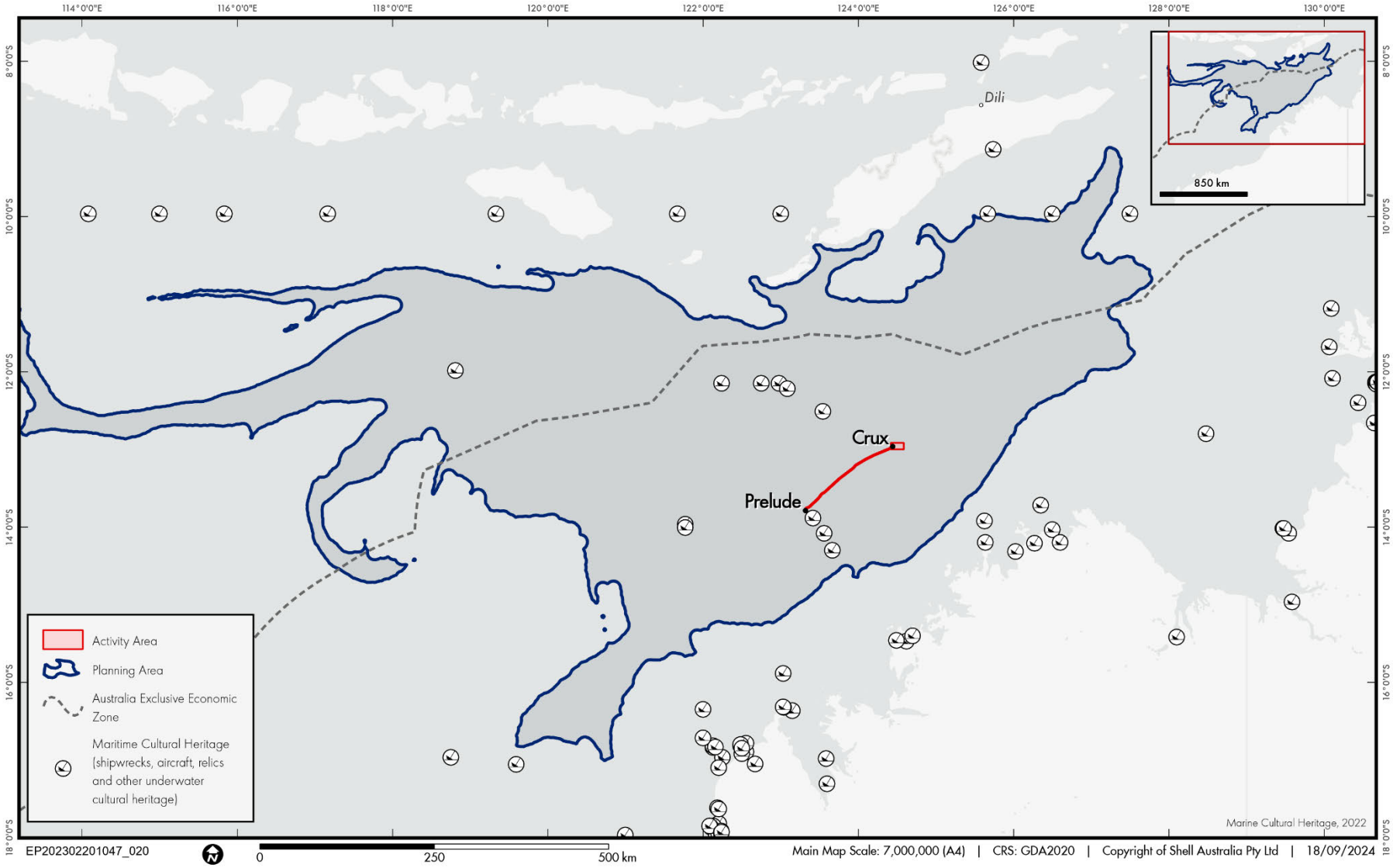


Figure 7-35:Underwater Cultural Heritage

7.11.2 Traditional Indonesian Fishing

In 1974, Australia recognised access rights for traditional Indonesian fishers in shared waters north of Australia, granting long-term fishing rights in recognition of the long history of traditional Indonesian fishing in the area. An MOU between the governments of Australia and Indonesia allows traditional Indonesian fishers to continue their customary practices. This area is known as the 'MOU Box', and falls within the Planning Area. The MOU Box covers Scott Reef and surrounds, Seringapatam Reef, Browse Island, Ashmore Reef and Cartier Island, representing an area of ~50,000 km^2 (see Figure 7-36). The MOU Box allows Indonesian fishers to fish in designated areas using traditional methods only. These methods include reef gleaning, free-diving, hand lining and other non-mechanised methods.

The Activity Area intersects the MOU Box (Figure 7-36). Trochus, sea cucumbers (holothurians), abalone, green snail, sponges, giant clams and finfish, including sharks, are targeted by the traditional fishers. As traditional fishers primarily target shallow-water species, interaction is considered unlikely and limited to fishers transiting to reef locations. Scott Reef is currently the principal reef in the MOU Box and the utilised season is July to October due to more favourable wind conditions, and to allow fishers to sun dry their catch on their boat decks.

Restrictions were introduced around Ashmore Reef and Cartier Island following their designation as Nature Reserves under the *National Parks and Wildlife Conservation Act 1975* (Cth) in 1983 and 2000, respectively. Restrictions permit the use of access to parts of Ashmore Reef for shelter, freshwater and to visit grave sites only.

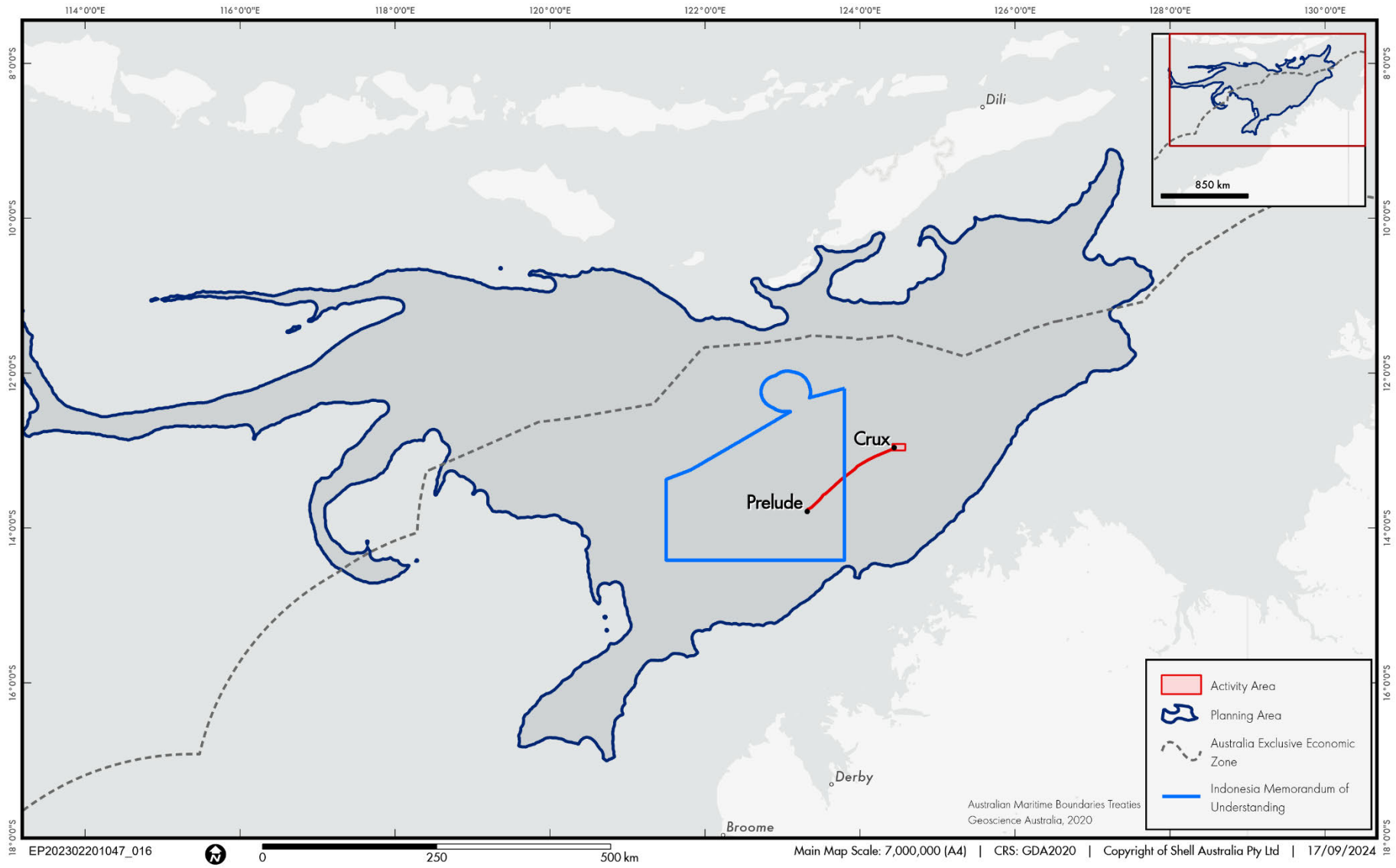


Figure 7-36: Traditional Indonesian Fishing MOU Box

7.11.3 Indigenous Cultural Heritage

7.11.3.1 Overview

Cultural and social values and sensitivities relevant to the Planning Area are described in reference to:

- Caring for Country, including:
- Country (see Section 7.11.3.2.1).
- Law and spirituality (see Section 7.11.3.2.2).
- Traditional knowledge (see Section 7.11.3.2.3).
- Conservation and healthy Country (see Section 7.11.3.2.4).
- Sea resource use practices (see Section 7.11.3.3).
- Indigenous Peoples rights and interests (see Section 7.11.3.4).

Information in this section has been sourced from JMPs prepared for a number of protected areas (e.g. IPAs and marine reserves), Commonwealth government and Aboriginal Land Council websites, Healthy Country Plans prepared by various Indigenous organisations and books published by Dambimangari and Wunambal Gaambera Aboriginal Corporations:

- Nyara Pari Kala Niragu (Gaambera): Gadawara Ngyaran-gada (Wunambal): Inganinja Gubadjoongana (Woddordda): We are coming to see you. 2021.
- Karadada, J. et al. (2011). Uunguu Plants and Animals: Aboriginal Biological Knowledge from Wunambal Gaambera Country in the North-west Kimberley.
- WGAC (2017). Uunguu Indigenous Protected Area: Wundaagu (Saltwater) Country, Plan of Management 2016-2020.
- WGAC (2021). Wunambal Gaambera Healthy Country Plan, 2021-2030.
- WGAC, 2023. Uunguu Inddigenous Protected Area: Wundaagu (Saltwater) Country, Plan of Management 2021-2030.

The purpose of this section is to highlight the many and varied cultural and social values of Indigenous Peoples and the associated interests and activities that may overlap the Planning Area, and in particular, sea Country. The following sections avoid detailed descriptions of specific areas of cultural significance including cultural heritage sites and sites associated with songlines and dreaming stories, and also avoids reproduction of Dreaming stories. This information is retained in ownership by the associated Indigenous group.

7.11.3.2 Caring for Country

7.11.3.2.1 Country

The coastal areas, islands and surrounding waters of northern Australia have been used and occupied by Indigenous Peoples for thousands of years. The water and lands are components of Indigenous cultural landscape that are of enormous significance to Indigenous Peoples.

For Indigenous Peoples, Country is homeland, where culture, history, traditions and social structures are embedded, connected and find full meaning. Custodianship means caring for Country (i.e. land and water, plants and animals) as if land and seas are kin (Janke et al. 2021).

> *Country is filled with relations speaking language and following Law, no matter whether the shape of that relation is human, rock, crow, wattle… Country is family, culture, identity. Country is self.* (Kwaymullina 2005)

In the context of the Planning Area, many elements within sea Country form significant components of Indigenous Peoples culture, including their history, dreaming and creation stories (discussed in Section 7.11.3.2.2). Marine life, cultural sites, and places of significance are directly connected to the wellbeing and everyday life of Indigenous Peoples. The health and wellbeing of sea Country is one and the same as the health and wellbeing of Indigenous Peoples. Hence any potential changes in the condition of sea Country (such as that which could result from activities associated with the activity) may have implications for the health and wellbeing of Indigenous Peoples who may have connection to the affected sea Country area.

Many Indigenous Peoples with traditional land and sea Country within or adjacent to the Planning Area (e.g. the Wunambal Gaambera People and Balanggarra People) refer to themselves as Saltwater People – people who have a vibrant and traditional society based on a deep relationship with sea Country.

7.11.3.2.2 Law and Spirituality

Indigenous law and spirituality are intertwined with the land, the people and creation. Indigenous law and spirituality reinforce culture and sovereignty. Indigenous Peoples have a complex system of law (also referred to as lore), that preceded European arrival. The term law refers to the stories, customs, beliefs and spirituality of Indigenous Peoples. Law is passed on through generations—through songs, stories, and dance and it guides how Indigenous Peoples live their everyday lives.

For Indigenous Peoples customary law provides the rules and responsibilities for looking after culture, plants, animals, people and Country. Customary law and protocols provide rules on how to interact with the land, kinships and community. Different Indigenous groups have different law systems and many are strongly related to creation stories such as the Wanjing and Wunggurr of the Wunambal Gaambera people (native title holders near the Planning Area) and the Wolara the Creator, of the Balanggarra people (native title holders further outside of the Planning Area).

7.11.3.2.2.1 Songlines and Totemic Systems

Songlines are the Indigenous travel routes that crossed the Country (land and sea), linking important sites, locations and clans. Songlines are maps of the land and sea. Songlines include dreaming pathways or tracks—forged by Creator Spirits during the Dreaming. Many of these songlines have specific ancestral stories attached to them. Literature reviews indicate that songlines exist along the coast of northern WA and the NT. There are sacred sites entwined with the songlines. For Saltwater People, stories and songlines locate, interpret and inscribe knowledges of the dreaming tracks, bodies and movements of ancestral beings that crisscross sea Country. A number of the natural features within/adjacent the Planning Area (e.g. islands, reefs and coastline features) form core components of Dreaming stories for different Indigenous Peoples.

For the Balanggarra people the saltwater and islands of Balanggarra sea Country are Dreaming creations (BAC 2011). The saltwater was created by Wolara as he ‘poled his canoe’ in the coastal regions. The pole of Wolara also created some of the islands in Balanggarra sea Country (Balanggarra Ventures Ltd 2021). The King George River and Berkley Rivers (outside of the Planning Area) are of high cultural significance to the Balanggarra people. King George Falls are the male and female Wungkurr (Department of Parks and Wildlife 2016).

Totems connect Indigenous Peoples on a spiritual level, providing a deeper connectivity and understanding to their family groups, their Country, Dreaming and creation events. Many of the marine species (such as whale sharks, sawfish, whales, turtles) found within the Planning Area are of totemic value to different Indigenous Peoples (see Section 7.7.7) (WCA n.d.). Marine animals and plants found in sea Country hold special cultural significance to different Indigenous Peoples and may be important for subsistence and medicinal purposes. For example, the dugong and marine turtle are both of high cultural value to the Wunambal Gaambera people, Balanggarra People and many other Indigenous groups (Karadada, J. et al. 2011). Marine turtles are a key food source for Saltwater People (WWF n.d.).

7.11.3.2.3 Traditional Knowledge and language

Indigenous Peoples have strong and extensive traditional knowledge (both cultural and ecological) of their Country and natural processes. This knowledge has been used for thousands of years to maintain a sustainable balance between the use and care of their natural environment. This knowledge is alive today and evident in law, culture and practices. Traditional knowledge requires the building up of understanding over time and can be defined as a ‘cumulative body of knowledge, practice and belief’ (Berkes 2008 p7 in Kearney et al. 2023). Indigenous Peoples are increasingly concerned about the difficulties in being able to pass on their traditional knowledge. Active and ongoing participation in land and sea management is a means by which Indigenous Peoples are seeking to improve the intergenerational transfer of knowledge, critical to future health of land and sea Country.

7.11.3.2.3.1 Intergenerational Knowledge Transfer

Older Indigenous Peoples, in particular those who are senior, cultural leaders or law-people are responsible for passing on traditional cultural and ecological knowledge to young people. Knowledge transfer is traditionally undertaken on-Country through the sharing of stories, song and dance, participation in ceremony and rituals,

making tools, engaging in land and resource use activities (e.g. hunting, fishing), learning about bush tucker and traditional medicine. Maintaining easy access to traditional Country and traditional resources (e.g. sea Country resources), and ensuring protection of important cultural heritage sites is imperative for the ongoing transfer of traditional knowledge.

Indigenous children learn about customary laws and protocols through many avenues including observing and participating in customs and ceremonies such as songs and dances on Country. Such laws, traditions and customs do not exist in the past as historical practices, but are considered living, contemporary and vital.

7.11.3.2.4 Conservation and Healthy Country

7.11.3.2.4.1 Biological and Ecological Values

For Indigenous Peoples, sea Country is rich in cultural, biological and ecological values. Fish, marine mammals and sea birds, coral and fringing reef communities are all important components of biodiversity values (see Sections 7.5 and 7.7). Managing and conserving the ecological values of sea Country is important to Indigenous Peoples with custodial responsibilities for sea Country, and to the broader Indigenous community.

7.11.3.2.4.2 Contemporary Land and Sea Management

Management Plans and Joint Management

Indigenous sea management in areas adjacent the Planning Area is undertaken in accordance with the objectives of key plans including Healthy Country Plans, IPA Management Plans and JMPs. Healthy Country Plans are contemporary representations of Indigenous land and sea management and represent the way Indigenous Peoples can manage and implement their traditional knowledge, whilst still looking after Country in ways prescribed by the old people.

Many IPAs have corresponding Healthy Country Plans or tailored management plans (e.g. Uunguu Indigenous Protected Area: Wundaagu (Saltwater) Country, Plan of Management 2016-2020 [WGAC 2017]), prepared by each relevant Indigenous group. Healthy Country Plans, IPA management plans and JMPs for marine areas articulate Indigenous Peoples aspirations for Country and seek to fulfill their cultural responsibility to look after Country.

Land and Sea Ranger Programs

Land and sea rangers work on land and sea Country across tenure, including native title lands and protected areas. Many of the land and sea ranger programs across WA and NT are supported by the Commonwealth and State funding. Land and sea rangers care for Country, combining traditional knowledge of Country with contemporary training and experience. Rangers are engaged in protecting and monitoring the health of sea Country, including marine species such as turtle and dugong. Many of the land and sea ranger programs are delivered as part of broader Aboriginal Land Council or Aboriginal Corporation operations.

Recent studies have also found that IPAs and associated ranger programs contribute considerable social, cultural and environmental benefits for local Indigenous people, including the general Australian public (SVA 2016; Austin et al. 2017). Native Title, IPAs and JMPs for Country give strength and security to Aboriginal people to look after Country.

7.11.3.2.4.3 Cultural Heritage Sites and Protection

For Indigenous Peoples, the protection of sacred and significant cultural sites forms a central focus of looking after Country. Cultural sites can tell different narratives about creation, Indigenous lore (law) and history. All Country is considered a cultural place, and there are rules and requirements for how Indigenous Peoples look after it. Healthy Country Plans and IPAs help Indigenous Peoples look after cultural heritage sites. Aboriginal Land Councils and Aboriginal Corporations, together with Land and Sea Rangers work together to control access to cultural heritage sites and sacred areas including sea Country sacred sites.

Cultural sites are specific sites identified and protected through Australian law and which include particular places of importance to Indigenous Peoples, in a broader landscape of cultural significance.

The overlap of the Planning Area with sites of Aboriginal cultural heritage is described in the following sections. A search of the WA Department of Planning Lands and Heritage Aboriginal heritage places and Aboriginal heritage surveys datasets identified no registered Aboriginal sites or lodged Aboriginal heritage places within the Planning Area. Not all cultural sites are recorded or registered and captured through database searches. This can be attributed to a number of reasons including but not limited to distrust of government and desire to keep important sites private.

A search of the NT AAPA Sacred Sites Register was undertaken to identify potential sacred sites (registered and recorded) that overlap with the Planning Area. The term sacred site is defined in Section 3 of the *Northern Territory Aboriginal Sacred Sites Act 1989* (NT) by reference to its meaning in the ALRA which provides a sacred site is:

'a site that is sacred to Aboriginals or is otherwise of significance according to Aboriginal tradition, and includes any land that, under a law of the NT, is declared to be sacred to Aboriginals or of significance according to Aboriginal tradition'.

Based on information provided by AAPA there are no recorded[22] sacred sites, registered[23] sacred sites, burial sites, and other sites[24] located within the Planning Area. The majority of registered and recorded sites are located along the mainland coastline or island coastlines within the intertidal zone.

7.11.3.2.4.4 Protected Areas

Sections 7.3.1.2 and 7.3.1.4 describe the protected areas within the Planning Area including marine parks and Commonwealth heritage places. As outlined in Section 7.10.3.4 there are no IPAs within the Planning Area. There are tangible and intangible Aboriginal cultural and social values associated with protected areas, as described below.

Commonwealth Heritage Places

Section 7.3.1.4 describes and Figure 7-5 illustrates the Commonwealth heritage places within the Planning Area. Table 7-19 summarises the defined Aboriginal cultural and social values associated with some of these protected areas.

Marine Parks

Figure 7-2 and Figure 7-3 illustrates and Table 7-3 lists the marine parks within the Planning Area. The Aboriginal cultural values of the AMPs are described in the various AMP Network Management Plans (Director National Parks 2018a,b,c).

The primary Indigenous value associated with the marine parks relate to the use of sea Country and support custodial obligations to care for Country. Sea Country is valued for Indigenous cultural identity, health and wellbeing. Across Australia, Indigenous people have been sustainably using and managing their sea Country for tens of thousands of years. Table 7-19 summarises the Indigenous cultural values within the marine parks that overlap the Planning Area.

Table 7-19: Cultural Values and Sensitivities of Protected Areas within the Planning Area

Listed Place	Cultural Values	Distance from Activity Area (~km)	Distance from Crux Platform (~km)
Commonwealth Heritage Places			
Ashmore Reef National Nature Reserve	Ashmore Reef is significant for its history of human occupation and use (DCCEEW 2023). Many of the marine species (see Section 7.3.1.4) that use the marine waters of Ashmore Reef are of cultural (including totemic) importance to Indigenous Peoples.	128	149
Scott Reef and surrounds	Scott Reef is significant due to its rich biodiversity and ecological importance as a diverse and thriving marine ecosystem, providing habitat for a wide range of species, including endangered and vulnerable ones, and serving as an important breeding and feeding ground for marine life in the region	153	294

[22] A recorded sacred site is a site that is known to the AAPA but has not been registered and includes recorded sacred burial sites. AAPA may hold the information required to register the site should this become the wishes of the custodians. Alternatively, a recorded sacred site may still require further research in order to obtain all necessary information. The recorded coordinate point for a sacred site is a reference point only and does not necessarily indicate the location or extent of any specific site feature.

[23] A registered sacred site is a site that has been added to the Register of Sacred Sites maintained by the AAPA following the process set out in Part III Division 2 of the *Aboriginal Sacred Sites Act 1989* (NT).

[24] Other sites include archaeological places or sacred objects. These places and objects are protected under the *Heritage Act 2011* (NT).

Listed Place	Cultural Values	Distance from Activity Area (~km)	Distance from Crux Platform (~km)
	(AIMS 2013). Many of the marine species (see Section 7.3.1.4) that use the marine waters of Scott Reef and surrounds are of cultural (including totemic) importance to Indigenous Peoples.		
Australian Marine Parks			
Argo-Rowley Terrace	Sea Country is valued for Aboriginal cultural identity, health and wellbeing. Across Australia, Aboriginal people have been sustainably using and managing their sea Country for tens of thousands of years.	322	455
Ashmore Reef	Aboriginal People: • Sea Country is valued for Aboriginal cultural identity, health and wellbeing. Across Australia, Aboriginal people have been sustainably using and managing their sea Country for tens of thousands of years (DNP 2018a). • Tourism, recreation and scientific research are important activities in the Marine Park. These activities contribute to the wellbeing of regional communities and the prosperity of the nation (DNP 2018a). Indonesian People: • The Ashmore Reef AMP contains Indonesian artefacts and grave sites and Ashmore lagoon is still accessed as a rest or staging area for traditional Indonesian fishers travelling to and from fishing grounds within the MoU Box (DNP 2018a).	128	149
Kimberley	The Wunambal Gaambera people, Dambimangari, Mayala, Bardi Jawi and the Nyul Nyul people's sea Country extends into the Kimberley AMP. The Wunambal Gaambera people's Country includes daagu (deep waters), with about 3,400 km^2 of their sea Country located in the AMP. Sea Country is culturally significant and important to the identity of these Aboriginal groups. The Wunambal Gaambera, Dambimangari, Mayala, Bardi Jawi and the Nyul Nyul people have an unbroken connection to their sea Country, having deep spiritual connection through Wunggurr (creator snakes) that still live in the sea. Staple foods of living cultural value include saltwater fish, turtles, dugong, crabs and oysters. Access to sea Country by families is important for cultural traditions, livelihoods and future socio-economic development opportunities. The national heritage listing for the West Kimberley recognises these key cultural heritage values: • Wanjina Wunggurr Cultural Tradition which incorporates many sea Country cultural sites; • Log-raft maritime tradition, which involved using tides and currents to access warrurru (reefs) far offshore to fish; • Interactions with Makassan traders around sea foods over hundreds of years; • Important pearl resources that were used in traditional trade through the wunan and in contemporary commercial agreements. The Wunambal Gaambera, Dambimangari and Bardi Jawi people consider that these values extend into the Kimberley AMP. The Wanjina Wunggurr is law of the Wunambal Gaambera and Dambimangari people and it is recognised that all of the sea Country, land, plants and animals were put there by Wanjina Wunggurr. Under Wanjina Wunggurr law, the Wunambal	80	160

Listed Place	Cultural Values	Distance from Activity Area (~km)	Distance from Crux Platform (~km)
	Gaambera and Dambimangari people have a responsibility to manage country, to maintain the health of the Country and all living things. The Wunambal Gaambera, Bardi Jawi, Mayala and the Nyul Nyul people have had native title determined over parts of their sea Country included in this Park (DNP 2018a).		
Oceanic Shoals	Sea Country is valued for Indigenous cultural identity, health and wellbeing. Across Australia, Indigenous Peoples have been sustainably using and managing their sea Country for tens of thousands of years. The Miriuwung, Gajerrong, Doolboong, Wardenybeng and Gija and Balangarra people have responsibilities for sea Country in the Marine Park. They are represented by the following PBCs: Miriuwung and Gajerrong Aboriginal Corporation and BAC. These corporations are the points of contact for their respective areas of sea Country in the Marine Park.	162	178
WA Marine Park			
North Kimberley	The North Kimberley Marine Park covers an area of almost 2 million hectares. The long-standing connections, rights and interests of Indigenous Peoples have been recognised through native title determinations for the lands and waters in and adjacent to the North Kimberley Marine Park for the Wunambal Gaambera, Balanggarra, Ngarinyin and Miriuwung Gajerrong people. The Indigenous Peoples have cultural, spiritual and social connections to the north Kimberley sea Country (DBCA 2023). The marine park is of intrinsic biological, ecological and cultural value for Indigenous Peoples, but also provides Indigenous Peoples with cultural, recreational and commercial benefits. The marine park contains many places of cultural and spiritual importance to Indigenous Peoples. Whilst most locations occur on land, many are sea-related. Registered sites include those with artifacts, ceremonial and mythological paintings, fish traps, burial grounds, quarrying, many-made structures and middens (DPAW 2016). The marine park is jointly managed with Indigenous Peoples in accordance with the North Kimberley Marine Park Joint Management Plan 2016 (DPAW 2016). Joint management of the marine park provides opportunities for Indigenous Peoples to fulfill cultural obligations to care for Country, record and share cultural and language, and the intergenerational transfer of traditional knowledge.	80	160
Nature Reserves			
Browse Island	Many of the marine species that use the Browse Island marine waters are of cultural (including totemic) importance to Indigenous Peoples.	42	159
Scott Reef	Many of the marine species that use the Scott Reef marine waters are of cultural (including totemic) importance to Indigenous Peoples.	153	294

Source: DNP 2018a,b,c

7.11.3.2.4.5 Threats to Country

Through the IPA process and associated Healthy Country Plan framework, Indigenous Peoples have identified specific threats to the health of land and sea Country. Frequently identified threats include:

- Loss of traditional knowledge and connection to Country. Literature review of Healthy Country Plans suggests that this is one of the biggest threats. Traditional knowledge links the country to its people and conversely the people to their Country.
- Illegal commercial fishing by Australian and foreign fishing vessels, as well as overfishing by recreational and commercial fishers who access areas without permission.
- Lack of culturally appropriate consultation with Indigenous Peoples, particularly in relation to cultural sites and sea resources such as turtle and dugong.
- Climate change and potential changes in sea levels, climatic conditions including rainfall and resulting impacts on Country including land and sea resources, and the integrity of cultural heritage sites.
- Coastal pollution such as general rubbish, oil and fuel spills at sea and marine debris. Coastal pollution is a threat to marine life particularly turtles and marine mammals.
- Lack of land and sea management capacity. Traditional sea Country is often extensive in size and difficult to reach, hindering stewardship practices.
- Lack of infrastructure to access Country. Without access to Country, it is difficult for elders to effectively pass on traditional knowledge to younger generations.
- Difficulty in gaining permission to access Country, and frequently changing regulations and conditions to access Country.
- Resource extraction activities (e.g. sea mining, oil and gas drilling). Indigenous Peoples are concerned about the potential risks these activities present to marine fauna resources (e.g. fish, turtle and dugong), and risks associated with accidents during operations, as well as potential disturbance of the marine floor during pipeline construction and increased shipping activity.

7.11.3.3 Sea Resource Use Practices

7.11.3.3.1 Customary Sea Resource Use

Indigenous Peoples engage in the customary use of sea Country proximal to the Planning Area. Access to and customary use of sea Country is an important part of Indigenous culture, integral to maintaining connection to Country and the health and wellbeing of Indigenous Peoples.

Customary activities undertaken in sea Country within/adjacent the Planning Area include hunting for food and ceremonial purposes, visiting and maintaining cultural sites, making medicine, engaging in ceremonial activities, sharing traditional knowledge including passing on important Dreaming stories, and general on-Country recreation shared with family. Many customary rights to land and sea resource use are protected through native title and/or are provided for through management plans. Customary activities are also managed in accordance with the cultural protocols of different Indigenous groups.

Examples of customary use within or adjacent the Planning Area include the harvesting of green turtles by the Dambimangari people (and many other Indigenous People) for food, and the collection of sea turtle eggs. Dugongs are an important food source for many coastal Aboriginal people including the Dambimangari people, Bardi Jawi people and Mayala people.

Commercial activities have been identified as impacting Traditional Owners' ability to carry out cultural activities in private or fish/hunt/gather resources (DBCA 2022).

7.11.3.3.2 Contemporary Sea Resource Use

Indigenous Peoples engage in a range of different resource use activities in the sea Country. These activities include commercial fishery and aquacultural activities (Section 7.11.3.3.2.1), cultural based tourism activities (Section 7.11.3.3.2.2) and commercial sea management (Section 7.11.3.3.2.3).

7.11.3.3.2.1 Commercial Fisheries Activities

There a no known aquaculture licences held by Indigenous Peoples or organisations under the *Fish Resources Management Act 1994* (WA) that overlap the Planning Area.

7.11.3.3.2.2 Cultural-based Tourism

Section 7.8.3 describes the socioeconomic values of tourism within the Planning Area. Areas of sea Country within/adjacent the Planning Area feature spectacular scenery, diverse wildlife and cultural heritage, all of which provide opportunities for nature-based and cultural-based recreational and tourism activities.

Indigenous People are using or have aspirations to use their IPAs, JMPs for marine parks and land tenure arrangements (native title and freehold land tenure) to develop commercial opportunities based around cultural connections and conservation tourism. Existing commercial cultural-based tourism activities operating within or adjacent the Planning Area include expedition cruise boat operations, nature-based on sea Country guided tours and cultural learning and immersion experiences.

7.11.3.3.2.3 Commercial Sea Management

IPAs can be used by native title groups to facilitate environmental management contracts and projects. Both IPAs and JMPs present opportunities for the direct employment of Indigenous Peoples but also the delivery of fee for service management work. WGAC has developed an ongoing partnership with Bush Heritage Australia and tour operators (WGAC n.d.).

7.11.3.4 Indigenous Peoples Rights and Interests

7.11.3.4.1 Statutory Rights and Interests

Native title holders are afforded certain rights and title to land and sea. These rights may include the right to camp, hunt and gather on land and sea, rights of access, use and occupation, perform ceremony and protect cultural sites. The various rights granted are different for each native title determination. Importantly native title holders have the right to be consulted about decision or activities that could affect the enjoyment of native title rights and interests.

Native title holders may be granted exclusive native title rights in some areas of a determination, and non-exclusive rights in other areas. Within WA, native title rights held over waters seaward of the high-water mark are generally non-exclusive. As outlined in Section 7.10.3.2, there are no native title holder determinations within the Planning Area.

7.11.3.4.2 Self Determination

Self-determination refers to the movement, both political and social, of Indigenous Peoples and communities to have full agency in determining how the lives of Indigenous Peoples are governed, to have full autonomy in decisions that affect Indigenous communities and to have control over the economic, social, and cultural development which may impact Indigenous communities (AHRC n.d.). The theme of self-determination is intrinsically important when considering Indigenous rights and interests that may overlap the Planning Area. In terms of economic self-determination, Indigenous-owned tourism operations with interests within or adjacent the Planning Area have similar significance.

Native title, IPAs and JMPs empower collective self-determination through recognising the Indigenous ownership of the land. This ‘ownership’ of land grants Indigenous Peoples the right to carry out cultural practices, and to use the land for social and economic benefit. These cultural practices include hunting and gathering of animal and food species, the maintaining of significant cultural sites and Country, law and ceremonial practices. The recognition of Indigenous rights and interests is integral to understanding their collective value for overall Indigenous health and well-being.

8 Acceptable Levels of Impact and Risk

The OPGGS(E) Regulations require the titleholder to include an evaluation of all the impacts and risks that determined whether these will be of an 'acceptable' or 'unacceptable' level. To comply with this requirement, Shell has determined acceptable levels of impact to the environmental receptors that may credibly be impacted by the activities considered within this EP. Shell's process for determining the acceptability of risks and impacts is detailed below.

8.1 Considerations in Developing Defined Acceptable Levels of Impact and Risk

Shell has established defined acceptable levels of impacts and risks for the activities considered in this EP relating to all the environmental receptors that were identified as being credibly impacted, or at risk of being impacted. The outcomes of the evaluation of environmental impacts and risks were assessed against these defined acceptable levels to determine if the impacts or risks were acceptable. Shell considered these aspects to establish the acceptable levels of impacts and risks:

- Principles of ESD (Section 8.1.1).
- Other relevant requirements (Section 8.1.2).
- Significant impacts[25] to MNES (Section 8.1.2.1).
- Internal context (Section 8.1.3).
- External context (Section 8.1.4).

8.1.1 Principles of ESD

Shell has considered the principles of ESD to define the acceptable levels of impacts and risks, as defined in Section 3A of the EPBC Act. The principles of ESD are summarised as:

- Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social, and equitable considerations.
- If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
- The principles of inter-generational equity—the present generation should ensure that the health, diversity, and productivity of the environment is maintained or enhanced for the benefit of future generations.
- The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making.
- Improved valuation, pricing and incentive mechanisms should be promoted.

8.1.2 Other Relevant Requirements

Shell considered other relevant requirements that apply to define acceptable levels of impacts and risks including:

- Commonwealth Policy (Section 3.1).
- Commonwealth Legislation (Section 3.2).
- Other Legislation (Table 3-2).
- Standards and Guidelines (Section 3.3).
- International Agreements and Conventions (Section 3.4).
- Significant Impacts to MNES (Section 8.1.2.1).
- EPBC Management Publications (Section 3.2.2.1).

[25] Significant impacts refer specifically to the levels of impacts defined in the MNES – Significant Impact Guidelines 1.1 (DoE 2013). 'Significant' is defined as 'an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts'. Any subsequent reference in this EP to significant impacts refers to these levels unless stated otherwise.

- Protected Areas (Section 7.3.1).

8.1.2.1 Significant Impacts to MNES

This EP forms the basis for NOPSEMA's assessment of matters protected under Part 3 of the EPBC Act in Commonwealth Waters. Therefore, Shell has given specific attention to define the acceptability of impacts and risks to MNES. Shell used the criteria listed in Table 8-1—consistent with the Significant impacts refer specifically to the levels of impacts defined in the MNES – Significant Impact Guidelines 1.1 (DoE 2013)—where a potential interaction was identified between the relevant MNES and an aspect of the activity.

Potential impacts and risks to MNES from aspects of the activity were deemed inherently acceptable if:

- the significant impact criteria in relation to the MNES are not anticipated to be exceeded.
- the management of the aspect aligns with EPBC management publications from the DCCEEW, including threat abatement plans, recovery plans and Conservation Advice.

Table 8-1: MNES Significant Impact Criteria Applied to the Petroleum Activities Considered in this EP

Category	Significant Impact Criteria
Listed Critically Endangered and Endangered Species	An action is likely to have a significant impact on critically endangered or endangered species if there is likelihood that it will: • lead to a long-term decrease in the size of a population. • reduce the area of occupancy of the species. • fragment an existing population. • adversely affect habitat critical to the survival of a species. • disrupt the breeding cycle of a population. • modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline. • result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat. • introduce disease that may cause the species to decline, or interfere with the recovery of the species.
Listed Vulnerable Species	An action is likely to have a significant impact on vulnerable species if there is a likelihood that it will: • lead to a long-term decrease in the size of an important population. • reduce the area of occupancy of and important population. • fragment an existing important population into two or more populations. • adversely affect habitat critical to the survival of a species. • disrupt the breeding cycle of a population. • modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline. • result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat. • introduce disease that may cause the species to decline. • interfere substantially with the recovery of the species.
Listed Migratory Species	An action is likely to have a significant impact on migratory species if there is likelihood that it will: • substantially modify, destroy or isolate an area of important habitat for a migratory species. • result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species. • seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species.
Wetlands of International Importance	An action is likely to have a significant impact on a wetland of international importance if there is likelihood that it will result in:

Category	Significant Impact Criteria
	• areas of wetland being destroyed or substantially modified. • a substantial and measurable change in the hydrological regime of the wetland. • the habitat or lifecycle of native species dependent upon the wetland being seriously affected. • a substantial and measurable change in the water quality of the wetland which may adversely impact biodiversity, ecological integrity[26], social amenity or human health. • an invasive species that is harmful to the ecological character of the wetland being established in the wetland.
Commonwealth Marine Area	An action is likely to have a significant impact on the environment in the Commonwealth Marine Area if there is likelihood that it will: • result in a known or potential pest species becoming established in the Commonwealth Marine Area. • modify, destroy, fragment, isolate or disturb an important or substantial area of habitat that results in an adverse impact on marine ecosystem functioning or integrity in a Commonwealth Marine Area. • have a substantial adverse effect on a population of a marine species or cetacean including its lifecycle and spatial distribution. • result in a substantial change in air quality or water quality, which may adversely impact biodiversity, ecological integrity[26], social amenity or human health. • result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity[26], social amenity or human health may be adversely affected. • have a substantial adverse impact on heritage values of the Commonwealth Marine Area, including damage or destruction of an historic shipwreck.

8.1.3 Internal Context

Shell considered internal requirements to define acceptable levels of impacts and risks. The internal context included Shell's environment policy, environmental risk management framework, internal standards, procedures, technical guidance material and opinions of internal stakeholders.

Shell's internal impact and risk assessment defined acceptable levels as:

- Residual planned impacts that are ranked as minor or less (i.e. minor, slight, no effect or positive effect) and residual risks for unplanned events ranked light or dark blue, are inherently 'acceptable', if they meet legislative and Shell requirements and the established acceptable levels of impacts and risks.
- Moderate residual impacts, and yellow and red residual risks, are 'acceptable' with appropriate controls in place and if good industry practice can be demonstrated.
- Major and massive residual impacts from planned activities, and massive residual risks from unplanned events, are 'unacceptable'. The activity (or element of) should not be undertaken as the impact or risk is serious and does not meet the principles of ESD, legal requirements, Shell requirements or regulator and stakeholder expectations. The activity requires further assessment to reduce the risk to an acceptable level.

Table 8-2 summarises the acceptability statements, as correlated to the rankings presented in the environmental impact and risk assessments in Section 9.

[26] In the context of the petroleum activity, a change to ecological integrity is considered to take into account broadscale, long-term impacts to the ecosystem. With regards to the Commonwealth marine environment, the Activity Area is located in open offshore waters and the seabed is generally characterised by soft sediments and typical of the region.

Table 8-2: Acceptability Categories

Acceptability Statement	Residual Impact (Planned)	Residual Risk (Unplanned)
Inherently acceptable: manage for continuous improvement by effectively implementing the HSSE & SP-MS	• Positive Impact Consequence • No Impact Consequence • Slight Impact Consequence • Minor Impact Consequence	• Light Blue • Dark Blue
• Acceptable with controls: Apply the hierarchy of control to reduce the risks to ALARP	• Moderate Impact Consequence	• Yellow • Red
• Unacceptable	• Major Impact Consequence • Massive Impact Consequence	• Red – X

8.1.4 External Content

Shell considered the external context to establish the acceptable levels of impacts and risks, including information provided by relevant persons during the preparation of this EP and the Crux OPP. Shell routinely implements an ongoing consultation program managed by Shell's Corporate Relations team (see Section 5.13). Reference is made to Section 5 for further information on the stakeholder engagement process and Appendix B summarises the responses and objections/claims made by relevant persons.

8.1.4.1 Indigenous Cultural Features and Values Impact Criteria

A key objective for the relevant persons consultation process is to seek information regarding Indigenous cultural heritage features and values that could potentially be exposed to impacts or risks from Shell's activities. An overview of Indigenous cultural heritage features and values within the Planning Area is also provided in Sections 7.8.2 and 7.11.3 respectively. Shell used the criteria listed in Table 8-3—which reflect the criteria defined by DCCEEW for Indigenous cultural heritage values of National Heritage places in the Significant Impact Guidelines 1.1 (DoE 2013)—where a potential interaction was identified between the Indigenous cultural heritage and an aspect of the activity.

Table 8-3:Acceptability Categories for Indigenous Cultural Heritage Features and Values

Category	Significant Impact Criteria
Indigenous Cultural and Social Values	An action is likely to have a significant impact on Indigenous cultural heritage features or values if there is likelihood that it will: • Restrict or inhibit the continuing use of a cultural or ceremonial site causing its values to notably diminish over time. • Permanently diminish the cultural value of a place for an Indigenous group to which its values relate. • Alter the setting of a place in a manner which is inconsistent with relevant values. • Remove, destroy, damage, or substantially disturb archaeological deposits or cultural artifacts. • Destroy, damage or permanently obscure cultural or ceremonial, artifacts, features, or objects. • Notably diminish the value of a place in demonstrating creative or technical achievement. • Permanently remove, destroy, damage or substantially alter Indigenous built structures.

8.2 Defined Acceptable Levels of Impact and Risk

Table 8-4 summarises the acceptable levels of impacts and risks to environmental receptors from the petroleum activities considered in this EP.

In accordance with Section 56(1) of the Environment Regulations, reference to the Project Area is defined in Section 5.3.1 of the accepted Crux OPP has been made throughout this EP. The Project Area is defined as

the in-field development area (30 km radius around the proposed Crux topsides) and export pipeline corridor (1 km buffer either side of the route with a 2 km radius around the Prelude-end) encompassing ~314,000 hectares. The accepted Crux OPP (NOPSEMA ID: A742335) is available on the NOPSEMA website.

Table 8-4: Summary of Acceptable Levels

Receptor		Acceptable Level of Impact	Justification
Category	**Subcategory**		
Protected Areas	Marine conservation reserves	No impacts to the values of marine parks.	The environmental values within Australian marine parks would only be impacted by a worst-case unplanned incident such as a large-scale hydrocarbon spill. In a regional environmental context, the nearest Marine Parks to the Crux platform and Activity Area are ~94 km and 80 km away, respectively. Shell considers any large-scale hydrocarbon spill to be unacceptable.
	Wetlands of international and national importance	No impacts to the ecological values of wetlands of international and national importance.	The environmental values within wetlands of international and national importance would only be impacted by a worst-case unplanned incident such as a large-scale hydrocarbon spill. Ashmore Reef is located ~128 km from the Crux Platform. The oil spill modelling predicts that there is no contact by floating films or shoreline accumulations and a low (2%) probability of exposure to entrained hydrocarbons above adverse thresholds. Shell considers any large-scale hydrocarbon spill to be unacceptable.
	Commonwealth and national heritage places	No impacts to Commonwealth or national heritage places values.	The environmental values within Commonwealth or national heritage places values would only be impacted by a worst-case unplanned incident such as a large-scale hydrocarbon spill. Ashmore Reef National Nature Reserve is located ~128 km from the Crux Platform. The oil spill modelling predicts that there is no contact by floating films or shoreline accumulations and a low (2%) probability of exposure to entrained hydrocarbons above adverse thresholds.
Physical features, values and sensitivities	Marine regions	No significant impacts to the physical features of a marine region.	The physical features of a marine region would only be impacted by a worst-case unplanned incident such as a large-scale hydrocarbon spill. Shell considers any large-scale hydrocarbon spill to be unacceptable.
	Australian environment	No significant impacts to the Australian environment.	The activity consists of Scope 1 GHG emissions (e.g. Flare systems, power generation and fugitive emissions) and Scope 3 GHG emissions (e.g. Prelude FLNG processing, third-party end users). The incremental increase in GHG emissions from the activity is considered to be negligible in the context of Australian and global GHG emissions and therefore Shell predicts no impact to the overall consequence level reasonably expected. It will

Receptor		Acceptable Level of Impact	Justification
Category	**Subcategory**		
			nevertheless manage its GHG emissions and any potential impacts to ALARP. It is important to recognise that potential climate change impacts cannot be directly attributed to a single project or facility. Therefore, there is no direct connection between GHG emissions from the activity and potential impacts to specific receptors. Shell recognises that direct emissions must be reduced to ALARP by implementing control measures and achievement of the associated EPO to be acceptable. These emissions will be in accordance with relevant requirements, such as Australian GHG emissions reporting, where required by the NGER Act. GHG emissions attributable to the activity are not likely to have a significant impact on MNES. Waste that could pose a biosecurity risk will be managed in accordance with relevant regulations, such as the *Biosecurity Act 2015* (Cth) and other requirements (including Annex V of MARPOL). Shell considers any introduction and establishment of pests and diseases to Australian waters as a result of the activity to be unacceptable.
	Air quality	No significant impacts to air quality. Impact not expected to result in a substantial change in air quality, which may adversely impact biodiversity, ecological integrity[26], social amenity or human health.	Planned atmospheric emissions from the activity consist primarily of combustion of fuel (e.g. engine exhaust emissions) and hydrocarbons through flare systems, and fugitive releases (e.g. from platform and vessels). These emissions will be in accordance with relevant requirements, such as MARPOL air pollution requirements. The activity is located in the open ocean and is well-removed from nearest residential or sensitive populations of the WA coast, with limited interaction with regional airsheds.
	Water quality	No significant impacts to water quality. Impact not expected to result in a substantial change in water quality, which may adversely impact biodiversity, ecological integrity[26], social amenity or human health.	The area influenced by produced water and other activity discharges is expected to be limited to within 1 km of the discharge locations. The potential magnitude of impacts to water quality is expected to be very low. Given the offshore location and absence of particularly sensitive marine ecosystems within the Activity Area, potential impacts restricted to 1 km of the discharge location are considered acceptable.

Receptor		Acceptable Level of Impact	Justification
Category	**Subcategory**		
	Sediment quality	No significant impacts to sediment quality. Impact not expected to result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity[26], social amenity or human health may be adversely affected.	Sediment quality within the Activity Area is characteristic of the region. Activity discharges may result in changes in sediment quality in the vicinity of discharge locations. However, accumulation of persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity[26], social amenity or human health may be adversely affected, is not predicted. This level of impact is considered acceptable.
	Underwater noise	No increase in underwater noise that will have a substantial adverse effect on a population of a marine species or cetacean including its lifecycle and spatial distribution.	Activity specific noise will not significantly increase underwater noise within the Activity Area. Noise generating activities which may result in behavioural changes within specific marine species, which are limited in nature, scale and duration throughout the activity. This level of impact is considered acceptable.
Natural features, values and sensitivities	Marine bioregions	No significant impacts to benthic habitats and communities. Impacts to non-sensitive benthic communities limited to a maximum of 5% of the Project Area (as defined in the OPP). No significant adverse effect on demersal or pelagic communities, populations, habitats or spatial distribution of a species. No substantial adverse effect on a population of a marine species or cetacean including its lifecycle and spatial distribution. No known or potential pest species become established in the Commonwealth Marine Area.	With the exception of banks and shoals, the benthic and pelagic habitats and communities within the Activity Area are widely represented in the Timor Sea. Impacts to non-sensitive benthic communities limited to <5% of the Project Area (as defined in the OPP) which do not result in substantial adverse effects on marine species are considered acceptable.
	BIAs	No significant impacts to functional values of BIAs. Impacts do not modify, destroy, fragment, isolate or disturb an important or substantial area of habitat that results in an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area.	Impacts to BIAs that do not reduce the functional values of BIAs or adversely affect an important or substantial area of habitat are considered acceptable.
	Critical habitat	No significant impacts to functional values of critical habitat. Impacts do not modify, destroy, fragment, isolate or disturb an important or substantial area of habitat that results in an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area.	Impacts that do not reduce the functional values of Critical Habitats or adversely affect an important or substantial area of habitat are considered acceptable.

Receptor		Acceptable Level of Impact	Justification
Category	**Subcategory**		
	Shoals and banks	No direct impacts to named banks and shoals. No loss of coral communities at named banks or shoals as a result of indirect/offsite impacts[27]. No known or potential pest species become established in the Commonwealth marine area.	The shoals and banks of the Timor Sea are considered of high environmental value. Shell considers direct impacts to these features unacceptable. No direct or indirect impacts to shoals and banks are expected as a result of the activity, except in the event of a worst-case unplanned incident such as a large-scale hydrocarbon spill. Shell considers any large-scale hydrocarbon spill to be unacceptable.
	Offshore reefs and islands	No impacts to offshore reefs and islands. No known or potential pest species become established in the Commonwealth marine area.	Offshore reefs and islands would only be impacted by a worst-case unplanned incident such as a large-scale hydrocarbon spill. Oil spill modelling predicted that Cartier Island has the highest likelihood (compared to other regional offshore reefs and islands) of hydrocarbons exposure above adverse impact thresholds, with a 6% probability of shoreline accumulating, and 10% probability of entrained and 1% probability of dissolved hydrocarbons reaching the surrounding waters. Shell considers any large-scale hydrocarbon spill to be unacceptable.
	Coastal reefs and islands	No impacts to coastal reefs and islands.	The are no known planned impacts to coastal reefs and islands as a result of the activity. Stochastic oil spill modelling shows that a worst case credible spill would not impact coastal reefs and islands at any impact thresholds.
	KEFs	No significant impacts to environmental values of KEFs.	The export pipeline corridor intersects one KEF—Continental slope demersal fish communities at a water depth of ~200 m–300 m. This KEF is valued for high diversity of demersal fish assemblages at depths between 225 m and 1,000 m. The IMR activities in the vicinity of this KEF will likely be infrequent and limited in duration disturbing <0.05% of the total KEF area. Given the nature and scale of the planned activities, impacts to the KEF will be below the significant impact threshold. Shell considers impacts to KEF below this threshold to be acceptable.

[27] As defined in the matters of National Environmental Significance: Significant Impact Guidelines 1.1 (DoE 2013).

Receptor		Acceptable Level of Impact	Justification
Category	**Subcategory**		
			Two KEFs—Ashmore Reef and Cartier Islands and surrounding Commonwealth waters and Continental slope demersal fish communities—would only be impacted by an unplanned incident such as a hydrocarbon spill. Oil spill modelling (RPS 2024) predicted a 6% probability of shoreline accumulating, and 10% probability of entrained and 1% probability of dissolved hydrocarbons reaching the surrounding waters at Cartier Island. The modelling also predicted no contact with floating films or shoreline accumulations and a low (2%) probability of exposure to entrained hydrocarbons above adverse thresholds at Ashmore Reef and the surrounding waters. In the event of a subsea pipeline rupture at the Continental slope demersal fish communities KEF, the affected area would likely be small and over a very short duration (i.e. 4 hours). Shell considers any large-scale hydrocarbon spill to be unacceptable.
	Threatened, migratory, marine and cetacean species	No mortality or injury of cetaceans. Management of aspects of the activity must align with Conservation Advice, recovery plans and threat abatement plans (Table 7-16). No significant impacts to EPBC Act listed threatened, migratory, marine or cetacean species.	Impacts that are below the significant impact thresholds are considered acceptable. Shell considers significant impacts to MNES to be unacceptable. Impacts that are below the significant impact threshold defined Table 8-1 are considered as acceptable.
Socioeconomic features, values and sensitivities	People and communities	No significant impacts to people and communities	The Activity Area is distant from any population centres and the modelling for a worst-case spill scenario does not predict any exposure for people or communities. No impacts are considered acceptable.
	Fishing industry	No negative impacts to targeted fisheries resource stocks that result in demonstrated loss of income for commercial fisheries. Temporary displacement of fishing activities within the Activity Area (excluding PSZs) is acceptable. Permanent exclusion of fishing activities from PSZs is acceptable.	Shell considers impacts or restricted access to targeted fish stocks that measurably reduces the potential revenue for commercial fishers, charter operators or other benefits provided to traditional fishers (intersects the MoU Box) to be unacceptable. In a regional context, commercial, recreational and traditional fishing is typically concentrated mostly in coastal/shallow waters and minimum fishing effort is known to occur within the Activity Area, given its remoteness offshore. Shell considers the displacement of other users (e.g. commercial, recreational and

Receptor		Acceptable Level of Impact	Justification
Category	**Subcategory**		
			traditional fishers) from relatively small areas of the open ocean environment in the Activity Area to be acceptable and necessary from a safety and security perspective.
	Tourism and recreation	No negative impacts to nature-based tourism resources resulting in demonstrated loss of income. Temporary displacement of tourism activities within the Activity Area (excluding PSZs) is acceptable. Permanent exclusion of tourism activities from PSZs is acceptable.	Shell considers impacts to nature-based tourism resources that measurably reduces the potential revenue for tourism operators to be unacceptable. In a regional context, there are no known tourist attractions or destinations within the Activity Area or surrounding marine waters, however charter vessels may transit the broader regional waters. Shell considers the displacement of other users (e.g. tourism operators) from the Activity Area, which is a relatively small area of the open ocean environment where existing tourism and recreation use is very low, to be acceptable and necessary from a safety and security perspective.
	Defence	Temporary displacement of defence activities within the Activity Area (excluding PSZs) is acceptable. Permanent exclusion of defence activities from PSZs is acceptable.	Shell considers the displacement of other users (e.g. defence vessels and aircraft) from relatively small areas of the open ocean environment within the Activity Area to be acceptable. In a regional context, there are no designated military/defence exercise areas in the Activity Area, however there are regional defence exercise areas with large geographic extents.
	Scientific research/restoration	No impacts resulting in abandonment of long-term established scientific research or restoration programs. Temporary displacement of scientific research and restoration within the Activity Area. Permanent displacement of scientific research and restoration within the petroleum safety zone (excluding activity specific programs).	Shell considers the displacement of scientific research and restoration projects from the petroleum safety zone which is a relatively small area of the open ocean environment, to be acceptable. Given the remote location, it is unlikely that any scientific research or restoration programs outside of those commissioned in association with the activity are feasible.
	Oil and gas industry	Temporary displacement/interruption of petroleum exploration activities and operations within the Activity Area (excluding PSZs) is acceptable. Permanent exclusion of petroleum exploration activities from PSZs is acceptable.	Shell considers the displacement of other users (e.g. petroleum exploration and operations) from relatively small areas of the open ocean environment in the Activity Area to be acceptable. In a regional context, the Prelude FLNG facility is interconnected to the activity, and outside of Shell operations the nearest operational

Receptor		Acceptable Level of Impact	Justification
Category	**Subcategory**		
			facility is Ichthys, ~20 km away. Temporary interruption of operations due to an unplanned incident is considered acceptable.
	Indonesian and Timor-Leste coastlines	No impacts to Indonesian and Timor-Leste coastlines are acceptable.	Oil spill modelling predicted a 2% probability of shoreline accumulation and no floating hydrocarbons reaching the Indonesian or Timor-Leste coastlines at low thresholds (RPS 2024). Shell considers any large-scale hydrocarbon spill to be unacceptable.
Heritage and cultural features, values and sensitivities	Underwater cultural heritage	No damage or destruction to historical shipwrecks and sunken aircraft is acceptable.	Shell considers any disturbance of historical shipwrecks or sunken aircraft to be unacceptable. No known historical shipwrecks or sunken aircraft will be impacted due to the activity
	Traditional Indonesian fishing	No negative impacts to exploited fisheries resource stocks. Temporary displacement of traditional fishing activities within the Activity Area (excluding PSZ) is acceptable. Permanent exclusion of traditional fishing activities from gazetted petroleum exclusion zones is acceptable.	Shell considers the displacement of other users (e.g. traditional Indonesian fishers) from relatively small areas of the open ocean environment in the Activity Area to be acceptable. The fisheries resource stocks of importance for traditional Indonesian fishers would only be impacted by a worst-case unplanned incident such as a large-scale hydrocarbon spill. Shell considers any large-scale hydrocarbon spill to be unacceptable.
	Indigenous cultural connections	No impacts to Indigenous cultural connections.	Consistent with the criteria defined by DCCEEW for Indigenous cultural heritage of National Heritage places, Shell does not accept impacts to cultural heritage features. In August 2023, DAC commented that no impacts from a spill to their sea Country are acceptable.
	Indigenous cultural heritage values	No significant impacts to Indigenous cultural heritage values.	Consistent with the criteria defined by DCCEEW for Indigenous cultural heritage of National Heritage places (see Table 8-3), Shell does not accept significant impacts to cultural values of a place for an Indigenous group to which its values relate. Consistent with the acceptable criteria for the physical and biological environment, Shell recognises that impacts to the environment may also impact cultural values. Shell considers that no significant impact to these values is acceptable.

9 Evaluation of Environmental Impacts and Risks

9.1 Introduction

This section documents the process for evaluating environmental (including socioeconomic and cultural features) impacts and risks and the development of mitigation measures for the activity.

9.1.1 Risk Assessment Methodology

Shell Group has a standardised Hazards and Effects Management Process (HEMP) by which Shell Group identifies and assesses hazards and implements measures to manage them. This process is consistent with the principles outlined in the Australian Standard AS/NZS ISO 31000:2018 Risk Management and Handbook 203:2012 Managing Environment Related Risk Environmental Risk. The process is summarised in Figure 9-1. The HEMP is a fundamental element of the Shell Group SEAM Framework and is a process that is applied at every phase of projects and operations.

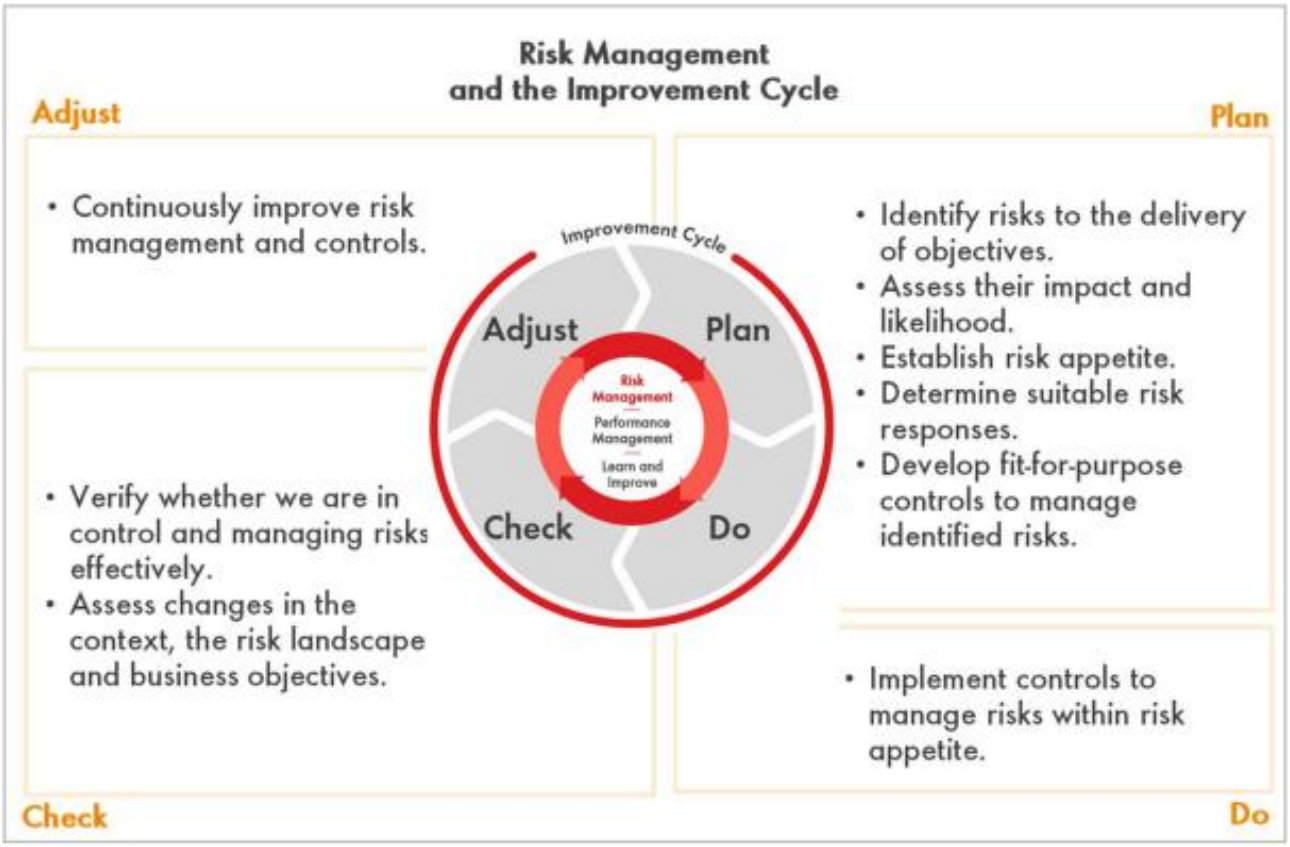


Figure 9-1: Risk Management Framework (Shell Risk Management Practice 2024 v1.1)

Shell's HSSE & SP-MS is continually improving because it incorporates:

- new and amended legislative requirements.
- changing community expectations.
- improved available technology.
- ongoing stakeholder engagement.
- learnings from incidents industry wide and within Shell Group.
- regular management review.

Shell ensures the HSSE & SP-MS is effective and continuously improving. Shell ensures compliance with new Shell standards through local self-assurance and the ongoing Shell Global auditing process. This process identifies gaps and drives closure of those gaps.

Shell standards are often aligned with, but in many cases more stringent than local legislation, global good industry practice benchmarks such as those published by the International Finance Corporation and World Bank. Both legislation and Shell standards are continually being updated and require a higher level of performance over time. Concurrently, new technologies are becoming available which make improved performance, reliability, and safety possible and more affordable. This continual improvement is reflected in more challenging ALARP and acceptability benchmarks, leading to better environmental outcomes over time.

Section 21(5)(b) of the OPGGS(E) Regulations requires that the EP includes 'an evaluation of all the impacts and risks, appropriate to the nature and scale of each impact or risk'. This is further clarified by section 21(6) of the OPGGS(E) Regulations which states that: 'to avoid doubt, the evaluation mentioned in section 21(5)(b) must evaluate all environmental impacts and risks arising directly or indirectly from (a) all operations of the activity; and (b) potential emergency conditions, whether resulting from accident or any other reason.' Based on this, Shell has chosen to present ALARP demonstrations for all identified impacts and risks, regardless of their ranking.

Section 9.2 details the environmental, socioeconomic, and cultural impacts and risks of the petroleum activities. Activities are described in terms of magnitude/sensitivity and the ranking of planned impacts and unplanned risks. Management actions proposed to reduce any effect on the environment to ALARP are also described.

Various environment professionals carried out a detailed desktop review of the impact and risks assessments when preparing this EP.

9.2 Impact Assessment Methodology

This section describes the approach adopted by Shell for identifying and assessing impacts on the environment as relevant to the activities within the OPGGS Act guidelines (e.g., NOPSEMA 2024a). Planned activities give rise to environmental impacts, while unplanned and accidental events pose a risk of environmental impact, if they occur. The risk ranking of environmental impacts resulting from unplanned or accidental events is evaluated by identifying the worst-case credible consequence (without controls) and then assessing the likelihood for the event occurring (with confirmed controls in place).

The approach aligns with Shell's methodology that enables a balanced assessment of planned impacts and unplanned risks. The methodology ties potential 'Magnitude' of a predicted impact and the 'Receptor Sensitivity' (see Table 9-5). The matrix is used for assessing impacts and consequences for both planned activities and unplanned events.

Table 9-1 defines the key terminology used in this assessment.

Table 9-1: Definition of Key Terminology for Impact Assessment

Term	Definition
Acceptable	The level of impact and risk to the environment that may be considered broadly acceptable with regard to all relevant considerations.
Activity	Components or elements of work associated with the project. All activities associated with the project have been considered at a broad level (as outlined in Section 6).
ALARP	The point at which the cost (in time, money, and effort) of further risk or impact reduction is grossly disproportionate to the risk or impact reduction achieved.
Aspect	Elements of the proponent's activities or products or services that can interact with the environment. These include planned activities and unplanned (e.g. emergency) events.
Control	A measure that prevents and/or mitigates risk by reducing the overall likelihood of a worst-case credible consequence occurring. Controls include existing controls (i.e. company management controls or industry standards) or additional controls (i.e. additional measures identified during the risk assessment processes).
Event	One or more occurrences of a particular set of circumstances; can have several initiating causes.
Factor	Relevant physical, biological, socioeconomic, and cultural features of the environment (also referred to as values, sensitivities and/or receptors).
Hazard	A substance, situation, process, or activity that can cause harm to the environment.

Term	Definition
Impact	Any change to the environment from a planned activity, whether adverse or beneficial, wholly, or partially resulting from a proponent's environmental aspects.
Impact consequence	The outcome of a planned activities or unplanned events, which can lead to a range of worst-case, credible consequences. A consequence can be certain or uncertain and can have positive or negative effects. Consequences can be expressed qualitatively or quantitatively.
Inherent risk	The potential exposure defined as the plausible worst-case event in the absence of controls.
Likelihood	Description of probability or frequency of a consequence occurring with controls in place.
Residual impact	The level of impact remaining after impact treatment, i.e. application of controls (includes unidentified impact).
Residual risk	The level of risk remaining after risk treatment, i.e. application of controls (includes unidentified risk).

9.2.1 Aspects and Impact/Risk Identification

An initial screening process examined each aspect (see Table 9-2) to identify potential environmental receptors, as listed in Section 9.2.2.3, that may be exposed to associated impacts or risks. The screening process identified the environmental receptors for each aspect associated with the activities covered by this EP before the detailed evaluation was conducted and potential control measures were not considered.

Table 9-2: Key Aspects Arising from the Activity

Aspect	EP Section
Physical presence	Section 9.3
Lighting	Section 9.4
Noise	Section 9.5
Seabed disturbance	Section 9.6
Vessel movements	Section 9.7
Introduction of IMS	Section 9.8
Produced water discharge	Section 9.9
Activity discharges	Section 9.10
Atmospheric emissions	Section 9.11
GHG emissions	Section 9.12
Unplanned minor releases	Section 9.13
Emergency events	Section 9.14
Oil spill response strategies	Section 9.15

9.2.2 Evaluation of Impacts

9.2.2.1 Impact Consequence Assessment

The ranking of environmental impact consequence is assessed in terms of:

- magnitude based on the size, extent, and duration/frequency of the impact (Section 9.2.2.2).
- sensitivity of the receiving receptors (Section 9.2.2.3).

9.2.2.2 Magnitude

Table 9-3 outlines the levels of magnitude of environmental impacts. The magnitude of an impact or predicted change (as illustrated in Figure 9-2) takes into account:

- nature of the impact and its reversibility.
- duration and frequency of an impact.

- extent of the change.
- potential for cumulative impacts.

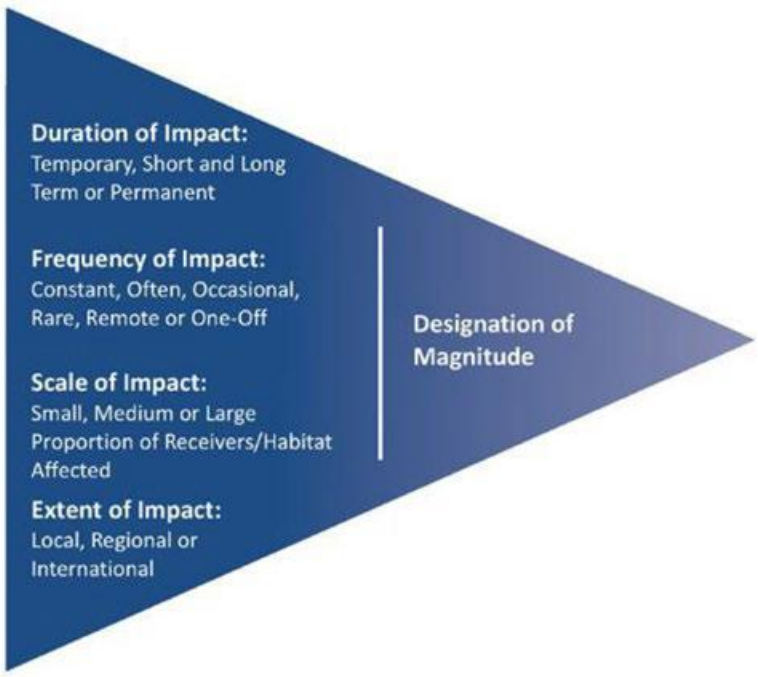


Figure 9-2: Magnitude Considerations in the Context of Impact Identification

Magnitude is defined differently depending on the type of impact—numerals can be used for readily quantifiable impacts (e.g. noise, liquid discharge plume extent), but for others (e.g. communities, habitats) a more qualitative definition applies. The criteria listed in Table 9-3 capture high-level definitions, adapted as appropriate to the offshore context of the Crux Project.

Table 9-3: Magnitude Criteria

Definition	Environmental Impact
Positive effect +1	• Net positive effect arising from a proposed aspect of the petroleum activity.
No effect 0	• No environmental damage or effects.
Slight effect −1	• Slight environmental damage contained within the Activity Area. • Effects unlikely to be discernible or measurable. • No contribution to transboundary or cumulative effects. • Short-term or localised decrease in the availability or quality of a resource, not effecting usage.
Minor effect −2	• Minor environmental damage, no lasting effects (or persistent effects are highly localised). • Minor change in habitats or species. • Unlikely to contribute to transboundary or cumulative effects. • Short-term or localised decrease in the availability or quality of a resource, likely to be noticed by users.

Definition	Environmental Impact
Moderate effect −3	• Moderate environmental damage that will persist or require cleaning up. • Widespread change in habitats or species beyond natural variability. • Observed off-site effects or damage (e.g. fish kill, damaged habitats). • Decrease in the short-term (1–2 years) availability or quality of a resource affecting usage. • Local or regional stakeholders' concerns leading to complaints. • Minor transboundary and cumulative effects.
Major effect −4	• Severe environmental damage that will require extensive measures to restore beneficial uses of the environment. • Widespread degradation to the quality or availability of habitats and/or wildlife requiring significant long-term restoration effort. • Major oil spill over a wide area leading to campaigns and major stakeholders' concerns. • Transboundary effects or major contribution to cumulative effects. • Mid-term (2–5 years) decrease in the availability or quality of a resource affecting usage. • National stakeholders' concern leading to campaigns affecting Shell's reputation.
Massive effect −5 (to be used only for unplanned events)	• Persistent severe environmental damage resulting in loss of use or loss of natural resources over a wide area. • Widespread long-term degradation (not readily rectified) to the quality or availability of habitats. • Major impact on the conservation objectives of internationally/nationally protected sites. • Major transboundary or cumulative effects. • Long-term (>5 years) decrease in the availability or quality of a resource affecting usage. • International public concern.

9.2.2.3 Receptor Sensitivity

For this EP, receptors are grouped into these primary categories (described and subcategorised further in Section 7):

- Protected Areas[28].
- Physical Features.
- Physical Values and Sensitivities.
- Natural Features.
- Natural Values and Sensitivities.
- Socioeconomic Features.
- Socioeconomic Values and Sensitivities.
- Heritage and Cultural Features.
- Heritage and Cultural Values and Sensitivities.

Receptor sensitivity criteria are based on these key factors:

- Importance of the receptor at local, national, or international level

[28] Impacts and risks to the Commonwealth Marine Area are evaluated via assessment of impacts and risks to its constituent physical, natural and cultural heritage values from each aspect of the Activity, and compared to the EPBC Act significant impact criteria for the Commonwealth Marine Area to determine acceptability.

For example, a receptor will be of high importance at international level if it is categorised as a designated protected area (e.g. a Ramsar site). Areas that may potentially contain high value habitats are of medium importance if their presence/extent has not yet been confirmed.

- Sensitivity/vulnerability of a receptor and its ability to recovery

  For example, certain species can adapt to changes easily or recover from an impact within a short time. Thus, as part of the receptor sensitivity criteria (Table 9-4), recovery time of a receptor from identified impacts is considered, as well as if the receptor was already under stress.

- Sensitivity of the receptor to certain impacts

  For example, vessel emissions will potentially affect air quality but not affect other receptors (e.g. seabed).

Table 9-4: Receptor Sensitivity Criteria

Sensitivity	Environmental Impact
Low (L)	• Receptor with *low* value or importance (e.g. habitat or species is abundant and not of conservation significance, exhibits immediate to short-term recovery, and/or easily adapts to change).
Medium (M)	• Receptor of *medium* importance (e.g. recognised as an area/species of potential conservation significance, such as KEF or listed threatened species), or • Recovery likely within 1–2 years following cessation of activities, or localised medium-term degradation with recovery in 2–5 years.
High (H)	• Receptor of *high* importance (e.g. recognised as an area/species of potential conservation significance with development restrictions, such as marine parks or conservation reserves, or habitat critical to the survival of a species), or • Recovery not expected for an extended period (>5 years following cessation of activity) or cannot be readily rectified.

9.2.2.4 Impact Consequence Ranking

The magnitude of the impact and sensitivity of receptor are combined to determine the impact consequence ranking (see Table 9-5). Key management controls are then identified to reduce the magnitude of such an event occurring in order to determine the final residual impact ranking.

Table 9-5: Impact Consequence Ranking Matrix

Magnitude	Sensitivity: L	Sensitivity: M	Sensitivity: H
+1			
0			
-1			
-2			
-3			
-4			
-5			

Residual Impact Consequence Ranking	Residual Impact Acceptability Categories
Positive Impact Consequence	Inherently acceptable - Manage for continuous improvement through effective implementation of the HSSE and SP management system
No Impact Consequence	
Slight Impact Consequence	
Minor Impact Consequence	
Moderate Impact Consequence	Acceptable with controls - Apply the hierarchy of control to reduce the risks to ALARP
Major Impact Consequence	Unacceptable
Massive Impact Consequence	

9.2.3 Evaluation of Risks (Addition of Likelihood Criteria)

To determine the risk ranking of unplanned/emergency events, the likelihood of such an event occurring must be assessed along with the impact consequence. For example, based on magnitude and sensitivity alone a

hydrocarbon spill associated with a loss of well control to surface would be classed as having a major impact consequence; however, the inherent likelihood of such an event occurring would typically be in the range of unlikely to remote. In addition, the mitigation measures for such impacts focus on reducing the likelihood of the well head failing not reducing the magnitude of the impact itself. Thus, unplanned events must be assessed in terms of residual risk.

As with planned activities, the potential impacts of unplanned events are identified, and the impact consequence ranking is determined—this considers the magnitude of the event and sensitivity of the relevant receptor(s). The residual impact consequence ranking is then combined with the likelihood of the event occurring (Table 9-6) to determine the overall environmental risk ranking (using Table 9-7). To determine the residual risk, controls are then identified to reduce the risk of such an event occurring.

Table 9-6: Likelihood Criteria

A	• Never heard of in the industry – **extremely remote**. • <10^{-5} per year. • Has never occurred within the industry or similar industry but theoretically possible.
B	• Heard of in the industry – **remote.** • 10^{-5}–10^{-3} per year. • Similar event has occurred somewhere in the industry or similar industry but not likely to occur with current practices and procedures.
C	• Has happened in the Shell Group or more than once per year in the industry – **unlikely**. • 10^{-3}–10^{-2} per year. • Event could occur within the lifetime of similar facilities; has occurred at similar facilities.
D	• Has happened at the location or more than once per year in the Shell Group – **possible**. • 10^{-2}–10^{-1} per year. • Could occur within the lifetime of the development.
E	• Has happened more than once per year at the location – **likely**. • 10^{-1} – >1 per year. • Event likely to occur more than once at the facility.

Table 9-7: Environmental Risk Matrix (Unplanned Events)

Residual Impact Consequence	Likelihood A	B	C	D	E
No Impact Consequence					
Slight Impact Consequence					
Minor Impact Consequence					
Moderate Impact Consequence					
Major Impact Consequence					
Massive Impact Consequence			X	X	X

	Residual Risk Acceptability Categories
Light Blue	Inherently Acceptable - Manage for continuous improvement through effective implementation of the HSSE and SP management system
Dark Blue	
Yellow	Acceptable with Controls - Apply the hierarchy of control to reduce the risks to ALARP
Red	
Red - X	Unacceptable

9.2.4 Assessment of Residual Impacts and Risks

The risk assessment methodology applied ensured these key steps were completed throughout scenario development:

1. Hazards identified.
2. Initiating causes determined.
3. Worst-case credible scenarios agreed (without controls in place).
4. Release of hazards understood (i.e. top events).

5. Preventive controls listed.
6. Mitigative controls listed.
7. Likelihood determined (with confirmed controls in place).
8. Risk ranking attributed.

When evaluating residual impacts and risks (see Table 9-5 and Table 9-7), Shell assumed all controls were implemented effectively and functioning as intended.

The residual rankings displayed in the summary tables in each subsection represent the highest residual impact or risk (where relevant) for each primary receptor category (i.e. physical environment, biological environment, and socioeconomic values and sensitivities), and therefore are considered a conservative assessment for individual environmental values/sensitivities. These residual rankings were then compared to the acceptability categories outlined in Section 8 to determine a final ALARP and acceptability statement.

Cumulative environmental impacts and risks are also considered and discussed, where relevant, through the impact and risk assessment process and consider current and foreseeable pressures on the environment (e.g. other petroleum activities, other marine industries and users, other ecosystem pressures).

9.2.5 ALARP Assessment

For Shell, ALARP means the point at which the cost (in time, money, and effort) of further risk or impact reduction is grossly disproportionate to the risk or impact reduction achieved.

ALARP can be demonstrated using various mechanisms:

- quantitative methods, such as technical assessments (e.g. modelling studies) or where the costs of the various options can be compared with the respective impact/risk reduction
- semi-quantitative methods, where impacts/risks within a certain level require a predefined number of barriers of a certain effectiveness in place to prevent the hazard being realised
- qualitative analysis, where ALARP is established using standards, legislative requirements and judgement based on experience.

Shell applies a hierarchy of control process to demonstrate ALARP, as shown in Figure 9-3.

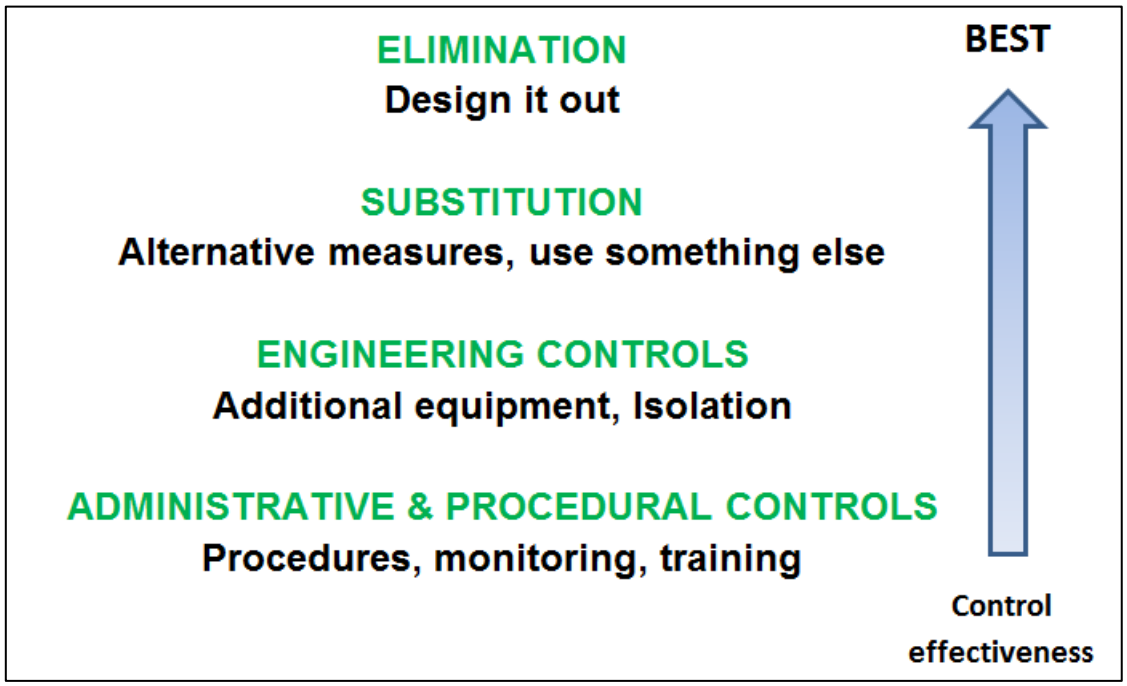


Figure 9-3: Hierarchy of Controls

9.2.6 Environmental Performance Outcomes and Environmental Performance Standards

Environmental Performance Outcomes (EPOs) have been developed for all aspects of the activity. The purpose of the EPOs is to provide specific, measurable levels of environmental performance that are:

- consistent with the principles of ESD; and
- demonstrate that the environmental impacts and risks are of an acceptable level.

Note that the consideration of acceptability for each aspect is provided in the relevant **Acceptability** sections in the evaluation of environmental impacts and risks. Consequently, these acceptability considerations are a component of the EPO.

The acceptable levels of impact defined in section 8.2 are implemented through measurable EPOs in Section 9. These EPOs translate qualitative acceptable levels into quantitative, measurable and specific EPOs, ensuring that impacts remain within acceptable levels defined.

This EP has considered recent Federal Court findings in DEA v NOPSEMA (VID527/2025), which emphasised the importance of clear, measurable controls.

EPOs associated with planned impacts will generally be demonstrated through successful implementation of controls, environmental performance standards and associated measurement criteria. Note that controls may include environmental monitoring programs, however these are not required where there is high confidence in the effectiveness of controls and the potential for environmental impact is low. Where an unplanned event (e.g. accidental discharge) results in the potential for environmental harm, the incident reporting and investigation process will identify if there is the potential for environmental impacts. This process will provide sufficient information to determine if the EPO has been achieved. An evaluation of concordance with OPP EPOs and EPSs is provided in Appendix G.

Environmental Performance Standards (EPSs) and associated Measurement Criteria (MC) that include references to specific sections of the EP are provided solely for the convenience of the reader. These references are intended to facilitate ease of understanding and navigation. It is important to note that these references are not part of the EPS or MC itself, and the referenced information does not form part of the EPS or MC itself.

9.3 Physical Presence

9.3.1 Aspect Context

The physical presence of the activity infrastructure, notably the Crux platform substructure and the export pipeline, will provide hard substrate within an area that is predominantly soft sediments. Over time, this is likely to be subject to colonisation and growth of encrusting organisms and encourage the development of more diverse marine communities.

The physical presence of infrastructure and vessels also has the potential to displace other marine users from the Activity Area. A permanent PSZ will be gazetted 500 m around the platform from which unauthorised vessels will be excluded. This is in addition to the 500 m PSZ around the Prelude FLNG turret, DC-1P drill centre, and dynamic portions of the associated mooring catenaries and the riser base manifold. Outside of the PSZs, there may be temporary displacement due to the presence of vessels. This displacement could affect activities and access to areas associated with fishing, tourism and recreation, defence, commercial shipping and other oil and gas activities within the region. The potential for impact, however, is limited due to the restricted size of the PSZs compared to the area available for transit, the expected low number of vessels operating during the scope of this activity and the low level of third-party use of the area.

9.3.2 Description and Evaluation of Impacts

Table 9-8 indicates the environmental features and values and sensitivities that have been identified to be potentially affected by physical presence during the activities covered by this EP, with further evaluation of the impacts and/or risks to each potentially affected receptor category (including cumulative impacts) provided in Sections 9.3.2.1 to 9.3.2.4. Features or values and sensitivities which could not be credibly affected are not discussed further.

Table 9-8: Physical Presence Receptor Impact Screening Summary

	Protected Areas			Features															Values and Sensitivities																							
				Physical		Natural				Socioeconomic								Heritage and Cultural			Physical				Natural							Socioeconomic							Heritage and Cultural		
Aspect	Receptor	Marine Conservation Reserves	Wetlands of International and National Importance	Commonwealth and National Heritage Places	Marine Regions	Australian Environment	Northwest Shelf Province Bioregion	Northwest Shelf Transition Bioregion	Northwest Transition Bioregion	Timor Province Bioregion	People and Communities	Fishing Industry	Tourism and Recreation	Defence	Shipping	Scientific Research/Restoration	Oil and Gas Industry	Indonesian and Timor-Leste Coastlines	Underwater Cultural Heritage	Traditional Indonesian Fishing	Indigenous Cultural Connections	Air Quality	Water Quality	Sediment Quality	Underwater Noise	BIAs	Critical habitat	Shoals and Banks	Offshore Reefs and Islands	Coastal Reefs and Islands	KEFs	Threatened, Migratory, Marine and Cetacean Species	Fishing Industry	Tourism and Recreation	Defence	Shipping	Scientific Research/Restoration	Oil and Gas Industry	Indonesian and Timor-Leste Coastlines	Underwater Cultural Heritage	Traditional Indonesian Fishing	Indigenous Cultural Heritage
										*		*																					*									

Legend:		
		Potentially affected
	*	Predicted impact

9.3.2.1 Natural Features, Values and Sensitivities

9.3.2.1.1 Timor Province Bioregion

The seabed within the Activity Area is predominately bare and unconsolidated sediment, which supports relatively low diversity and abundance marine communities. The physical presence of installed Crux infrastructure will provide a substrate for the attachment of organisms such as sponges and gorgonians. The resulting habitat will be relatively complex compared to much of the pre-existing habitat and will serve as an artificial reef. Survey work on the North West Shelf has highlighted the increased fish species richness and abundance associated with offshore oil and gas infrastructure, and subsea pipelines (Bond et al. 2018; McLean et al. 2017). Although localised, the expected change in benthic and demersal communities, including a likely increase in fish diversity and abundance, is considered to be a Positive impact (Magnitude: +1, Sensitivity: L).

9.3.2.1.2 KEFs

A small section (~7 km) of the export pipeline falls within the Continental slope demersal fish communities KEF (see Figure 7-9). The ecological value of the Continental slope demersal fish communities KEF is the relatively high diversity of demersal fish species (DSEWPaC 2012). These species tend to occupy two distinct demersal community types (biomes) associated with the upper slope (water depth of 225–500 m) and the mid-slope (750–1,000 m) (DSEWPaC 2012).

The ongoing physical presence of the pipeline on the seabed has the potential to locally displace the benthic bacterial and fauna communities that are thought to underpin the food web that supports the demersal fish (and other higher order) communities on the slope. Assuming (conservatively) a 1 m wide seabed footprint for the pipeline (0.8 m OD) and associated stabilisation, the pipeline will affect <0.00005% of the KEF and its presence will locally increase the extent of hard substrate if/where it traverses areas of soft sediment. Eventually, the bacterial or epifauna communities that exist on natural hard substrates of the KEF within the pipeline corridor can be expected to colonise the pipeline infrastructure and the additional hard substrate provided by the export pipeline will encourage the development of more abundant and diverse attached communities, potentially providing a localised increase in habitat for fish and invertebrates. Survey work on the North West Shelf has highlighted the increased fish species richness and abundance associated with offshore oil and gas infrastructure, and subsea pipelines (Bond et al. 2018; McLean et al. 2017). Therefore, it can be expected that the export pipeline may eventually provide benefits to the values of the KEF that offset or partially offset any adverse impacts of physical presence. However, considering the very small proportion of the KEF involved, the highly localised and negligible ecosystem consequences of changes to the food web are expected to represent no more than Slight residual impacts (Magnitude: -1, Sensitivity: M).

9.3.2.2 Socioeconomic Features, Values and Sensitivities

9.3.2.2.1 Fishing Industry

Three managed fisheries (one Commonwealth–managed and two WA–managed) have the potential to interact with Crux infrastructure and/or vessels/equipment within the Activity Area. Potential impacts of physical presence include minor interference (navigational hazard), localised displacement/avoidance by commercial fishing vessels, damage or loss of fishing equipment, and loss of commercial fish catches within the immediate vicinity of the infrastructure.

However, such interaction is considered unlikely because:

- low fishing effort occurs within the Activity Area (Table 7-18)
- restricted access due to the activity is small compared to the fishing licence area available for their use (Section 7.8.2)
- fishers are aware of and avoid the existing PSZ locations.

The seabed within the Activity Area is predominately bare and unconsolidated sediment, which supports relatively low diversity and low abundance fish assemblages compared to more complex habitats (e.g. reefs and shoals). Fishers traversing the Activity Area may have to make minor navigational adjustments to avoid infrastructure or vessels but significant disruption to these fishers is considered unlikely, given the remote location and size of the PSZs and the water depths in the Activity Area. As described in Section 9.3.2.1, the hard substrate provided by the infrastructure will encourage the development of more abundant and diverse attached communities, providing a localised increase in habitat for fish and invertebrates. Survey work on the

North West Shelf noted that the fish assemblages associated with pipelines tended to have a relatively high portion of commercially targeted fish species that preferred complex habitats (Bond et al. 2018; McLean et al. 2017). Therefore, it can be expected that the Crux infrastructure may eventually provide benefits to fishers that offset or partially offset any adverse impacts of physical presence, and overall this aspect is considered to have low impact on the fishing industry.

9.3.2.2.2 Tourism and Recreation

No known tourism-based activities occur within the Activity Area and most tourism and recreational activities within the Planning Area are concentrated in shallower waters, close to coastlines (see Section 7.8.3). Given the water depths in the Activity Area, the lack of any geographic or UCH features such as shoals, banks, reefs or shipwrecks, and the distance offshore it is unlikely any tourism or recreation activities will occur in or near the Activity Area over the duration of operation. Tourism operators and recreational users may occasionally transit the Activity Area, but any minor navigational adjustments required to avoid activity infrastructure or vessels is expected to have negligible impacts.

9.3.2.2.3 Defence

No designated defence exercise areas or planned activities occur within the Activity Area (see Section 7.8.4). Maritime and border force surveillance and enforcement activities may occur within Commonwealth waters in and around the Activity Area but no impacts to these operations are expected as a result of the physical presence of infrastructure or vessels.

9.3.2.2.4 Shipping

Most shipping movements in the vicinity of the Activity Area are associated with offtake tankers and vessels serving the Prelude FLNG and Ichthys facilities (see Section 7.9.4; Figure 7-29). It is possible that commercial shipping may transit near to Crux facilities, however, given the distance to shipping channels, Shell expects minimal impacts.

9.3.2.2.5 Oil and Gas Industry

The Activity Area is entirely within the Shell production and pipeline licences. The Prelude FLNG facility is interconnected to the activity. The next closest permanent petroleum infrastructure are the Ichthys FPSO (~20 km south of the Activity Area and ~170 km southwest of the Crux platform) and Montara FPSO (~30 km and 36 km north of the Activity Area and Crux Platform respectively) (see Section 7.8.7). Exploration activities undertaken by other operators in the region within other permit areas are considered possible. No impacts to non–Shell operated oil and gas activities within the region are expected.

Overall, worst-case potential residual impacts to socioeconomic features, values and sensitivities are considered to be Minor (Magnitude: -2, Sensitivity: M)

9.3.2.3 Heritage and Cultural Features, Values and Sensitivities

9.3.2.3.1 Traditional Indonesian Fishing

The western (Prelude) part of the pipeline intersects the MOU Box within which traditional fishers may operate. The deep open waters in this part of the Activity Area are very unlikely to support traditional fishing activity and the physical presence of the pipeline would not affect traditional fishing methods. Therefore, potential effects are limited to a requirement for transiting Indonesian fishing vessels to navigate around vessels that may temporarily be operating along the pipeline corridor. With the controls that are proposed to be implemented, adverse impacts to traditional fishing are not anticipated (Magnitude: 0, Sensitivity: L).

9.3.2.4 Cumulative Impacts

On the basis that concurrent activities (see Section 9.3.1) will occur, the potential for cumulative impacts is acknowledged. The existing Crux Platform and Prelude FLNG PSZs prohibit unauthorised marine users from entering a small area. Any Crux activities conducted within the vicinity of the Prelude FLNG PSZ (e.g. IMR) may further restrict other marine user movements. Due to the low levels of activity by fishers and other marine users (excluding Prelude related operations), and the relatively small area affected by combined facilities/activities compared to the area available for other users, the additive or cumulative effects to marine users is considered to be negligible. Therefore, no change to the overall consequence level is expected.

9.3.3 Impact Assessment Summary

Table 9-9 lists the highest impact consequence rating in the relevant environmental receptor group.

Table 9-9: Physical Presence Evaluation of Residual Impacts

Environmental Receptor	Magnitude	Sensitivity	Residual Impact Consequence
Evaluation – Planned Impacts			
Protected Areas	N/A	N/A	N/A
Physical Features	N/A	N/A	N/A
Physical Values and Sensitivities	N/A	N/A	N/A
Natural Features	+1	L	Positive impact
Natural Values and Sensitivities	−1	M	Slight
Socioeconomic Features	0	L	No Impact
Socioeconomic Values and Sensitivities	−2	M	Minor
Heritage and Cultural Features	0	L	No Impact
Heritage and Cultural Values and Sensitivities	0	L	No Impact

9.3.4 ALARP Assessment and Environmental Performance Standards

Table 9-10: ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
ALARP Assessment						
Elimination	N/A	N/A	The physical presence of the vessels and infrastructure cannot be eliminated.	N/A	N/A	N/A
Substitution	N/A	N/A	The physical presence of the vessels and infrastructure cannot be substituted.	N/A	N/A	N/A
Engineering	N/A	N/A	No additional engineering control measures have been identified to reduce the impact from physical presence.	N/A	N/A	N/A
Administrative and Procedural	Infrastructure and PSZ locations communicated to AHO to allow inclusion on maritime charts.	Yes	Inclusion of facilities and PSZ on maritime charts will allow other marine users to navigate accordingly to avoid adverse interactions with Crux facilities and restricted areas. This procedural control is also consistent with standard industry practice.	1.1	Active PSZ notification and infrastructure locations issued through AHO.	Consultation records show information was provided to AHO.
Administrative and Procedural	Give a minimum of four weeks' notice of commencement of activities under this EP to the AHO to enable a 'Notice to Mariners' to be issued.	Yes	Allows notifications to be made to other marine users in the area to minimise disruption to their activities. A 'Notice to Mariners' may be issued by the relevant authority before the activity. Under the *Navigation Act 2012* (Cth), the AHO is also responsible for maintaining and disseminating navigational charts and publications, including providing safety-critical information to mariners (including any change to prohibited/restricted areas, obstructions to surface navigation, etc.) via the Notice to Mariners system. Notice to Mariners can be permanent or temporary notifications. This procedural control is also consistent with the relevant persons consultation outcomes. The benefits outweigh the costs associated with implementing this control and are considered to reduce risks to ALARP.	1.2	AHO is notified, at least four weeks prior, to enable a 'Notice to Mariners' to be issued before activities under this EP commence.	Consultation records show sufficient information provided to AHO to generate 'Notice to Mariners' at least four weeks prior to the activities commencing under this EP.

Administrative and Procedural	Vessels equipped and crewed in accordance with Australian maritime requirements; Marine Order 21, Marine Order 27, Marine Order 30 and Marine Order 71.	Yes	The vessels within the Activity Area will adhere to the navigation safety requirements contained within the COLREGS, Chapter 5 of the SOLAS, STCW Convention, the *Navigation Act 2012* (Cth) and any subsequent Marine Orders, which specify standards for crew training and competency, navigation, communication, and safety measures. Implementing this equipment and personnel control is required under the legislative requirements, hence it must be adopted.	1.3	Vessels will be equipped and crewed in accordance with the *Navigation Act 2012* (Cth) (as applicable for vessel size, type and class), including implementing:
					• Marine Order 21 (Safety and emergency procedures), including:
					  ○ safety measures such as manning and watchkeeping.
					• Marine Order 27 (Safety of navigation and radio equipment), including:
					  ○ radio equipment and communications.
					  ○ navigation safety measures and equipment.
					  ○ danger, urgency and distress signals and messages.
					• Marine Order 30 (Prevention of Collisions), including:
					  ○ lights and signals as applicable to vessel class per COLREGS requirements.
					• Marine Order 71 (Masters and Deck Officers), including:
					  ○ all master, mate and watchkeeper officer duties undertaken by crew certified as applicable to vessel class per STCW Convention) requirements.
						Marine assurance records demonstrate compliance with navigation safety requirements including:
						• A Minimum Safe Manning Certificate is in place and identifies minimum crew qualifications to meet the STCW Convention requirement.
						• Records of vessel crew STCW Convention qualifications align with the Minimum Safe Manning Certificate (as applicable for vessel size, type and class).
						• A Vessel Cargo Ship Safety Equipment Certificate demonstrates the vessel has lights, shapes and means of making sound signals and distress signals in accordance with COLREGS requirements (as applicable for vessel size, type and class).
						• Records of Shell's marine vessel assurance process (as applicable for vessel size, type and class).

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
ALARP Demonstration Statement						
Based on the impact assessment outcomes and control measures adopted, Shell considers implementing the control measures appropriate to manage the potential impacts associated with activity physical presence. No additional, alternative or improved controls were identified. Therefore, the impacts are considered to be reduced to ALARP.						

9.3.5 Acceptability of Impacts

Table 9-11: Acceptability of Impacts – Physical Presence

Receptor		Acceptable Level of Impact	Acceptable?	Acceptability Assessment
Category	**Subcategory**			
Natural features, values and sensitivities	Marine bioregions	No significant impacts to benthic habitats and communities. Impacts to non-sensitive benthic communities limited to a maximum of 5% of the Project Area (as defined in the OPP). No significant adverse impact on pelagic communities, populations, habitats, or spatial distribution of a species. No substantial adverse effect on a population of a marine species or cetacean including its lifecycle and spatial distribution.	Yes	Physical presence of installed subsea infrastructure likely to form additional hard substrate allowing colonisation by fouling communities that over time become habitats of greater complexity than the existing soft sediments that are prevalent in the Activity Area and support localised increases in abundance and diversity of benthic, demersal, and pelagic marine species. Impact predicted to be highly localised to subsea infrastructure location and to represent <5% of the Project Area (as defined in the OPP). Given the localised scale of potential effects, no significant adverse impact on benthic and pelagic communities, populations, habitats, or spatial distribution of a species is expected.
Socioeconomic features, values and sensitivities	Fishing industry	No negative impacts to targeted fisheries resource stocks that result in demonstrated loss of income for commercial fisheries. Temporary displacement of fishing activities within the Activity Area (excluding PSZs) is acceptable. Permanent exclusion of fishing activities from PSZs is acceptable.	Yes	Area surrounding the Crux infrastructure supports minimal fishing activity and no negative impacts are predicted for the target species of the fisheries that may operate. Activities that may require other users, including fishers, to avoid an area outside of the PSZ (e.g. pipeline IMR) are relatively small scale, infrequent and short-term. Temporary exclusions of other marine users from the Activity Area are considered to be acceptable and necessary from a safety, security and oil spill prevention (collision) perspective. Permanent exclusion of marine users from gazetted PSZs is acceptable.

The assessment of impacts from physical presence has been determined a Minor residual worst-case impact consequence (Magnitude: −2, Sensitivity: M). The acceptability of the potential impacts from physical presence associated with the activity has been considered in the following context.

Principles of ESD

The potential impacts from physical presence are consistent with the principles of ESD because:

- The physical presence aspect does not degrade the biological diversity or ecological integrity of the Commonwealth Marine Area in the Northern Browse Basin.
- Significant impacts to MNES will not occur.
- The health, diversity and productivity of the marine environment will be maintained for future generations.
- The project does not significantly impinge upon the rights of other parties to access environmental resources (e.g. commercial and traditional fishers).
- The precautionary principle has been applied, and studies have been undertaken where knowledge gaps were identified. This knowledge was applied when evaluating environmental impacts and risks.

Relevant Requirements

Managing the potential impacts from physical presence is consistent with relevant legislative requirements, including:

- Part 6.6 of the OPGGS Act.
- Compliance with international maritime conventions, including:
  - STCW Convention.
  - SOLAS.
  - COLREGS.
- Compliance with Australian legislation and requirements, including:
  - *Navigation Act 2012* (Cth) and *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth):
    - Marine Order 21 (Safety of Navigation and Emergency Procedures).
    - Marine Order 27 (Radio Equipment).
    - Marine Order 30 (Prevention of Collisions).
    - Marine Order 71 (Masters and Deck Officers).

Matters of National Environmental Significance

Physical presence will not have a significant impact on MNES.

External Context

To date, no objections or claims about physical presence have been raised by Relevant Persons. Shell's ongoing consultation program will consider feedback and claims or objections made by relevant persons throughout the life of this EP (Section 5.13). Where new impacts or risks are established, these will be subject to the MOC process described in Section 10.3.5.

Internal Context

Shell also considered the internal context, including Shell's environmental policy and Environmental, Social and Health Impact Assessment (ESHIA) requirements. The EPOs and the controls that will be implemented for the activity are consistent with Shell's internal requirements.

Acceptability Summary

The assessment of impacts and risks from physical presence determined the residual impact rankings were Minor or lower (Table 9-9). Shell considers residual impacts of Minor or lower to be inherently acceptable if

they meet legislative and Shell requirements. The acceptability of impacts from physical presence have been considered in the context of:

- the established acceptability criteria.
- ESD.
- relevant requirements.
- MNES.
- external context (i.e. stakeholder claims).
- internal context (i.e. Shell requirements).

Shell considers the potential impacts from physical presence associated with the activity to be ALARP and acceptable.

9.3.6 Environmental Performance Outcome

EPO #	EPO	Measurement Criteria
1.1	No adverse interactions between the activity and other marine users within the Activity Area. Displacement of other marine users is restricted to: • temporary displacement within the Activity Area. • exclusion from gazetted PSZs.	No supported claims reported that demonstrate direct loss of income or other impacts to marine users as a result of undertaking the activity.

9.4 Lighting

9.4.1 Aspect Context

Light emissions will result from both temporary activities and equipment, and permanent lighting systems throughout all activity phases. Safe illumination of work areas for temporary activities on the platform, such as workovers and well maintenance, may require additional light fittings which may be intrinsic to the equipment and/or involve additional luminaires installed for the duration of the temporary activities. Permanent light sources on the topsides include the flare system flame (including additional flame lengths that may occur because of unplanned flaring) and platform lighting (walkways, equipment, escape routes, stairways, temporary refuge, helideck, etc) as required to meet safe navigation and occupational safety requirements. Light emissions are also expected from temporary flare systems during well clean-up/completions phases which may extend beyond 24-hours. Light emissions from flaring during hot commissioning, start-up, or operations may extend for 24-48+ hours, depending on the situation. When the facility is manned, light may also be emitted by the W2W vessel, ASV, vessels and work area lighting on the topsides required for safe habitation. Intermittent vessel activities and IMR campaigns in the Activity Area are likely to involve 24-hour operations and require lighting on vessels and associated equipment. Helicopters may occasionally transit to and from the topsides in 24-hour operations throughout the facility lifecycle.

The light emissions from most of these sources will result in light spill to the surrounding marine environment but will generally be low intensity and effects on ambient light levels are likely to be restricted to the immediate vicinity (~2 km) of the platform (Imbricata 2018).

Typically, this lighting is either bright white (i.e. metal halide, halogen, fluorescent) or yellow/red (high-pressure sodium) and is not dissimilar to lighting used for other offshore activities, including fishing and shipping. To the human eye, light falls within the visible range of ~380–780 nanometres, spanning from violet to red in the electromagnetic spectrum. In fauna, light perception ranges from 300–>700 nanometres, depending on the species. Some fauna cannot perceive long-wavelength red light, whereas others can detect light beyond the blue-violet range and into the UV spectrum (CoA 2020). Therefore, the potential for impact from light sources not only relates to the amount of artificial light, but also the types of light and the wavelengths that the different light types emit.

Potential impacts of changes to ambient light are included in several recovery plans and Conservation Advice, including the Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA 2017b) and the Wildlife Conservation Plan for Migratory Shorebirds (DoE 2015a). The National Light Pollution Guidelines for Wildlife (DCCEEW 2023b) address potential impacts from artificial light to EPBC Act listed threatened and migratory

species, species that are part of a listed ecological community, and species protected under state or territory legislation for which artificial light has been demonstrated to affect behaviour, survivorship, or reproduction. These guidelines recommend a specific artificial light impact assessment process is undertaken for listed species that are known to be affected by artificial light where important habitat exists within 20 km of a project. This 20 km threshold provides a precautionary limit and is based on observed effects of sky glow on marine turtle hatchlings (demonstrated to occur at 15–18 km; Kamrowski et al. 2014; Hodge et al. 2007) and fledgling seabirds grounded in response to artificial light 15 km away (Rodríguez et al. 2014).

The Activity Area is >20 km from any emergent features and known BIAs for marine turtles, seabirds, and migratory shorebirds; therefore, with appropriate lighting design, alignment with the guidelines may not require specific assessment of potential impacts of artificial lighting to these light sensitive receptors. However, consistent with Shell's adoption of the precautionary principle, a detailed assessment of potential impacts has been undertaken and controls implemented to ensure potential impacts from lighting have been reduced to ALARP and acceptable levels.

9.4.1.1 Overview of Light Modelling

Imbricata (2018) characterised the sources of light emissions (platform and vessels) from the Crux Project and assessed the predicted impact of light on identified sensitive receptors. The report determined the extent of light spill (line-of-sight modelling) to identify potential receptors and intensity of luminance from the light sources relative to ambient light conditions (light intensity modelling). The modelling report was included in the Crux OPP and the results were used (in conjunction with other published information) to inform the impact assessment for this activity.

Line-of-Sight Assessment

The Imbricata (2018) study determined that during operations, the flame of the flare pilot or from maintenance flaring is predicted to be theoretically visible (on a clear moonless night) on the horizon up to ~34 km from the platform. In the event of a safety blowdown event, modelling predicted that visibility could extend to ~38 km due to the increased flame height. The light from a vessel (assuming a maximum height of light source at 30 m above sea level) may be visible on the horizon up to 19.6 km away. The topsides, with a maximum light source height of ~75 m above sea level is predicted to be visible on the horizon up to 30.9 km away. The nearest island to the Crux platform (Cartier Island) is over 100 km away. Therefore, light sources associated with the activity would not be visible from any emergent land in the region.

Light Intensity Assessment

Although the line-of-sight may extend tens of kilometres from the source, the light intensity (measured in Lux) rapidly decreases as distance from the light source increases. Table 9-12 summarises the light intensity modelling results (Imbricata 2018). Light intensity represents the intensity of light that arrives at or leaves a surface, as perceived by the human eye. The total amount of light, as it arrives at a surface, is referred to as illuminance and is the parameter that was modelled in this assessment.

The results can be compared with typical ambient light conditions, as summarised below:

- >1 Lux (daylight)
- 0.1–1.0 Lux (full moon to twilight)
- 0.01–0.1 Lux (quarter moon to full moon)
- 0.001–0.01 Lux (moonless clear night to quarter moon).

The results of light intensity modelling show low levels of light influence can be expected from operations activities. The light associated with routine activities at the Crux platform, including from vessels, topsides and flares, is predicted to fall below ambient conditions (0.001 Lux) within 9 km (Table 9-12). Therefore, no key habitats would be affected.

In the unlikely safety blowdown event, the temporarily operating flare is predicted to result in light levels approximating a quarter-to-full moon (0.002–0.006 Lux) at Vulcan, Goeree and Eugene McDermott shoals.

Vessels undertaking intermittent IMR activities along the pipeline or elsewhere in the Activity Area may result in light reaching Goeree Shoal and Eugene McDermott Shoal (~8 km from the Activity Area).

Table 9-12: Extent of Horizontal Light Propagation from the Crux Platform at Ambient Light Conditions and Key Habitats within this Range

Location of Light Source	Horizontal Light Propagation (km)	Key habitats reached	Luminance received (above ambient)
Platform flare – pilot	2.2	None	-
Platform flare – maintenance operation	2.2	None	-
Platform flare – safety event	32	Vulcan Shoal, Eugene McDermott Shoals and Goeree Shoal	Vulcan – 0.0021 Lux Eugene McDermott – 0.0031 Lux Goeree – 0.0061 Lux
Platform flare – start-up	3.2	None	-
Vessels at the platform	9	None	-
Platform topsides (manned)	9	None	-

Source: Imbricata 2018

The modelling results combined with the 20 km potential affects zone outlined in the National Light Pollution Guidelines for Wildlife (DCCEEW 2023b) were used to determine a Light Assessment Area—defined as 20 km around the Activity Area (where IMR activities are expected to typically involve a single, relatively small vessel along the export pipeline) and an additional 38 km radius surrounding the Crux platform location (where a safety flaring event may occur).

9.4.2 Description and Evaluation of Impacts

Artificial lighting can alter ambient light conditions, which has the potential to affect marine fauna that use light as cues for navigation or behaviour. The impacts of artificial light on these animals may include:

- disorientation, misorientation, attraction or repulsion.
- disruption to natural behavioural patterns and cycles.
- indirect impacts such as increased predation and reduced fitness.

Table 9-13 indicates the environmental features and values and sensitivities that have been identified to be potentially affected by the lighting associated with the activities covered by this EP, with further evaluation of the impacts and/or risks to each potentially affected receptor category (including cumulative impacts) provided in Sections 9.4.2.1 to 9.4.2.4. Features or values and sensitivities which could not be credibly affected by activity light emissions are not discussed further.

Table 9-13: Lighting Receptor Impact Screening Summary

	Protected Areas			Features															Values and Sensitivities																					
				Physical		Natural				Socioeconomic								Heritage and Cultural			Physical				Natural							Socioeconomic							Heritage and Cultural		
Receptor	Marine Conservation Reserves	Wetlands of International and National Importance	Commonwealth and National Heritage Places	Marine Regions	Australian Environment	Northwest Shelf Province Bioregion	Northwest Shelf Transition Bioregion	Northwest Transition Bioregion	Timor Province Bioregion	People and Communities	Fishing Industry	Tourism and Recreation	Defence	Shipping	Scientific Research/Restoration	Oil and Gas Industry	Indonesian and Timor-Leste Coastlines	Underwater Cultural Heritage	Traditional Indonesian Fishing	Indigenous Cultural Connections	Air Quality	Water Quality	Sediment Quality	Underwater Noise	BIAs	Critical Habitat	Shoals and Banks	Offshore Reefs and Islands	Coastal Reefs and Islands	KEFs	Threatened, Migratory, Marine and Cetacean Species	Fishing Industry	Tourism and Recreation	Defence	Shipping	Scientific Research/Restoration	Oil and Gas Industry	Indonesian and Timor-Leste Coastlines	Underwater Cultural Heritage	Traditional Indonesian Fishing	Indigenous Cultural Heritage
Aspect									×																					×										

Legend:		
		Potentially affected
	×	Predicted impact

9.4.2.1 Natural Features

9.4.2.1.1 Timor Province Bioregion

Benthic Communities

No light-generating activities will credibly impact benthic communities as the Crux infrastructure is located in waters exceeding 160 m deep.

Pelagic Communities

Pelagic communities in the Light Assessment Area include planktonic communities and pelagic fish and invertebrates. Threatened and migratory species of fish (including sharks and rays) are discussed in Section 9.4.2.2.4.

Fish and zooplankton may be directly or indirectly attracted to lights. Light can alter the daily vertical migration patterns of zooplankton and/or associated predation by other marine species. Experiments using light traps have found that some fish and zooplankton species are attracted to light sources (Meekan et al. 2001), with traps drawing catches from up to 90 m (Milicich et al. 1992). Lindquist et al. (2005) concluded from a study of larval fish populations around an oil and gas platform in the Gulf of Mexico that an enhanced abundance of clupeids (herring and sardines) and engraulids (anchovies), both of which are highly photopositive, was caused by light fields emanating from platforms.

Marine predators are known to aggregate at the edges of artificial light halos where the concentration of marine organisms attracted to light (and potentially the light intensity) increases the food source for these predatory species. Shaw et al. (2002), in a similar light trap study, noted that juvenile tunas (Scombridae) and jacks (Carangidae), which are highly predatory, may have preyed on concentrations of zooplankton attracted to platforms' light fields. This behaviour could potentially lead to increased predation rates in lit areas compared to unlit areas.

The potential for increased predator activity is considered unlikely to result in a significant impact on zooplankton or fish populations. The closest known fish aggregation site is Goeree Shoal ~8 km away from the Activity Area and ~13 km from the Crux platform. Light modelling indicates that potential changes to prevailing light conditions at Goeree Shoal from activities at the platform would be limited to safety flaring events, which are expected to be highly infrequent and short-term. Therefore, it is considered unlikely that artificial lighting will adversely affect fish at aggregation sites.

Imbricata (2018) concluded that potential disturbance to fish from Crux operations would be restricted to localised attraction, extending up to ~100 m from the light source. Given the small impact area surrounding the petroleum activities relative to the extent of zooplankton and fish habitat, any potential impacts would be expected to be highly localised and unlikely to have discernible consequences at a population level. The impact is therefore assessed as Slight (Magnitude: –1, Sensitivity: L).

9.4.2.2 Natural Values and Sensitivities

9.4.2.2.1 Shoals and Banks

Some coral species use moonlight cues to trigger reproductive spawning events; significant light pollution can prevent these corals from detecting moonlight, resulting in their failure to spawn. Light modelling (see Section 9.4.1) predicts that the lighting associated with normal activities at the Crux platform location, including from vessels, topsides and flares, will fall below ambient conditions (0.001 Lux) within ~9 km (Table 9-12). Therefore, no shoals or banks would be affected.

In the unlikely event of safety blowdown event, the temporarily operating flare would result in light levels (0.002–0.006 Lux) approximating a quarter-to-full moon at Vulcan, Goeree and Eugene McDermott shoals. However, given the infrequent and temporary nature of these low levels of light reaching these submergent shoals, the shoals are considered unlikely to be impacted. Therefore, no discernible residual impact consequence is expected (Magnitude: 0, Sensitivity: H).

9.4.2.2.2 Offshore Reefs and Islands

No light-generating activities will credibly impact offshore reefs and islands because of the distance to these features. The closest receptor to the Activity Area and platform is Browse Island (~42 km) and Cartier Island (~105 km) respectively (See Table 7-8).

9.4.2.2.3 KEFs

The Activity Area intersects one KEF—Continental slope demersal fish communities. The values associated with the KEF are at water depths greater than 225 m (see Section 7.7.6) and hence are unlikely to be impacted by light from the activity.

Based on the assessment of impacts to fish (Section 9.4.2.1.1), only localised attraction of fish and invertebrates to lighting is expected. Impacts on demersal fish in the water depths associated with the Continental slope demersal fish communities KEF from surface lighting are not credible. Therefore, there is not predicted to be any discernible residual impact consequence (Magnitude: 0, Sensitivity: L) for the KEF values.

Other KEFs are too distant to be credibly impacted by activity lighting.

9.4.2.2.4 Threatened, Migratory, Marine and Cetacean Species

An EPBC Act protected matters search was undertaken for the 20 km Light Assessment Area, as recommended in the National Light Pollution Guidelines for Wildlife (DCCEEW 2023b). No additional species were identified within the Light Assessment Area compared to the Activity Area (Appendix F).

Marine Mammals

The Light Assessment Area does not intersect any marine mammal BIAs. Threatened and migratory marine mammals that may occur within the Light Assessment Area are predominantly cetaceans (Section 7.7.7.1). Cetaceans and other marine mammals are not known to be significantly attracted to light sources at sea, and therefore disturbances to behaviour are unlikely. There is no evidence to suggest that artificial light sources affect the migratory, feeding or breeding behaviours of cetaceans. Cetaceans predominantly use acoustic senses to survey their environment, rather than visual cues (Simmonds et al. 2004). However, light glow may act as an attractant to light-sensitive prey species (e.g. squid, fish) that may alter predator–prey dynamics, particularly in dolphins. Therefore, a Slight residual impact consequence from lighting on marine mammals is expected (Magnitude: −1, Sensitivity: L).

Marine Reptiles – Turtles

Of the marine turtle species identified as protected under the EPBC Act (see Table 7-10), only green turtles are known to nest on Cartier Island (~83 km from the Activity Area) and Browse Island (~42 km south-east of the Prelude FLNG facility) (CoA 2017b).

Light can affect the behaviour of adults and hatchling marine turtles. On nesting beaches, light pollution can alter critical nocturnal behaviours in adult and hatchling turtles (CoA 2020). Research suggests that artificial lighting can disrupt or affect the choice of nesting location by female turtles, particularly light visible on the landward side of nesting beaches (Salmon et al. 1992). Turtle hatchlings leaving nesting beaches are particularly sensitive to artificial lighting because they use celestial cues to orientate (Limpus 2008; Salmon et al. 1992).

Marine turtle hatchlings may use celestial lights as navigational markers during oceanic migrations and are attracted towards bright lights. Hatchlings can become disorientated and trapped within light spill around platforms and vessels, resulting in increased energy expenditure, increased predation and decreased survival rates (Witherington and Martin 1996, CoA 2020). However, as hatchlings swim offshore from their natal beach, they become less influenced by light cue and rely predominantly on wave motion, currents and the earth's magnetic field (Lohmann and Lohmann 1992).

Although artificial lighting from the activity may be visible up to tens of kilometres away from the vessels and Crux platform (as outlined in the modelling discussion above), the light intensity will typically be low beyond several hundred metres from the light sources and, even in the unlikely event of a safety blowdown, would not affect light regimes at the nearest turtle BIAs. No important habitat for listed turtle species occurs within the Light Assessment Area. The closest critical habitat to the Activity Area is at Browse Island (~23 km from the Activity Area and ~160 km south-west from the Crux platform), while Ashmore Reef and Cartier Island and (~86 km distant) is the closest to the Crux platform (Table 7-13). Additionally, the closest internesting buffer and nesting BIAs to the Crux platform (~90 km and ~110 km distant, respectively) are not expected to be influenced by light from the activity (Table 7-12).

Individual turtles, including hatchlings, may transit through the Light Assessment Area, but given the distance to the nesting beaches of Cartier and Browse Islands and the absence of BIAs and habitat critical to the survival of turtles (see Table 7-12 and Table 7-13), turtles are unlikely to be present in significant numbers.

Considering the large distance between the Light Assessment Area and the closest critical habitat for turtles, and the low numbers of any turtle species likely to occur in the area potentially affected by activity light emissions, there is expected to be a Slight residual impact consequence of light from the activity on hatchling and adult turtles (Magnitude: −1, Sensitivity: M).

Marine Reptiles – Sea snakes

Sea snakes are unlikely to occur in significant numbers in the Activity Area due to the water depths and general absence of preferred habitat types (e.g. shallow reefs, shoals and banks). The three EPBC Act listed threatened species of sea snake that may occur within the Planning Area (*Aipysurus fuscus*, *A. foliosquama* and *A. apraefrontalis*) are all expected to occur in habitats of 0-20 m (TSSC 2010a, TSSC 2010b and DCCEEW 2024h) associated with reefs, shoals and banks. The closest island, shoal or reefs where sea snakes have been recorded are Cartier Island, Heywood Shoal and Ashmore Reef, located ~83 km, ~20 km and ~130 km from the Activity Area respectively and outside of the Light Assessment Area. However, the shallow areas of the shoals nearest the Crux platform (ie Goeree ~13 km, Vulcan ~22 km and Eugene Mcdermott ~18 km) may provide habitat for sea snakes, including threatened species, and fall within the area potentially affected by lighting during the activity.

Sea snakes from the *Aipysurus* genus are not attracted to night lights on vessels (DCCEEW 2024h) and studies on theolive sea snake (*A. laevis*) found it was active for equal periods of time in the day and night (Burns & Heatwole 1998), with indications that tides and sex may influence the level of activity (Lynch et al. 2023) more than light. The National Light Pollution Guidelines for Wildlife (DCCEEW 2023b) do not describe impacts to sea snakes and artificial light is not identified as a threat in the Conservation Advice for the dusky sea snake.

Light modelling (see Section 9.4.1) predicts that the lighting associated with normal activities at the Crux platform location would fall below ambient conditions (0.001 Lux) within ~9 km (Table 9-12). Therefore, no shoals or banks would be affected. In the unlikely event of a safety blowdown event, the temporarily operating flare would result in light levels (0.002–0.006 Lux) approximating a quarter-to-full moon at Vulcan, Goeree and Eugene McDermott shoals.

Given the infrequent and temporary nature of low levels of light reaching these submergent shoals, and the very low numbers of individual sea snakes likely to occur in areas affected by lighting in the Activity Area, adverse impacts on sea snakes as a result of lighting is not expected (Magnitude: 0, Sensitivity: L).

Sharks and Rays

A whale shark BIA for foraging intersects the Light Assessment Area, and migration behaviours may occur within this area (Section 7.7.7.3). However, it is expected that whale shark presence near the activity would be transitory and of short duration. This is consistent with tagging studies of whale shark movements that show continual movement of whale sharks in deeper, open offshore waters (Meekan and Radford 2010). There are no BIAs and/or habitat features that might support aggregations of other threatened or migratory sharks or rays in the Light Assessment Area, suggesting that the numbers that may be exposed to activity lighting are very low.

As with other species of fish, light may directly or indirectly affect the behaviours of sharks and rays with ‘light pooling’ (shining of high intensity lighting directly into the sea) used to attract whale sharks for tourism purposes in some countries (Carroll and Harvey-Carroll 2023). However, given the relatively low intensity of light sources associated with the activity (Section 9.4.1), and the oceanic, deep waters within the Light Assessment Area, significant adverse effects on shark or ray behaviours are unlikely. The Conservation Advice for the whale shark does not identify light emissions as a threat (DoE 2015e).

Threatened or migratory species of sharks or rays are not expected to be impacted by lighting during the activity due to their highly transient nature, low likelihood of encountering elevated light levels and generally limited sensitivity to light (Magnitude: 0, Sensitivity: L).

Birds

Studies conducted in the North Sea between 1992 and 2002 confirmed that artificial light was the reason that birds were attracted to and accumulated around lit offshore infrastructure (Marquenie et al. 2008) and that lights can attract birds from large catchment areas (Wiese et al. 2001). Birds may be directly attracted by the light source or indirectly—structures in deepwater environments tend to attract marine life at all trophic levels, creating food sources and shelter for birds (Surnam 2002). Potential deleterious impacts on birds attracted by

artificial lighting are limited but can include collisions with infrastructure and alteration of normal behaviours (CoA 2020).

When considering line-of-sight with respect to light assessment for birds, the factors that need to be considered include:

- the distance between the light source and the receptor
- the potential elevation of the receptor.

If migratory birds rely on visual cues (e.g. ambient light, moonlight, starlight) to navigate, in addition to their magnetic compass, then artificial light could alter their natural migratory patterns, particularly in the absence of terrestrial landmarks. Light emissions from offshore platforms in the North Sea have been shown to attract migrating birds, with those that migrate during the night especially affected (Verheijen 1985). During other studies conducted in the North Sea (Marquenie et al. 2008), it was noted that birds travelling within a 5 km radius of illuminated offshore platforms may deviate from their intended route and either circle or land on the platform. Beyond this distance, it is assumed that light source strengths were not sufficient to attract birds away from their preferred migration route.

According to Bamford et al. (2008), 33 species of migratory birds that use the EAAF are regularly present in Australia. Migratory shorebird species are mostly present during the non-breeding period, from as early as August each year to as late as April/May the following year. According to Marquenie et al. (2008), the change in behaviour of migratory birds is expected to be significantly smaller, about two orders of magnitude, than the visibility limit within a 5 km radius from an artificial light source.

Bird injuries and mortalities from direct collisions with infrastructure are inferred from the literature, the collision rate appears to be related to weather conditions, the cross-sectional area of the obstacle, amount of light and number of birds travelling through an area. Where bird collision incidents have been reported, low visibility weather conditions (cloudy, overcast, and foggy nights) have usually been implicated as the major contributing factor; by contrast, few collisions occur on clear nights (Avery 1976; Elkins 1988; Wiese et al. 2001). Conditions in the Activity Area are not conducive to significant fog formation. However, most rainfall in the Activity Area is seasonal and associated with the summer monsoon and cyclones in November to April, which overlaps with the peak migratory period for birds (see Section 7.7.7.4).

No important habitats (CoA 2017c; DCCEEW 2023j) for listed threatened or migratory bird species that are known to be potentially affected by artificial light occur within the Light Assessment Area. The applied 20 km threshold provides a precautionary zone of potential effect based on observed effects of sky glow on fledgling seabirds grounded in response to artificial light 15 km away (CoA 2020). On this basis, light generated within the Activity Area is not predicted to result in any adverse impacts given the distance to the nearest sensitive habitats, which are:

- 30 km to known breeding BIA for greater frigatebird and the red-footed booby
- 33 km to known breeding BIA for wedge-tailed shearwaters and lesser frigatebirds
- 40 km to known breeding BIA for tropicbirds.

Although it is possible that small numbers of birds may be attracted to the vessels' or platform lighting sources, impacts from any such attraction are not predicted to be significant at a local population level, based on fauna observations at the adjacent Prelude FLNG facility and the results of light modelling studies. Therefore, it is concluded that under the worst-case conditions, there is expected to be a Slight residual impact consequence (Magnitude: −1, Sensitivity: M).

9.4.2.3 Heritage and Cultural Values and Sensitivities

9.4.2.3.1 Indigenous Cultural Heritage

Impacts to fauna from light, including fish and other marine species of potential cultural significance (identified in Sections 7.11.3.2 and 7.11.3.3), are likely to be limited to localised, temporary behavioural effects and unlikely to result in significant impacts to marine species at the individual or population level. For an assessment of potential impacts to marine species that may be of cultural significance, see Sections 9.4.2.1.1 and 9.4.2.2.4.

No specific objection, claim or relevant matters were raised during consultation for this EP regarding potential impacts to Indigenous cultural heritage features and values from this aspect. The overall impact consequence is considered to be No Impact (Magnitude: 0, Sensitivity: L).

9.4.2.4 Cumulative Impacts

Light emissions from the activity will result in localised and mostly temporary changes to ambient light. The Activity Area is a significant distance from coastal sources of light emissions, and existing anthropogenic lighting in the region is limited to offshore facilities and shipping traffic. As the Crux platform will operate in normally not-manned modes, the light emissions from the activity are predicted to be lower than manned offshore facilities and are not predicted to result in a notable increase in regional ambient light conditions.

Light modelling shows that the potential for lighting impacts on sensitive receptors is generally limited to the vicinity of activities, and mostly confined to waters surrounding the platform location. The proportion of any light sensitive fauna population that might be affected by light emissions from the activity is very low and the artificial lighting associated with the activity will generally not increase ambient light levels in areas supporting important behaviours for light sensitive threatened and migratory fauna. The closest operating facility to the Crux platform is the Montara production FPSO facility, which is located ~36 km north. The Ichthys project offshore facilities are located ~170 km to the south-west of the Crux platform, and the Prelude FLNG facility is ~165 km to the south-west. None of the areas that modelling indicates might be exposed to increased light levels during normal activities at the Crux platform overlap with the zone of potential lighting effects on wildlife (i.e. 20 km) from other facilities in the region, and the frequency of overlap with light emissions from other vessel activities is likely to be very low. Emergency flaring may illuminate areas that partly overlap with the area of potential lighting impacts from the Montara facility, but this is expected to be a highly infrequent and temporary event and there are no aggregation sites for light sensitive fauna in the area involved.

Vessel-based IMR activities along the pipeline corridor approaching the Prelude FLNG may overlap with lighting from the Prelude facility. However, the potential changes to ambient light associated with these vessels will not extend closer to the important habitats for light sensitive fauna nearest the Prelude FLNG, nor have the intensity to affect light sensitive fauna in those areas, given that the separation distances of the Prelude FLNG to the nearest sensitive habitats are:

- ~23 km and ~43 km to the Browse Island green turtle critical internesting habitat and foraging and nesting BIA.
- ~59 km to the nearest bird breeding BIA.

Due to the absence of significant feeding, breeding, or aggregations of light-sensitive fauna in areas of potential lighting overlap and the very short duration of any concurrent and proximal activities, the additive and cumulative light effects due to the activity can reasonably be expected to be negligible. Therefore, no changes are warranted to the overall consequence level for light impacts from the activity due to cumulative effects.

9.4.3 Impact Assessment Summary

Table 9-14 lists the highest impact consequence rating in the relevant environmental receptor groups.

Table 9-14: Light Emissions Evaluation of Impacts

Environmental Receptor	Magnitude	Sensitivity	Residual Impact Consequence
Evaluation – Planned Impacts			
Protected Areas	N/A	N/A	N/A
Physical Features	N/A	N/A	N/A
Physical Values and Sensitivities	N/A	N/A	N/A
Natural Features	-1	L	Slight
Natural Values and Sensitivities	-1	M	Slight
Socioeconomic Features	N/A	N/A	N/A

Environmental Receptor	Magnitude	Sensitivity	Residual Impact Consequence
Socioeconomic Values and Sensitivities	N/A	N/A	N/A
Heritage and Cultural Features	N/A	N/A	N/A
Heritage and Cultural Values and Sensitivities	0	L	No Impact

9.4.4 ALARP Assessment and Environmental Performance Standards

Table 9-15: ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
ALARP Assessment						
Elimination	Eliminate lighting and night activities.	No	Lighting at the operating platform cannot be safely eliminated given the flare system and requirement for navigation safety. 24-hour activities are necessary throughout all activity phases to meet execution schedules and achieve NNM modes as soon as possible. Therefore, work area lighting and safe illumination from permanent and temporary luminaires will be required and cannot be eliminated. Restricting or eliminating vessel or IMR activities (etc) at night is likely to require vessels to remain stationary on DP, leading to incremental increases in: • GHG emissions. • Discharges and atmospheric pollutants. • Duration. • Project costs. Hence this control is not considered feasible.	N/A	N/A	N/A
Substitution	Specify luminaire wavelength.	No	Lighting of a particular standard (intensity, wavelength etc) is required to meet safety and navigation requirements on topsides, substructure, navigation aids and vessels. Given the Light Assessment Area is not within a known BIA for turtles, seabirds or other light sensitive marine fauna, the financial cost or potential safety implications of changing out lighting is considered disproportionate to the negligible environmental benefit gained from adopting this control.	N/A	N/A	N/A
Substitution	Substitute external lighting with light sources designed to minimise impacts: • Use flashing/ intermittent lights instead of fixed beam. • Use motion sensors to turn lights on only when needed. • Avoid high intensity light of any colour.	No	Lighting of a particular standard (intensity, wavelength etc) is required to meet safety and navigation requirements on topsides, substructure, navigation aids and vessels. Given the potential impacts during this activity are insignificant, implementation of this control would not result in a reduction in consequence. Implementation of the control has potential financial, operational and/or safety implications considered disproportionate to the negligible environmental benefit gained from adopting this control.	N/A	N/A	N/A
Engineering	Facility Operating Procedures require GTG's to be started using backflow pipeline gas rather than well gas, to minimise flaring and emissions. .	Yes	The Crux design has enabled the backflow of clean gas from Prelude as an alternative to start-up and full restarts (i.e. from a black start after an emergency shutdown or after a planned shutdown) from Crux wells, therefore reducing the duration of flaring required to achieve the required fuel gas specifications. Therefore, this measure reduces GHG and light emissions. Crux well gas may be a contingency for start-up and full restarts where Prelude backflow gas is unavailable or if, due to unforeseen circumstances, the measure turns out not to be ALARP in reducing environmental impacts and risks. Example scenarios where backflow gas may not available may include insufficient lead time or schedule capacity; SIMOPS impacting backflow operation at either Prelude FLNG or Crux; pipeline maintenance activities (such as IMMR); flow assurance considerations; and health or safety considerations. The requirement is captured within Operating Procedures (under development) for the GTGs.	2.1	Full restarts of GTGs will be from backflow of pipeline gas in accordance with Operating Procedures.	Distributed Control System (DCS) records demonstrate full restarts of GTGs were from backflow of pipeline gas in accordance with operating procedure. Where full restarts of GTGs do not occur from backflow of pipeline gas, records demonstrate the decision report based on the principles of ALARP. Operating Procedure/s.
Engineering	Use filtered wavelength lighting on the Crux platform.	No	Whilst lights can be filtered, if required, by filtering the light the overall light emitted per bulb is reduced, which results in an increased number of light fittings throughout the facility, increasing energy consumption and waste generation for spent bulbs, as well as the increased cost for purchase and maintenance, which is not in line with the NNM philosophy. Given there is no or little environmental benefit in providing a select wavelength, due to the remote, offshore location away from sensitive areas, filtered lights were not adopted.	N/A	N/A	N/A
Engineering and Administrative and Procedural	Greenhouse Gas and Energy Management Plan (GHGEMP) for the Crux Project execute phase includes; • Goals and limits for key emissions generating activities and/or risks	Yes	Shell uses GHGEMPs to manage significant sources of GHG emissions to ALARP throughout project lifecycles. Given its primary purpose is managing GHG emissions, a fuller description of it can be found in Table 9-80.	10.3	Refer to EPS 10.3.	Refer to EPS 10.3.
				10.4	Refer to EPS 10.4.	Refer to EPS 10.4.
				10.5	Refer to EPS 10.5.	Refer to EPS 10.5.
				10.6	Refer to EPS 10.6.	Refer to EPS 10.6.

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
	• Key measures to minimse GHG emissions • Process for regularly reviewing performance and feedback to improve performance during key emissions generating activities.		However, the GHGEMP for execute phase will be an important control measure for reducing flaring during key activities to ALARP and acceptable levels. And therefore, reducing flare related light emissions to ALARP and acceptable levels.	10.7	Refer to EPS 10.7.	Refer to EPS 10.7.
				10.8	Refer to EPS 10.8.	Refer to EPS 10.8.
Administrative and Procedural	Vessels shall not operate within 1 km of named Shoals adjacent to the Activity Area.	Yes	This procedural requirement of prohibiting vessels from operating within 1km of named Shoals adjacent to the Activity Area will reduce the potential impacts of vessel light over the Shoals and species which rely on them.	2.2	Vessels shall not operate within 1 km of named Shoals adjacent to the Activity Area.	Vessel AIS system shows vessels do not enter within 1 km of the named Shoals adjacent to the Activity Area.
Administrative and Procedural	Concept design simplification minimised light emission sources from platform topsides. Lighting will be limited to that required for safe work conditions and navigational purposes.	Yes	The concept design eliminates unnecessary equipment and systems to support NNM operations which reduces light emission sources, platform visitations and maintenance requirements offshore. Platform and vessel lighting will be used as required for safe work conditions and navigational purposes. Safety and maritime regulations require a well-lit work area to support 24-hour operations, and the minor residual consequence associated with impacts. Light spill from unnecessary lighting reduced, even further lowering the likelihood of potential impacts to transiting fauna from vessel lighting. Lighting is assessed to only provide necessary lighting for safety and navigation during the activity. Reducing the potential for additional light pollution to the environment, thus reducing the potential impacts to transiting marine fauna to ALARP.	2.3	Lighting will be limited to levels required for safe operations and navigation, with operational lighting directed downward onto the working area where practicable.	Platform and vessel light inspection record inspections.
Administrative and Procedural	Implement vessel light management actions recommended in the National Light Pollution Guidelines for Wildlife (DCCEEW 2023b), including: • switch off outdoor/deck lights when not in use. • use existing block-out blinds on portholes and windows that are not necessary for safety or navigation at night. • manage and report seabird interactions.	No	The specific vessel light management actions recommended in the National Light Pollution Guidelines for Wildlife (DCCEEW 2023b) relate to activities in/adjacent to important habitat and/or important behaviours (such as foraging, reproduction, or dispersal) for light–sensitive fauna. Although these circumstances do not apply to the activity, as a conservative management measure, vessels working at night within the Activity Area will be required to reduce external lighting to the minimum necessary for safe operations and navigation purposes (refer to EPS 2.2). Given the distance from any known light–sensitive fauna BIA and coastline, the expected low densities of light–sensitive species that may transit the Light Assessment Area, and the lighting assessment predicting minor impacts to these light–sensitive species, the adoption of EPS 2.2 is considered adequate to reduce potential impacts to ALARP.	N/A	N/A	N/A

ALARP Demonstration Statement

Based on the impact assessment outcomes and control measures adopted, Shell considers implementing the control measures appropriate to manage the potential impacts associated with activity light emissions. No additional, alternative, or improved controls were identified that could further reduce the impacts—beyond negligible environmental benefits if any—without disproportionate effort and cost. Therefore, the impacts are considered to be reduced to ALARP.

9.4.5 Acceptability of Impacts

Table 9-16: Acceptability of Impacts – Lighting

Receptor		Acceptable Level of Impact	Acceptable?	Acceptability Assessment
Category	**Subcategory**			
Natural features, values, and sensitivities	Marine bioregions	No significant adverse effect on pelagic communities, populations, habitats, or spatial distribution of a species. No substantial adverse effect on a population of a marine species or cetacean including its lifecycle and spatial distribution	Yes	Potential impacts in pelagic communities due to behavioural changes and/or indirect effects such as increased predation are limited to the relatively small area illuminated by lighting, which is negligible in scale compared to regional population distributions of the biota that may be affected. There are no aggregation sites for fish or other marine species within the Light Assessment Area and significant adverse impacts are unlikely.
	Threatened, migratory, marine and cetacean species	Management of aspects of the activity must align with Conservation Advice, recovery plans and threat abatement plans (Table 7-16). No significant impacts to EPBC Act listed threatened, migratory, marine or cetacean species	Yes	Light from the activity may attract threatened and migratory birds, which may roost on the structures. Because there are no important bird habitats within the Light Assessment Area), light emissions are not expected to result in significant impacts at a population level and residual lighting consequences are expected to be minor. Light emissions are not anticipated to have a significant impact on marine turtle or sea snake species given the lack of sensitive habitat within the Light Assessment Area, hence are not inconsistent with the requirements of the relevant recovery plans. Given the location of the activities and low number of individuals potentially affected the residual consequences on marine reptiles are Slight. Individual whale sharks may transit the area which overlaps with a BIA for this species, but lighting is not a recognised threat to whale sharks, and it is considered that there is a negligible risk of impacts to whale sharks. Other sharks or rays may be attracted to light sources and/or to prey attracted to light sources, associated with the activity; however, the lack of BIAs and aggregation sites within the Light Assessment Area means that impacts are unlikely. Given this, there are no predicted significant impacts to threatened, migratory, marine and cetacean species.

The assessment of impacts from light emissions determined a Minor residual worst-case impact (Table 9-14). The acceptability of the potential impacts from light emissions associated with the activity has been considered in the following context.

Principles of ESD

The potential impacts from light emissions are consistent with the principles of ESD because:

- The light emissions aspect does not degrade the biological diversity or ecological integrity of the Commonwealth Marine Area and significant impacts to MNES are not anticipated to occur.
- The precautionary principle has been applied, and studies/reviews were undertaken (Environmental Resources Management 2009; Imbricata 2018) where knowledge gaps were identified. This knowledge was applied when evaluating environmental impacts.

Relevant Requirements

Managing the potential impacts from light emissions is consistent with relevant legislative requirements (Table 9-17), including:

- National Light Pollution Guidelines for Wildlife (DCCEEW 2023b).
- policies, strategies, guidelines, Conservation Advice, and recovery plans for threatened species.

Matters of National Environmental Significance

Threatened and Migratory Species

The evaluation of lighting impacts indicates that no credible significant impacts to threatened and migratory species are predicted to occur from the activity. Table 9-17 demonstrates alignment between the activity and management plans, recovery plans and Conservation Advice.

Commonwealth Marine Area

The lighting impacts from the activity are predicted to not exceed any of the significant impact criteria for the Commonwealth Marine Area listed in Table 8-1; as such, it is considered that the aspect does not pose a credible risk to the Commonwealth marine environment.

Table 9-17: Summary of Alignment with Relevant MNES Considerations

MNES	MNES Acceptability Considerations	Demonstration of Alignment
Threatened and Migratory Species – Birds	Significant impact criteria for critically endangered, endangered, vulnerable and migratory species (Table 8-1)	The evaluation of environmental impacts indicates that any impacts from artificial light emissions on threatened or migratory bird species that may occur are likely to be minor and would not constitute a significant impact to populations. As such, residual impacts from artificial light associated with the activity do not exceed any of the significant impact criteria for threatened and migratory bird species, as listed in Table 8-1.
	Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (CoA 2017c)	
	Wildlife Conservation Plan for Migratory Shorebirds (DoE 2015a)	Managing the light aspect of the activity has been aligned to 'Objective 4' of the Wildlife Conservation Plan for Migratory Shorebirds (DoE 2015a) by ensuring that anthropogenic disturbance was considered in the assessment processes. Migratory birds were considered as an environmental receptor when evaluating lighting impacts.
	National Light Pollution Guidelines for Wildlife (DCCEEW 2023b)	The National Light Pollution Guidelines for Wildlife (DCCEEW 2023b) identifies fauna likely to be affected by artificial light sources and outlines light management actions. Shell's proposed light management actions and the impact assessment/thresholds are based on the precautionary limits referenced in these guidelines (Section 9.4.3).

MNES	MNES Acceptability Considerations	Demonstration of Alignment
Threatened and Migratory Species – Marine Reptiles	Significant impact guidelines for critically endangered, endangered, vulnerable and migratory species (Table 8-1)	The evaluation of environmental impacts indicates that any impacts from artificial light emissions on threatened or migratory marine reptiles are minor and would not constitute a significant impact. As such, residual impacts from artificial light associated with the activity do not exceed any of the significant impact criteria for threatened and migratory marine reptile species, as listed in Table 8-1.
	Recovery Plan for Marine Turtles 2017–2027 (CoA 2017b)	Light pollution has been identified as a threat in the Recovery Plan for Marine Turtles (CoA 2017b). Nesting females and hatchling turtles are at greatest risk of light impacts; however, the nearest potential nesting habitat is Cartier Island (~80 km from the activity Area). Potential light-related impacts to turtles on nesting beaches is considered to be slight. Actions in the Recovery Plan for Marine Turtles (CoA 2017b) relating to the threat of artificial light include: • manage artificial light within or adjacent to habitat critical to the survival of marine turtles such that marine turtles are not displaced from these habitats • develop and implement best practice light management guidelines for existing and future developments adjacent to marine turtle nesting beaches • identify the cumulative impacts on turtles from multiple sources of onshore and offshore light pollution. Because the Activity Area is beyond any BIAs or habitat critical for the survival of marine turtles (e.g. nesting, internesting, foraging areas) and the light modelling and other studies predicted that any impacts to marine turtles would be minor, the actions listed above are not applicable to the activity.
	National Light Pollution Guidelines for Wildlife (DCCEEW 2023b)	Marine turtles were identified in the National Light Pollution Guidelines for Wildlife (DCCEEW 2023b) as species that can be affected by artificial light sources. Light emissions management for the activity considered the light management actions described in the guidelines and based the impact assessment/thresholds on the precautionary limits referenced in the guidelines (Section 9.4.2).
Commonwealth Marine Area	Significant impact guidelines for the Commonwealth marine environment (Table 8-1)	The evaluation of environmental impacts indicates that any impacts from light emissions from the activity are not predicted to exceed the Commonwealth marine environment significant impact criteria, as listed in Table 8-1; as such, it is considered that the aspect does not pose a credible risk to the Commonwealth marine environment.

External Context

To date, no objections or claims about lighting have been raised by Relevant Persons. Shell's ongoing consultation program will consider feedback and claims or objections made by relevant persons throughout the life of this EP (see Section 5.13). Where new impacts or risks are established, these will be subject to the MOC process described in Section 10.3.5.

Internal Context

Shell also considered the internal context, including Shell's environmental policy and ESHIA requirements. The EPOs and the controls that will be implemented for the activity are consistent with the outcomes from consultation for the petroleum activity and Shell's internal requirements.

Acceptability Summary

The assessment of impacts and risks from light emissions determined the residual impact ratings were minor (Table 9-14) given that any visible light (including sky glow) will not displace or disrupt any EPBC Act listed species from important habitat, nor will it prevent these species from being able to undertake critical behaviours such as foraging, reproduction and dispersal. Shell considers minor residual impacts to be acceptable if they meet legislative and Shell requirements. The acceptability of these impacts was considered in the context of:

- the established acceptability criteria.
- ESD.
- relevant requirements.
- MNES.
- external context (i.e. stakeholder claims).
- internal context (i.e. Shell requirements).

Shell considers impacts from light emissions associated with the activity to be ALARP and acceptable.

9.4.6 Environmental Performance Outcome

EPO #	EPO	Measurement Criteria
2.1	No impacts to marine fauna greater than that caused by minimum required light emissions for safe work / navigation.	Demonstrated implementation of aspect EPSs.
2.2	No injury or mortality of threatened, migratory or cetacean species associated with the Activities.	Reports of injury or mortality of EPBC listed threatened, migratory or cetacean species associated with the Activities sent to NOPSEMA and DECEEW in accordance with requirements outlined in Table 10-15.

9.5 Noise

9.5.1 Aspect Context

During all phases of the activity, sound levels will fluctuate depending on manning modes and activity phase.

For the well completions, hot commissioning and start-up activity phases, various vessel arrangements operating under DP will be required for a duration of ~16 months. The ASV and W2W vessel may be required to operate concurrently during the turnaround phase for a period of up to ~2 months, and potentially during transition from ASV to W2W vessel upon its first mobilisation to site (for a period of up to ~2 months).

Routine operation of the Crux facilities will comprise several different acoustic emissions sources, primarily associated with infield vessel operations and support activities, and mechanical equipment on the topsides and subsea facilities. Sound levels will fluctuate over the course of the activities depending on manning modes, maintenance activities, flaring status and concurrent vessel activities. Generally, sound associated with steady state operations will be limited, with periodic and short-term increases in sound associated with aviation, IMR and vessel operations, including the presence of the W2W vessel. These acoustic sources will contribute to and have the potential to exceed ambient noise levels in the region.

Sections 9.5.1.2 to 9.5.1.7 describe the key acoustic sources.

9.5.1.1 Sound Terminology

Table 9-18 summarises the terminology relevant to the underwater noise impact assessment.

Table 9-18: Sound Terminology

Term	Definition
Auditory injury (AUD INJ)	Damage to the inner ear that can result in destruction of tissue, such as the loss of cochlear neuron synapses or auditory neuropathy. Auditory injury includes, but is not limited, to Permanent threshold shift (PTS).

Term	Definition
Peak sound pressure level (PK) or 0-to-peak.	The peak pressure, also called the 0-to-peak pressure, is the range in underwater sound pressure between zero and the greatest pressure of the signal. It is represented by PK and the unit dB re 1 µPa and summarised as dB PK.
Peak-to-peak sound pressure level (PK-PK)	The peak-to-peak pressure is the range in underwater sound pressure between the most negative pressure and the most positive pressure of the signal. It is represented by PK-PK and the unit dB re 1 µPa or dB re 1 μPa^2m^2 and summarised as dB PK-PK.
Permanent threshold shift (PTS)	Permanent loss of hearing sensitivity caused by excessive noise exposure.
Received sound levels	The sound level measured at a receiver.
Root mean square (rms) sound pressure	The root-mean-square pressure is the square root of the average of the square of the underwater sound pressure of the sound signal over a given duration and if applicable, frequency band. It is commonly represented as SPL.
Sound pressure level (SPL)	The level of the time-mean-square underwater sound pressure in a stated frequency band and time window the units are dB re 1 µPa (equivalent to dB re 1 μPa^2) and summarised as dB SPL.
Sound exposure level (SEL)	A measure of the underwater sound energy that considers both received level and duration of exposure. It is the time integrated squared pressure over a given time interval and if applicable, frequency band. The time interval can be a specific duration (e.g. 24 hours) or from the start to end of an event like an airgun pulse, pile strike etc. For this assessment 24 hours has been used for the time interval (e.g. accumulation period) and is shown as SEL_{24h}. Units are dB re 1 μPa^2s or dB re 1 μPa^2m^2s.
Source sound level	The sound pressure level or sound exposure level measured 1 m from a theoretical point source.
Temporary threshold shift (TTS)	Temporary loss of hearing sensitivity caused by excessive noise exposure.

9.5.1.2 Underwater Noise from Topsides Operations

The topsides will have machinery and equipment that will generate noise whilst in operation and hot commissioning, including (but not limited to) the GTGs (78 A-weighted decibel noise rating (dBA)), BSDG and temporary diesel generators (110 dBA), LP and HP flares (79–110 dBA), inlet cooler (79 dBA), air compressors (78 dBA), electric pedestal crane (82 dBA at external work areas), choke valves (78 dBA), and pumps mounted or operating on the platform decks, all elevated above sea level ranging from ~15 to 55 m (and 120 m for the flare tips).

Machinery noise may be radiated into the underwater environment via the substructure and risers, with noise emitted to the air having limited input to underwater noise levels due to impedance at the sea surface (air/water boundary). The HP and LP flare system generates noise from combustion at the top of the flare tower, which is ~120 m above sea level, modelled at continuous rates of 85–94 dBA (LP flare and ~110 dBA during peak blowdowns (HP flaring, see Section 6.7.10) which is predicted to be the largest fixed equipment noise emission source (intermittent and non-routine). Only a very small fraction of the acoustic energy produced from flaring will transmit through the air/water boundary due to the surface of water acting as a reflective plane and a significant component of acoustic energy reflecting back into the air. Noise emissions from the LP and HP flare are also relevant to the second stage clean-up activities.

Underwater sounds produced by jacketed fixed platforms standing on metal legs (like the Crux platform) are expected to be relatively weak, due to the placement of the deck well above the sea surface and the small contact area of the structure with the water (Richardson et al. 1995). Gales (1982) reported underwater noise levels from 18 operating oil and gas platforms, including 11 fixed multi-legged platforms like the Crux platform, as ranging between 110–130 dB re 1 µPa at ~33 m away. Noise from the platforms was found to be lower than levels recorded from visiting vessels. Nedwell et al. (2003) recorded underwater noise from a production platform in the North Sea at ~135 dB re 1 µPa at a distance of 500 m, although this included vessel noise. Noise levels of 107.3 dB rms were measured ~340 m from an operating platform in Alaska (Blackwell and Greene 2003). McCauley (2002) indicates underwater noise from platforms is typically very low, or not detectable. Underwater noise generated by the Crux platform is expected to be comparatively low, due to its

NNM status and limited topside processing facilities. Therefore, underwater noise associated with Crux topsides platform operations alone is expected to have minimal potential for impacts and is not assessed further in this EP.

The acoustic bird deterrence system on the helipad of the platform will generate intermittent atmospheric noise. The system is designed to reduce the risk of helicopter bird strikes by mimicking bird calls that indicate a threat is present so that birds avoid the area. This involves speaker(s) mounted on the helideck producing a high frequency (118–137 MHz) sound of up to ~148 dB at source at ~20-minute intervals, and additionally immediately prior to helicopter landings, only when the platform is unmanned. Due to the high frequency and location (~40 m above sea level) of this sound emission, it is not considered to have potential for significant impacts subsea but will (by design) cause behavioural disturbance in any birds that may be in the vicinity. This is discussed further in Section 9.5.2.4.4

9.5.1.3 Underwater Noise from Subsea Infrastructure

Crux wellheads and choke valves are located on the topsides (not subsea) and subsea noise is therefore limited to the operating pipeline and SSIVs on the seabed at the Crux and Prelude ends of the pipeline infrastructure (see Section 6.5.1). Flow noise is predicted to be continuous and emitted from the pipelines and SSIVs, with the radiated noise field falling to ambient levels within ~100 m. Within the Activity Area, underwater noise will not have credible potential for significant impacts and noise from subsea infrastructure operations is not discussed further.

9.5.1.4 Underwater Noise from Vessel Operations

The sound levels and frequencies generated by vessels varies with the size of the vessel, speed, engine type and the activity being undertaken. Vessels used for routine operations are detailed in Section 6.12, and includes DP capable vessels (using bow and stern thrusters which can be a significant source of underwater noise when vessels are in operation). Vessels produce low frequency sound (i.e. below 1 kHz) from the operation of machinery, hydrodynamic flow sound around the hull and from propeller cavitation, which is typically the dominant source of sound.

During normal operations, vessels may be required to complete routine roundtrip voyages between the Activity Area and Darwin or another Australian Port. The underwater noise that is produced by vessels arises from two continuous sources—propeller cavitation and the propulsion machinery (engines) inside the vessel. Vessels typically produce sound levels around 160–180 dB re 1 µPa at 1 m generally dominated by low frequencies during transit and drop with reduced speed. As the ship's speed increases, broadband noise such as propeller cavitation and hull vibration noise become dominant over machinery related tones. When vessels are holding station, frequencies increase considerably with the use of thrusters to maintain position. A vessel using DP produces noise of low frequency, less than 1 kHz, with broadband values up to 177 dB re 1 µPa at 1 m (Simmonds et al. 2004).

Vessels in the 50–100 m size class (e.g. supply vessels) produce broadband source levels in the 165–180 dB re 1 µPa (SPL) range (Gotz et al. 2009). In comparison, underwater sound levels generated by large ships (e.g. large construction vessels) can produce levels exceeding 190 dB re 1 µPa (Gotz et al. 2009), and small vessels up to the 20 m size class typically produce sound at source levels of 151–156 dB re 1 µPa (Richardson et al. 1995).

McCauley (1998) measured underwater broadband noise equivalent to about 182 dB re 1 µPa at 1 m (SPL) from a vessel holding station in the Timor Sea; it is expected that similar noise levels will be generated by vessels used for routine operations.

9.5.1.4.1 IMR Vessels

Section 6.11.3 describes the acoustic survey methods that may be undertaken for IMR. Subsea IMR activities are typically undertaken from vessels that use a DP system. This allows manoeuvrability, station keeping and avoids anchoring when undertaking works near subsea infrastructure. Subsea inspections generally involve the IMR vessel travelling along the route of the subsea system with an ROV to identify or undertake maintenance or repair activities that may be required to ensure the assets are being maintained. As the vessel will maintain its position with the continual use of DP thrusters, the thrusters will dominate as the source of underwater noise. Noise generated from these activities will be intermittent and of short duration and like the noise produced by other marine vessels in the field (e.g. supply boats).

Indicative source levels for inspection techniques with the potential to generate underwater noise are summarised in Table 9-19. MBES and SSS systems operate at high-frequency (HF) to offer high resolution images of the seabed. They produce short pulses of sound at frequencies in the tens or hundreds of kHz. Sound from the high-frequency pulses produced by MBES are focused within highly directional and narrow beams, which form a fan shape directed at the seabed (Salgado-Kent et al. 2016; Jiménez-Arranz et al. 2017). SSS also produces sound in a focused swathe directed at the seabed. Due to the high frequency of pulses produced by these instruments, sound rapidly attenuates outside the beam (Zykov 2013). Despite relatively high source levels, the operating frequencies of most MBESs and SSSs places the dominant sound energy at frequencies above (outside) the principal auditory range of most marine fauna species, although HF and VHF cetaceans that may occur in the Activity Area (e.g. Odontocetes) can hear some of the sound energy at the lower end of the operating frequency ranges. Sub-bottom Profilers (SBPs) are typically small, low-frequency, high-resolution and shallow-penetrating systems, producing pulses across a range of low frequencies (Jiménez-Arranz et al. 2017).

Acoustic positioning equipment may be used to support the accurate and safe positioning of infrastructure in the event of major repair activities. Acoustic positioning equipment typically involves LBL and/or USBL systems. LBL and USBL positioning systems use transponders that are typically fixed to seabed frames (LBL) or subsea equipment (USBL) and recovered once the infrastructure is correctly positioned.

Table 9-19 summarises indicative source levels for acoustic positioning equipment. USBL and LBL transponders typically emit pulses of medium to HF sound. The estimated sound pressure level (SPL) would be 180 to 206 dB re 1 µPa at 1 m (Jiménez-Arranz et al. 2017). Transmissions are not continuous—they are short ‘chirps’ that last from 3–40 milliseconds. The frequency of chirps depends on the activity:

- general positioning (duration ~4 hours at a time): about one chirp every five seconds
- precise positioning (duration ~2 hours at a time): about one chirp every second.

Transponders will only be active when infrastructure positioning is required and will not emit any sound when on standby.

Table 9-19: Typical Source Levels for Survey Methods and Acoustic Positioning (Impulsive Sources)

Activity		Frequency	Source Level (dB re 1 µPa·1 m)	Reference
Impulsive sound				
Survey methods	MBES	Frequency range 200–400 kHz Operational frequency 300 kHz	~218	MacGillivray et al. 2013
	SSS	Operational frequency 300–675 kHz	~229	Geoscience Australia n.d.; Tritech 2023
	SBP	Operational frequency range 500 Hz to 16 kHz	~200	MacGillivray et al. 2013
	CPT	20 Hz–24 kHz	~160–170	Erbe and McPherson 2017
Acoustic positioning equipment / transponders (LBL/USBL)		Operational frequency 300–600 kHz	~229	Geoscience Australia n.d.; Tritech n.d. MacGillivray et al. 2013

9.5.1.5 Underwater Noise from Aviation Operations

Helicopters, which are used to transfer personnel, may enter the Activity Area for short periods particularly during well completions, hot commissioning and start-up phases with the frequency of flights reducing during the NNM phase of operations. The main acoustic source associated with helicopters is the impulsive noise from the main rotor. Dominant tones in noise spectra from helicopters are generally <500 Hz (Richardson et al. 1995). The level of underwater sound from helicopters depends on helicopter altitude, aspect and strength of noise emitted, and the receiver depth, water depth and other variables (Richardson et al. 1995).

The angle at which the line from the aircraft and receiver intersects the water surface is important. In calm conditions, at angles >13° from the vertical, much of the sound is reflected and does not penetrate the water

(Richardson et al. 1995). Therefore, strong underwater sounds are detectable for a period roughly corresponding to the time the helicopter is within a 26° cone above the receiver. Richardson et al. (1995) reports figures for a Bell 214 helicopter (stated to be one of the noisiest) being audible in air for four minutes before it passed over underwater hydrophones, but detectable underwater for only 38 seconds at 3 m depth and 11 seconds at 18 m depth. The maximum received level was 109 dB re 1µPa^{2}s. Due to their short duration and near-surface impacts only, helicopter noise emissions are not considered a credible source of noise impact/risk and are not considered further.

9.5.1.6 Underwater Noise from ROV Operations

ROVs may be deployed from the Crux platform and/or vessels and would be used for the activities outlined in Table 6-1. Typically, the noise generated from an ROV will have a considerably lower intensity than that from the operating platform or a vessel. Underwater sound levels depend on the primary (noisiest) sound source rather than being strictly additive. ROV operations undertaken from the platform or a vessel are thus expected to have minimal contribution to the overall noise emissions associated with platform or vessel operations, as described in Sections 9.5.1.1 and 9.5.1.3 respectively.

9.5.1.7 Underwater Noise from Well Completions and Workover Operations

During well completions, first stage well clean-up may occur for a short duration after opening the wells for clean-up, predicted to be 24–72 hours per well at flaring rates of 60–90 MMscfd (see Section 6.8.2). Safety studies modelled potential sound levels of ~132 dBA from the flare tip and 115 dBA at deck level. The coiled tubing package required for well perforation (see Section 6.8.1) will have predicted sound pressure level of ~82 dBA, with noise also generated by other supporting equipment on topsides such as diesel generators (95 dBA), steam generator (56 dBA), air compressors (90 dBA), and the ASV (~80 dBA). The clean-up flaring and machinery noise may be radiated into the underwater environment via the jacket substructure and risers. The noise in the water is expected to be relatively weak and for short duration (i.e. the well completions activity period), due to the placement of the topside decks and temporary flare boom well above the sea surface, and the small contact area of the structure with the water.

Future workovers may require the temporary installation and operation of a Modular Platform Rig (MPR) (or similar completions unit) on the platform. There is limited available literature on the noise generated by platform-based completion and/or workover activities, but measurements of underwater noise associated with platform drilling operations provide a conservative indication of the maximum levels that may be generated. Gales (1982) reported that fixed drilling platforms generated sound levels of 119–127 dB rms from near field measurements during a study involving one drilling platform and three combined drilling/production platforms (Jiménez-Arranz et al. 2020). The strongest tones in all platforms were found near 5 Hz, with the highest tone recorded at 1.2 kHz (Jiménez-Arranz et al. 2020). The underwater noise from the MPR during well completions/workovers is likely to be lower than these levels and given the relatively short duration of these activities and the coincident presence of vessels at the platform, the contribution of sound from completions/workovers to overall noise emissions from the activity is expected to be minimal.

9.5.1.8 Underwater Noise Impact Levels

Marine species with the greatest sensitivity to underwater noise are marine mammals (whales and dolphins), turtles and fish (including larvae). Other species that could be affected by underwater noise include sea snakes, sharks and rays, and invertebrates.

Impacts to marine fauna can be grouped in the decreasing order of effect:

- mortality or potential mortal injury: physical injury that may result in the death of an animal.
- impairment:
  - PTS: a permanent reduction in the ability of an animal to perceive sound. Recovery is not expected to occur.
  - Auditory injury: damage to the inner ear that can result in destruction of tissue. Auditory injury may or may not result in PTS.
  - TTS: a temporary reduction in the ability of an animal to perceive sound. Recovery to pre-exposure levels is expected to occur.

  - masking: no change in the ability for an animal to perceive sound, but biologically meaningful sounds may be 'drowned out' by anthropogenic noise.
- behavioural impacts: typically, short-term behavioural responses such as avoidance, surfacing etc. Behaviour will return to normal following cessation of the anthropogenic noise.

Impact thresholds for the fauna groups were derived from scientific literature and published guidelines, including:

- sound exposure guidelines for fish, fish eggs and larvae (Popper et al. 2014).
- marine mammal behavioural threshold based on the current US National Oceanic and Atmospheric Administration (NOAA) (2024) criterion for marine mammals of 120 dB re 1 µPa (SPL; L_p) for non-impulsive sound sources
- frequency-weighted accumulated sound exposure levels (SEL; $L_{E,24h}$) from Accomando et al. (2025) for the onset of temporary threshold shift (TTS) and permanent threshold shift (PTS) in sirenians and marine turtles
- 2024 update to technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing (version 3.0) (National Marine Fisheries Service [NMFS] 2024) and updated noise exposure criteria and cetacean hearing groupings (Southall et al. 2019).
- sound criteria and thresholds for U.S. Navy acoustic and explosive effects analysis (phase 4) (Accommando et al. 2025).
- 2024 update to technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing (NMFS 2024) including the updated Finneran technical report (Finneran 2024).

Table 9-20 to Table 9-23 summarise the thresholds that could result in PTS, auditory injury, TTS, and behavioural disturbance as a result of continuous and impulsive noise sources for cetaceans, sirenians, turtles and fish.

9.5.1.8.1 Marine Mammals

The vulnerability of marine mammals to underwater noise is linked to their ability to perceive sound. Marine mammals can be grouped based on similarities in their hearing range. Underwater noise exposure thresholds can then be weighted for each group to emphasise noise frequencies to which a group may be particularly vulnerable. This approach is described in Southall et al. (2007) and has been applied to a range of underwater noise guidelines and impact assessments on cetaceans. Southall et al. (2019) updated the nomenclature to describe three cetacean hearing groups as 'Low-frequency' (LF) (e.g. baleen whales), 'High-frequency' (HF) (e.g. dolphins), 'Very high-frequency' (VHF) (e.g. kogia) as well as a separate group for sirenians (dugongs) to better reflect their hearing sensitivities in marine bioacoustics terms. These groupings, along with updated hearing ranges, have been adopted in the 2024 update to technical guidance (NMFS 2024).

Most of the underwater noise associated with the activity involves continuous (non-impulsive) noise sources, such as vessel noise. Acoustic survey methods for IMR would involve impulsive noise for intermittent and short durations. Table 9-20 summarise the impact thresholds for continuous and impulsive underwater noise for cetaceans and sirenians. The thresholds are derived primarily from technical guidelines and exposure criteria published by NOAA (NMFS 2014, 2018, 2024) and Southall et al. (2019).

Table 9-20: Thresholds for PTS, TTS, and Behavioural Response Onset for LF, HF, VHF Cetaceans and Sirenians for Impulsive and Continuous Noise

Receptor	Impulsive			Continuous		
	PTS onset: SEL24h (dB re 1 µPa².s) SEL24h (dB re 1 µPa².s)	TTS onset: SEL24h (dB re 1 µPa².s)	Behavioural response: (dB re 1 µPa)	PTS onset: SEL24h (dB re 1 µPa².s) re 1 µPa².s)	TTS onset: SEL24h (dB re 1 µPa².s)	Behavioural response: (dB re 1 µPa)
LF cetaceans	183	168	160	197	177	120

Receptor	Impulsive			Continuous		
	PTS onset: SEL24h (dB re 1 µPa²·s) SEL24h (dB re 1 µPa²·s)	TTS onset: SEL24h (dB re 1 µPa²·s)	Behavioural response: (dB re 1 µPa)	PTS onset: SEL24h (dB re 1 µPa²·s) re 1 µPa²·s)	TTS onset: SEL24h (dB re 1 µPa²·s)	Behavioural response: (dB re 1 µPa)
HF cetaceans	193	178		201	181	
VHF cetaceans	159	144		181	161	
Sirenians	186	171		200	180	

Source: NMFS (2014, 2018, 2024); Southall et al. 2019 ; Accomando et al. 2025

9.5.1.8.2 Marine Turtles, Fish and Other Fauna

Table 9-21 summarises the sound exposure guidelines for marine turtles for continuous and impulsive sounds based on Popper et al. (2014) and Accommando et al. (2025). Table 9-22 and Table 9-23 provide similar guidelines for fish. Sharks and rays (including whale sharks) were grouped with fish (no swim bladder) for this assessment of impacts. In accordance with the Conservation Advice for the dusky sea snake (*Aipysurus fuscus*), the dusky sea snake has been grouped with fish with a swim bladder involved with hearing for this assessment of impacts. Notably, the dusky sea snake is proposed by the Conservation Advice to be grouped with a subset of fish with a swim bladder involved with hearing that includes oral gulping fish, also known as physostomous fish. Oral gulping fish have the capacity to gulp or expel air to change the volume of gas in their swim bladder. Being able to expel air in response to loud sounds may reduce the mass of gas and subsequent range of motion of the swim bladder, in turn likely reducing injuries to the swim bladder and surrounding organs (Casper et al. 2013).

There is a paucity in knowledge on noise impacts to sea snakes. A study by Chapuis et al. (2019) demonstrated that *Hydrophis stokesii* (Stokes' sea snake), are sensitive to low-frequency sounds, and have relatively low sensitivity compared with bony fishes and marine turtles with a likely peak sensitivity to sound at 60 Hz (163.5 dB re 1 µPa). Conversely, the Conservation Advice for *Aipysurus fuscus* (dusky sea snake) (DCCEEW 2024h) suggests that the hearing sensitivity for fish with a swim bladder involved with hearing could be used as a proxy for the dusky sea snake. It is noted that reef-dependent sea snakes, such as the dusky sea snake, have little capacity to relocate to avoid noise. The species are generally confined to their habitat of shallow banks and shoals (DCCEEW 2024h).

Although there are reputable published studies indicating the potential for underwater noise to impact invertebrates, currently there is insufficient evidence for setting interim quantitative impact assessment criteria for these species. No published studies or guidelines on the potential invertebrate response to continuous noise sources have been identified. Invertebrates have not been considered in the assessment of risks and impacts from underwater noise based on these grounds.

Table 9-21: Thresholds for PTS, TTS and Behavioural Response Onset in Marine Turtles for Impulsive and Continuous Noise

Receptor	Impulsive			Continuous		
	PTS onset thresholds: SEL_{24h} (dB re 1 µPa²s)	TTS onset thresholds: SEL_{24h} (dB re 1 µPa².s)	Behavioural response (dB re 1 µPa)	PTS onset thresholds: SEL_{24h} (dB re 1 µPa²s)	TTS onset thresholds: SEL_{24h} (dB re 1 µPa²s)	Behavioural response (dB re 1 µPa)
Marine turtles	184	169	166[+] 175[+]	198	178	(N) High (I) Moderate (F) Low[#]

Source: PTS and TTS thresholds (Accomando et al. 2025), + behavioural disturbance threshold (impulsive) (McCauley et al. 2000), # behavioural response threshold (continuous) (Popper et al. 2014),

Note: The sound units for masking and behavioural effects from continuous noise include relative risk (high, moderate and low) for fish (all types) at three distances from the source defined in relative terms as near (N – tens of metres), intermediate (I – hundreds of metres) and far (F – thousands of metres) (after Popper et al. 2014).

Table 9-22: Thresholds for Impulsive Sounds Applicable to Sharks, Rays, Other Fish and Dusky Sea Snakes

Type of animal	Mortality and Potential Mortal Injury	Impairment			Behaviour
		Recoverable injury	TTS	Masking	
Fish: No swim bladder (particle motion detection)	219 dB SEL_{24h} or >213 dB PK	216 dB SEL_{24h} or >213 dB PK	186 dB SEL_{24h}	(N) Moderate (I) Low (F) Low	(N) High (I) Moderate (F) Low
Fish: Swim bladder not involved in hearing (particle motion detection)	210 dB SEL_{24h} or >207 dB PK	203 dB SEL_{24h} or >207 dB PK	186 dB SEL_{24h}	(N) Moderate (I) Low (F) Low	(N) High (I) Moderate (F) Low
Fish: Swim bladder involved in hearing (primarily pressure detection) Dusky sea snakes	207 dB SEL_{24h} or >207 dB PK	203 dB SEL_{24h} or >207 dB PK	186 dB SEL_{24h}	(N) High (I) High (F) Moderate	(N) High (I) High (F) Moderate

Note: Popper et al. 2014 do not define an accumulation period. For this assessment 24 hours was used based on the independent, expert peer review by Popper (Santos 2018) that concluded that a 24-hour period to assess cumulative sound exposure levels and any associated effects is likely to be conservative for assessing the potential effects to fish.

Note: The sound units for masking and behavioural effects include relative risk (high, moderate and low) for fish (all types) at three distances from the source defined in relative terms as near (N – tens of metres), intermediate (I – hundreds of metres) and far (F – thousands of metres) (after Popper et al. 2014).

Table 9-23: Thresholds for Continuous Sounds Applicable to Sharks, Rays, Other Fish and Dusky Sea Snakes

Receptor	Mortality and Potential Mortal Injury	Recoverable Injury	TTS	Masking	Behaviour
Fish: no swim bladder	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Fish: swim bladder not involved in hearing	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Fish: swim bladder involving hearing Dusky sea snakes	(N) Low (I) Low (F) Low	170 dB rms SPL for 48-hours	158 dB rms SPL for 12-hours	(N) High (I) High (F) High	(N) High (I) Moderate (F) Low

Note: The sound units include relative risk (high, moderate, and low) for fish (all types) at three distances from the source defined in relative terms as near (N – tens of metres), intermediate (I – hundreds of metres) and far (F – thousands of metres) (after Popper et al. 2014).

9.5.1.9 Modelling Results vs Threshold Levels

Liu et al. (2025) conducted an underwater noise modelling study for expected noise levels from Crux vessel and platform operations at the Crux platform location. While vessel activities are expected to generally be low during operations, there is the potential for a temporal overlap in presence of the ASV and W2W accommodation vessels as well as the operational platform itself. The modelling provides a conservative indication of noise propagation associated with these activities.

The modelling identified distances at which underwater sound levels from the activity would reach defined noise effect thresholds and criteria. The modelling incorporated the effect thresholds (PTS, TTS and behavioural) that were current at the time.

The modelling study also provided an acoustic exposure analysis for migrating pygmy blue whales (the only threatened whale species with a BIA that overlaps the Planning Area) using the JASCO Animal Simulation Model Including Noise Exposure (JASMINE) approach, which describes the modelled predictions of sound levels that individual pygmy blue whales may receive during the activities. Simulations with animats (simulated animals) restricted to the BIA for pygmy blue whales can provide an understanding of how animals will be exposed given the location and environment-specific context where they are most likely to occur. Scenarios in which pygmy blue whales are seeded in an unrestricted manner allowed exposure ranges for effect thresholds to be calculated across the entire Activity Area, including any relevant areas beyond that. These ranges may then be interpreted to determine potential zones of effect (such as the noise impact assessment area) for the activity (see Table 7-1 for the Noise Assessment Area). The unrestricted seeding approach is particularly informative for projects that do not intersect the pygmy blue whale BIA, such as this activity. The platform location is 120 km away from the closest known pygmy blue whale BIA.

9.5.1.9.1 Vessel Noise

A site-specific modelling study was undertaken by JASCO of the predicted underwater noise generated by the activities proposed within this EP to assist in the assessment of potential impacts from noise to marine fauna (Liu et al. 2025). The modelled scenarios are deemed appropriate for the assessment of sound-producing activities from operations during the well completions and hot commissioning phases (which includes infield vessel operations) and major maintenance/turnaround activities and included the following sound producing sources:

- an ASV based on the *Safe Boreas*
- a W2W vessel based on the *MV Rem Wind,* and
- an operating Crux Platform based on a generic platform.

As described in Section 9.5.1.4, vessels of similar class size typically produce broadband source levels within comparable ranges. Table 9-25 summarises source levels for the modelling, including the ASV, which is the largest vessel proposed for this activity.

Table 9-24: Broadband Source Levels

Source	Frequency	Source Level (dB re 1 µPa^{2}m^{2}s)
Safe Boreas (ASV)	10 Hz to 25 kHz	189.2
MV Rem Wind (W2W vessel)	10 Hz to 25 kHz	175.6
Generic Platform (operational)	10 Hz to 25 kHz	150.4

Three scenarios were modelled relevant to underwater noise:

- 1: *Crux Platform* operating alone
- 2: *Crux Platform* operating simultaneously with the *W2W vessel* on DP
- 3: *Crux Platform* operating with the *W2W vessel* and the *ASV vessel* both operating on DP (24h) simultaneously.

Although the final vessel specifications and operational scenarios are yet to be determined, the assessment has considered the worst-case scenario for underwater noise relevant to the activities within this EP. This

includes the simultaneous operation of the platform, the W2W vessel, and the ASV vessel. The most conservative scenario (Scenario 3) was evaluated in this assessment. Modelling of this combined scenario showed (see Table 9-25 and Table 9-26):

- The 24-hour threshold for PTS in LF cetaceans may be met if animals remain within 0.15 km of the activity, based on acoustic modelling results. However, the more accurate exposure modelling predicted this threshold would only be met if animals remain within less than 10 m of the activity.
- The 24-hour threshold for TTS in LF cetaceans may be met if animals remain within 5.28 km of the activity, based on acoustic modelling results. However, the more accurate exposure modelling predicted this threshold would only be met if animals remain within 70 m of the activity.
- The 48-hour threshold for recoverable injury for fish with a swim bladder involved in hearing and dusky sea snakes (Popper et al. 2014) was not predicted to be met.
- The 12-hour threshold for TTS for fish with a swim bladder involved in hearing (Popper et al. 2014) and dusky sea snakes may be met if the animals remain within 50 m of the activity.
- The risk of exceeding the recoverable injury threshold for fish without a swim bladder (including whale sharks) is Low for any distance to continuous underwater noise.
- The threshold for marine mammal behavioural response to continuous noise (NOAA 2024) was reached at 22 km based on acoustic modelling results; however, the more accurate exposure modelling predicted this threshold would only be met within a maximum distance of 18.6 km from the activity (see Table 9-25).

Table 9-25: Modelled Maximum Horizontal Distances (R_{max}) and 95th Percentile ($ER_{95\%}$) Exposure Ranges for Pygmy Blue Whales from All Vessels

Modelling Approach	Parameter	PTS	TTS	Behavioural[29]
Acoustic modelling	Maximum Range (R_{max})	SEL_{24h}: 0.15 km	SEL_{24h}: 5.28 km	SPL: 22 km
Exposure modelling (JASMINE)	$ER_{95\%}$	SEL_{24h}: <0.01 km	SEL_{24h}: 0.07 km	SPL: 18.6 km
	Probability	SEL_{24h}: 33%	SEL_{24h}: 94%	SPL: 97%

Table 9-26: Cumulative (All Vessels) Exposure Scenario with Maximum Distances to Thresholds

Hearing group	Threshold Criteria (Continuous)	Max Distance from Vessels (km)
PTS		
LF cetaceans	197 SEL_{24}[30]	0.15
HF cetaceans	201 SEL_{24}	N/A
VHF cetaceans	181 SEL_{24}	0.03
Sirenians	200 SEL_{24}	N/A
Turtles	198 SEL_{24}	0.10
Sharks, rays, and other fish and dusky sea snakes	170 SPL[31]	N/A
TTS		
LF cetaceans	177 SEL_{24}	5.28
HF cetaceans	181 SEL_{24}	0.22
VHF cetaceans	161 SEL_{24}	0.41
Sirenians	180 SEL_{24}	0.07

[29] SPL (120 dB re 1 µPa) NOAA (2024) recommended unweighted behavioural threshold for marine mammals.
[30] Frequency-weighted SEL_{24h} PTS and TTS thresholds based on NMFS (2024) and Accomando et al. (2025).
[31] 48 h threshold for recoverable injury for fish with a swim bladder involved in hearing (Popper et al. 2014).

Hearing group	Threshold Criteria (Continuous)	Max Distance from Vessels (km)
Turtles	178 SEL_{24}	2.77
Sharks, rays, other fish and dusky sea snakes	158 SPL[32]	0.05

The distances over which modelling indicates sound generated from the activities may exceed behavioural thresholds were used to determine a Noise Assessment Area—defined as 20 km around the Activity Area (where IMR activities are expected to typically involve a single, relatively small vessel along the export pipeline) and the Crux platform location (where multiple vessels may operate simultaneously, e.g. during completions, commissioning and/or start-up) (see Section 7.1 for justification).

9.5.2 Description and Evaluation of Impacts

The Crux platform, export pipeline and associated activities are in water depths ranging from 160–280 m. Fauna that may be present within the Activity Area will mainly comprise pelagic and demersal fish species, with migratory species (including cetaceans, dugongs, turtles, and whale sharks) potentially transiting the area seasonally.

An EPBC Act protected matters search was undertaken for the Noise Assessment Area. No additional EPBC Act listed migratory species of marine fauna were identified within the Noise Assessment Area compared to the Activity Area (Appendix F). The Noise Assessment Area overlaps with the whale shark BIA, which broadly follows the 200 m isobath up the north-west coast of WA (Figure 7-20). Whale sharks are expected to be seasonally present, mainly from July to November, transiting through the Activity Area as part of their broad migratory movements to/from Ningaloo.

Table 9-27 indicates the environmental features and values and sensitivities that have been identified to be potentially affected by the noise associated with the activities covered by this EP, with further evaluation of the impacts and/or risks to each potentially affected receptor category (including cumulative impacts) provided in Sections 9.5.2.1 to 9.5.2.8. Features or values and sensitivities which could not be credibly affected by activity noise emissions are not discussed further.

[32] 12-hour threshold for TTS for fish with a swim bladder involved in hearing (Popper et al. 2014).

Table 9-27: Noise Receptor Impact Screening Summary

	Protected Areas			Features															Values and Sensitivities																						
				Physical		Natural				Socioeconomic								Heritage and Cultural			Physical				Natural								Socioeconomic							Heritage and Cultural		
Aspect	Receptor	Marine Conservation Reserves	Wetlands of International and National Importance	Commonwealth and National Heritage Places	Marine Regions	Australian Environment	Northwest Shelf Province Bioregion	Northwest Shelf Transition Bioregion	Northwest Transition Bioregion	Timor Province Bioregion	People and Communities	Fishing Industry	Tourism and Recreation	Defence	Shipping	Scientific Research/Restoration	Oil and Gas Industry	Indonesian and Timor-Leste Coastlines	Underwater Cultural Heritage	Traditional Indonesian Fishing	Indigenous Cultural Connections	Air Quality	Water Quality	Sediment Quality	Underwater Noise	BIAs	Critical Habitat	Shoals and Banks	Offshore Reefs and Islands	Coastal Reefs and Islands	KEFs	Threatened, Migratory, Marine and Cetacean Species	Fishing Industry	Tourism and Recreation	Defence	Shipping	Scientific Research/Restoration	Oil and Gas Industry	Indonesian and Timor-Leste Coastlines	Underwater Cultural Heritage	Traditional Indonesian Fishing	Indigenous Cultural Heritage
										×															×							×										

Legend:		
		Potentially affected
	×	Predicted impact

9.5.2.1 Physical Features

The localised and generally temporary nature of noise emissions generated by the activity precludes discernible impacts to the identified physical features of the region.

9.5.2.2 Physical Values and Sensitivities

9.5.2.2.1 Underwater Noise

The activity will generate underwater noise from both ongoing operational sources (e.g. flowlines, platform machinery and equipment) and from intermittent activities, such as vessel visits and IMR activities. Generally, the underwater noise generated during operations is low intensity and the potential changes to ambient underwater noise levels would be limited to close proximity to the infrastructure. During vessel operations and IMR campaigns, noise emissions will cause greater increases in ambient underwater noise levels. The environmental implications of changes in ambient underwater noise levels relate primarily to potential impacts on marine fauna, which are discussed below.

The overall residual impact consequence level to underwater noise is ranked as Slight (Magnitude: −1, Sensitivity: L).

9.5.2.3 Natural Features

9.5.2.3.1 Timor Province Bioregion

Benthic Communities

Underwater noise generated by operational platforms does not appear to have any detrimental effect on benthic communities. Inspection of fixed platforms worldwide shows these structures serve as artificial reefs and develop relatively diverse benthic communities (Lindquist et al. 2005). Benthic habitat surveys in the Activity Area indicated a very low abundance of macrobenthic fauna (Fugro 2017a; AECOM 2017). It is considered that, while the latter study was more of a general characterisation study and may not have provided an extensive and statistically robust dataset for future impact assessment comparison, it was sufficient to provide an adequate characterisation of the typical benthic communities present to conclude that the modelled noise levels would not pose a risk of significant impacts upon them.

Pelagic Communities

Pelagic communities in the Noise Assessment Area include planktonic communities and pelagic fish and invertebrates. Threatened and migratory species of fish (including sharks and rays) are discussed in Section 9.5.2.4.4.

Planktonic communities have a diverse range of taxa, which will differ in their potential to be impacted by underwater noise. Many species of pelagic and demersal fish have a planktonic larval stage. Modelling studies by the CSIRO indicate that planktonic communities are highly dynamic and have the potential to recover rapidly following disturbance (Richardson et al. 2017). Experiments have shown mixed results of larval stages to underwater noise. For example, experiments on several species of fish larvae and lobster larvae did not detect significant effects as a result of high-intensity impulsive noise (Bolle et al. 2012; Day et al. 2016; Payne et al. 2009). Therefore, the residual impact consequence to planktonic communities is considered to be Slight (Magnitude: −1, Sensitivity: L). The noise modelling of vessel operations predicted that under the 'worst-case' scenario representative of activities covered by this EP (scenario 3) the 12-hour threshold criteria for TTS in the most noise-sensitive fish (i.e. fish with a swim bladder involved in hearing) may be reached if individuals remain within 50 m of the vessel operations. The 48-hour threshold for recoverable injury for fish with a swim bladder involved in hearing was not predicted to be met. Modelling of the underwater noise generated by a single vessel, as typically involved with NNM operations and IMR activities, indicates these effects would be limited to within tens of metres of the operating vessel.

The potential for injury or TTS effects to fish resulting from single impulse or accumulated exposures to SBP, MBES and SSS sound during IMR is limited to within 1–2 m beneath or to the side of the sound source (Zykov 2013; McPherson and Wood 2017). Single impulse exposures at this range are highly unlikely to occur and accumulated exposures over several hours at this range are not credible.

Continuous and impulsive noise sources from the activity are assessed to have a Slight residual impact consequence (Magnitude: −2, Sensitivity: L) on resident and transient fish populations. This is based on the

limited spatial extent of predicted noise levels that may exceed impact criteria and the low numbers of individuals from any species likely to occur within the affected area.

9.5.2.4 Natural Values and Sensitivities

9.5.2.4.1 BIAs

The Noise Assessment Area overlaps a very small proportion of the whale shark low density foraging BIA. This BIA extends northwards from Ningaloo across the North West Shelf and the Browse Basin along the 200 m isobath and covers an area of ~224,416 km^2 (see Figure 7-20) and supports migration of whale sharks to/from the Ningaloo aggregation area. This BIA has a mapped width of ~170 km at the Crux platform location. Impacts to whale sharks using this BIA are described in Section 9.5.2.4.4. Given the generally low sensitivity to noise emissions in whale sharks, the very small proportion of the BIA that may be affected by activity noise emissions, potential impacts on the functional values of the BIA are assessed to have a Slight residual impact consequence (Magnitude: −1, Sensitivity: L).

9.5.2.4.2 Shoals and Banks

Three shoals—Eugene McDermott, Goeree and Vulcan—and no offshore islands are within the Noise Assessment Area. These shoals may potentially be exposed to short-term increases in underwater noise levels during vessel operations. However, based on the predicted noise attenuation away from noise sources within the Activity Area, as demonstrated by modelling (Liu et al. 2025), there is no credible potential for impacts to benthic or fish communities at these shoals as a result of the activity.

9.5.2.4.3 KEFs

The Noise Assessment Area overlaps a small portion (<0.05%) of the Continental slope demersal fish communities KEF. This KEF covers a vast area (~33,182 km^2) and intersects ~7 km of the export pipeline corridor. The KEF has a high diversity of demersal fish assemblages featuring >500 fish species.

IMR activities along the pipeline have the potential to affect fish within close proximity to an operating vessel, as outlined in the pelagic communities assessment above. IMR surveys are expected to be infrequent based on CMMS schedule. Water depths along the pipeline corridor are ~160 m providing substantial separation between the main (vessel generated) IMR noise source and demersal fish. Any effects on demersal fish communities would be localised and temporary, and the proportion of the KEF involved is very small. Therefore, potential impacts to the demersal fish communities KEF are assessed to have a Slight residual impact consequence (Magnitude: −1, Sensitivity: L).

9.5.2.4.4 Threatened, Migratory, Marine and Cetacean Species

An EPBC Act protected matters search was undertaken for the Noise Assessment Area with no additional species identified within the Noise Assessment Area compared to the Activity Area (Appendix F).

Marine Mammals

Marine mammals that may occur within the Noise Assessment Area include cetaceans and sirenians. Most cetacean species use sound to communicate (e.g. whale calls) or perceive their environment (e.g. echolocation of prey). This reliance on underwater noise, and the high conservation value of these species, makes cetaceans a focus when assessing potential impacts on marine mammals from underwater noise. The effects of anthropogenic noise on cetaceans may be exacerbated if they interfere with the animal's use of sound in areas that support important lifecycle behaviours. LF cetaceans are expected to be most vulnerable to underwater noise from the activity.

There are no known cetacean (or other marine mammal) BIAs within the Noise Assessment Area. Several LF cetaceans (including pygmy blue, humpback, sei, fin, and Bryde's whales) were identified as potentially occurring within the Noise Assessment Area (see Section 7.7.7.1). Noise monitoring in the Timor Sea for the Barossa Gas Project indicated pygmy blue, Omura's and Bryde's whales are the most likely to occur (McPherson et al. 2016, McPherson pers. comm. 2023). Based upon known distribution data, humpback whales are considered unlikely to occur, although they have been detected in the region previously. The closest known LF cetacean BIA is the migration BIA for pygmy blue whales, which is ~121 km from the Crux platform. Thums et al. (2022) and Ferreira et al. (2024) found that pygmy blue whales demonstrate extensive use of slope habitat off the WA coastline and only limited use of shelf waters, suggesting a presence mostly in water depths >250 m. During their migratory period, pygmy blue whales predominantly travel fast, with directed travel interspersed with relatively short periods of low movement persistence, indicating foraging, resting or

breeding behaviours along the WA coastline (Thums et al. 2022). The Perth Canyon, Cape Range Canyon and Cloates Canyon (Thums et al. 2022) were identified as key areas associated with these slower behaviours, supporting the 'possible' foraging areas identified in the Blue Whale Recovery Plan (CoA 2015a). During migration periods, pygmy blue whales are more likely to travel in greater numbers through the region in the deeper, and further offshore waters within their known BIA (outside the Noise Assessment Area), and are therefore outside the identified areas of potential impacts from underwater noise from the activity.

HF and VHF cetaceans are also vulnerable to underwater noise, although their functional hearing range means they are more vulnerable to higher noise frequencies which attenuate more rapidly. Several species of HF and VHF cetaceans were identified as potentially occurring within the Noise Assessment Area (see Section 7.7.7.1). Noise monitoring in the Timor Sea indicates HF and VHF cetaceans are present year-round (McPherson et al. 2016, McPherson pers. comm. 2023). Dugongs (Sirenians) have similar hearing ranges to HF cetaceans but have been assigned their own assessment category in accordance with Accommando et al. (2025) and have been incorporated into this assessment based on anecdotal sightings within or in close proximity to the Activity Area (pers comm Craig McPherson [JASCO] 2023). The closest known sirenian BIA to the Activity Area is the dugong high density seabed foraging BIA, ~135 km away.

The animat exposure modelling results for the 'worst-case' scenario of multi-vessel simultaneous operations predicted that vessel DP noise would only exceed any cetacean PTS and TTS impact threshold within very close proximity of a vessel (i.e. <10 m and 70 m respectively). Notably, an animal would need to remain swimming within 10 metres of the vessel for more than 24 hours to experience auditory injury, which is not a credible scenario. This modelling predicted the LF cetacean (most sensitive) behavioural threshold would be exceeded for animals present within 18.6 km of simultaneous vessel operations. Studies of cetaceans exposed to acoustic disturbance shows typical behavioural response is to move away from unpleasant stimuli, unless motivated to remain in the area due to biologically important activities (such as feeding or breeding). Several species of cetacean, including humpback whales, have been shown to avoid high-intensity low frequency sound (Dunlop et al. 2013; Kvadsheim et al. 2017; Sivle et al. 2015). Therefore, the most likely impact to cetaceans within the noise assessment area is a behavioural response such as avoidance. As there are no cetacean BIAs within the noise assessment area, such behavioural responses are unlikely to have biological consequences.

The HF pulses produced by survey method equipment will rapidly attenuate outside the immediate beam (MacGillivray et al. 2013; Zykov 2013). The high operating frequencies of these instruments also places the majority of sound frequencies above the auditory range of most marine fauna species. Dolphins and other HF cetaceans have peak hearing sensitivity up to 110 kHz, with potential for some limited hearing ability up to ~160 kHz (NMFS 2018). Therefore, they may be able to detect a small amount of the sound energy from some survey method equipment instruments in the lower operating frequency ranges (MacGillivray et al. 2013; Zykov 2013). Modelling of the propagation of high-frequency sound from survey method equipment has been undertaken by Zykov (2013) and MacGillivray et al. (2013). The modelling predicted that sound emissions outside the main beams would be below the threshold levels for PTS or TTS. Sound levels that may result in behavioural effects are likely limited to within tens of metres, but potentially up to a few hundred metres from the sound source for HF cetaceans (Zykov 2013; MacGillivray et al. 2013).

Acoustic modelling of SBP by Zykov (2013), MacGillivray et al. (2013) and McPherson and Wood (2017), predicts that limited horizontal sound propagation occurs outside the main directional beams of sound. The modelling studies also predict that SEL_{24h} thresholds for PTS (as outlined in Table 9-20) are not exceeded. The potential for TTS resulting from SEL_{24h} exposures is limited to a few metres from the moving sound source (Zykov 2013; McPherson and Wood 2017), which is not considered to be a credible exposure for mobile marine fauna. Exceedance of the 160 dB re 1 µPa SPL behavioural response threshold would also be limited to within hundreds of metres (Zykov 2013; McPherson and Wood 2017).

Based on the results of the noise assessment, the cetacean species that may occur within the Noise Assessment Area and the controls Shell will implement, potential impacts are expected to involve behavioural disturbance only. This behavioural disturbance is likely to involve avoidance of areas of high noise intensity. The nearest known BIA for whales is the seasonal migratory corridor for pygmy blue whales, which is ~121 km from the Crux platform (~77 km from the Activity Area). Behavioural disturbance is therefore expected to involve low numbers of animals and to be restricted to relatively infrequent, short periods when high noise intensity activities are occurring. Once the noise stops (i.e. the activity ceases), animal behaviour is expected to return to normal. Due to the anticipated behavioural responses (i.e. avoidance) and the controls that will be implemented (e.g. whale interaction procedures), potential impacts such as mortality, auditory injury, PTS and TTS are considered very unlikely to occur.

The overall impact consequence for marine mammals is considered to be Minor (Magnitude: −2, Sensitivity: M).

Marine Reptiles

The short-nosed, leaf-scaled and dusky sea snakes are not expected to be present within the Activity Area, however, these and/or other sea snake species may be present in the shallow waters and reef habitats within the Noise Assessment Area.

Excessive noise and constant marine vessel noise in areas where the dusky sea snake is known or likely to occur have been identified by the Conservation Advice for the dusky sea snake as a threat to the species (DCCEEW 2024h). There are no areas of known or likely dusky sea snake habitat (DCCEEW 2024h) that fall within the Noise Assessment Area. However, there are three areas where the species or species habitat may occur—Goeree Shoal (~8km away the Activity Area), Vulcan Shoal (~17 km) and Heywood Shoal surrounds (~17 km; noting Heywood Shoal is ~20 km from the Activity Area)—within the Noise Assessment Area.

The Conservation Advice suggests that the dusky sea snake should be grouped with gulping fish (physostomous fishes) for the purpose of noise impact assessment. Physostomous fishes are fish with swim bladders that are less sensitive to noise, as compared to other fish with swim bladders, due to their ability to expel air in response to loud noise and as such reduce the likelihood of severe injury or impact to organs including the swim bladder (Casper et al. 2013). A study of *Hydrophiinae stokesii* (true marine sea snakes) undertaken by Chapuis et al. (2019) suggested that sea snakes show low sensitivity to sound compared with bony fishes and marine turtles, and are likely to have a peak sensitivity at 60 Hz (163.5 dB re 1 µPa). Reef-dependent sea snakes, such as the dusky sea snake, have little capacity to relocate to avoid noise and may be considered indirectly vulnerable due to their habitat restriction. Current understanding of this species is that they are a reef specialist that is only known to occur on complex hard coral reefs and shoals, generally confined to the shallow waters of banks and shoals (DCCEEW 2024h). The Crux platform, where activities with the greatest potential to generate underwater noise are likely to occur, is in deep waters ~13 km from the nearest location (Goeree Shoal) where the dusky sea snake or its habitat may occur.

The noise modelling for the greatest source of marine noise from the activity (i.e. multiple vessels operating simultaneously) shows that the 48-hour threshold for recoverable injury for fish with a swim bladder involved in hearing (applicable to dusky sea snakes) is not predicted to be met by the activity (Table 9-26). The 12-hour threshold for TTS for fish with a swim bladder involved in hearing and dusky sea snakes may be met if the animals remain within 50 m of the activity (Table 9-26). Notably, the guidelines from Popper et al. (2014) advise that there is no direct evidence of mortality or potential mortal injury to fish from vessel noise. The risk of behavioural disturbance is predicted to be high near the source, moderate at intermediate distances and low at far distances. Vessel operations for the activity will be concentrated within the Activity Area, with multiple vessel activity most likely in the vicinity of the platform. The shortest distance between the Activity Area and areas where the dusky sea snake or its habitat may occur is 8 km, hence underwater noise from the activity is considered unlikely to impact the dusky sea snake.

The *Recovery Plan for Marine Turtles in Australia* (CoA 2017b) identifies noise interference as a key threat. Although marine turtles do not have external ears, they use sound for navigation and location of prey and avoidance of predators. Exposure to chronic loud noise in the marine environment therefore may lead to avoidance of important habitat. Research on marine turtles suggests that functional hearing is concentrated at frequencies between 100 and 600 Hz (which is a subset of the LF cetacean range). Several turtle species were identified as likely to occur within the Noise Assessment Area (no additional species were identified compared to the Activity Area) (Section 7.7.7.2), however no critical habitat or BIAs for these species overlap the Noise Assessment Area.

The noise modelling indicates that the 24-hour cumulative PTS threshold for turtles would not be exceeded by noise generated from any individual vessel and only over a maximum horizontal distance of less than 100 m for the 'worst case' simultaneous vessel operations scenario; PTS for marine turtles is therefore not considered credible. There is a paucity in knowledge and data for TTS onset in marine turtles. Accomando et al. (2025) presented revised threshold levels for marine turtles based on freshwater turtle studies. The modelling indicate that the revised criteria for TTS onset may be met if a turtle remained within 2.8 km of the location of the worst case vessel operations scenario (scenario 3) or within 70 m of the platform location while operational in the presence of the W2W vessel (scenario 2). Notably, SEL_{24h} is a cumulative metric that assumes the receptor is consistently exposed to the relevant noise effect criteria over a period of at least 24 hours prior to the potential onset of TTS. Considering no known marine turtle BIAs or habitat critical to their survival occur within the Noise

Assessment Area, and marine turtles (if present) are expected to be individuals transiting through the area, the risk of auditory impairment (TTS onset) is considered unlikely.

Sound levels that are likely to be produced by various equipment used in different IMR survey methods are predicted to fall below the 166 dB re 1 µPa SPL threshold (Table 9-21) within a few metres to tens of metres (Zykov 2013; McPherson and Wood 2017). The high-frequency sounds produced by the survey equipment are expected to be above the auditory range of marine turtles and so behavioural impacts are not expected to occur. Localised and short-term behavioural disturbances may result from the survey methods, affecting individuals (potentially exposed within tens of metres of the equipment for a brief period).

Based on the results of the noise assessment, potential impacts to marine reptiles are considered likely to be restricted to short-term behavioural disturbance to animals close to high-intensity noise sources. Given the absence of BIAs and expected low density of marine reptiles within the Noise Assessment Area, this potential impact would only affect a relatively small portion of turtle or dusky sea snake populations in the region. Recovery from behavioural disturbance is expected to occur immediately once the noise emissions stop. The overall impact consequence for marine reptiles is considered to be Minor (Magnitude: −2, Sensitivity: M).

Sharks and Rays

Sharks and rays (elasmobranchs) are not considered to be particularly vulnerable to noise-related impacts and were categorised as ‘fish with no swim bladder’ when determining impact thresholds. The Noise Assessment Area is not likely to support significant aggregations of any of the listed species of elasmobranchs that may occur in the region (Section 7.7.7.3) and the only recognised BIA that overlaps the area is the whale shark ‘low density’ foraging BIA.

This BIA extends northwards from Ningaloo across the North West Shelf and the Browse Basin along the 200 m isobath (Figure 7-20). Although whale sharks are likely to seasonally occur within the Noise Assessment Area when traversing the open waters within or surrounding the Activity Area during migration to/from aggregation off Ningaloo Reef, it is considered unlikely that whale sharks would occur in significant numbers as there is no aggregation area in the vicinity of the Noise Assessment Area—any presence would be anticipated to be transitory and short-term. This is consistent with tagging studies of whale shark movements, which show continual movement of whale sharks in deeper, open offshore waters (Meekan and Radford 2010, Ferreira et al. 2024). Given the contrast to the feeding behaviour in aggregation areas such as Ningaloo Reef, the BIA within the Noise Assessment Area is considered unlikely to be a dedicated foraging area; rather, it is likely to be a broad area within which migratory movements can be expected. This is consistent with the Conservation Advice (DoE 2015e) for this species, which indicates that the BIA along the north-west coast is a migration corridor rather than significant foraging habitat. There are no constraints (e.g. shallow water, shorelines) that would prevent whale sharks moving away from a noise source and the BIA is not considered a confined pathway. The Conservation Advice for the whale shark does not identify noise as a threat to the species (DoE 2015e) and it is not listed as a pressure on the whale shark in the Marine Bioregional Plan for the NWMR (DSEWPaC 2012).

Whale sharks forage on plankton and small fish, and high-intensity underwater noise has been shown to impact some taxa within zooplankton communities. However, potential effects on plankton and small fish from the noise sources associated with the activity are expected to be localised and short-term (Section 9.5.2.3). As a result, it is considered that any minor impacts to zooplankton, which would be of short duration, and would not have the potential to negatively affect any whale sharks moving through the area. Note: Small crustacean zooplankton comprise only part of whale shark diets, with larger plankton and nekton (e.g. krill, baitfish) forming a part of their diet (Colman 1997).

The noise modelling suggests that the 12-hour threshold criteria for TTS may be reached, for fish with a swim bladder involved in hearing, if the fish remain within 50 m of the vessel operations. The 48-hour criteria for recoverable injury for fish with a swim bladder involved in hearing was not predicted to be met for any scenario. As fish with no swim bladder, including elasmobranchs such as the whale shark, are less sensitive to underwater noise, exposure to noise levels that might result in injury or TTS in threatened or migratory sharks and rays would require the species to remain in very close proximity of operating vessels for an extended period, which is considered highly unlikely.

The potential for injury or TTS effects to sharks and rays resulting from single impulse or accumulated exposures to sound from IMR survey equipment is limited to within 1–2 m beneath or to the side of the sound source (Zykov 2013; McPherson and Wood 2017). Single impulse exposures at this range are highly unlikely to occur and accumulated exposures over several hours at this range are not credible.

Based on the results of the noise assessment, the potential impacts to EPBC Act listed sharks and rays, including whale sharks, are expected to be limited to minor, short-term behavioural disturbance to animals close to the noise source. The overall impact consequence is considered to be Minor (Magnitude: −2, Sensitivity: M).

Birds

There are no BIAs or critical habitats for threatened or migratory birds that overlap the Noise Assessment Area and no emergent or subsea features in the vicinity of the platform that might encourage roosting or foraging activity by birds. However, a number of bird species, including seabirds and migratory shorebird species, may fly over the platform and/or forage in surrounding waters. The platform could provide opportunities for these birds to rest on topside structures or forage on fish attracted to the substructure. Experience with unmanned platforms elsewhere indicates that, if not controlled, birds can be attracted to the structure and present a safety risk due to helicopter bird strike or to build up of guano, particularly on the helipad (Santos 2020a,b; Jadestone Energy 2023).

The potential for subsea noise associated with platform operations to impact foraging (i.e. diving) birds is considered negligible. However, the acoustic bird deterrent system that will be installed on the helideck has an effective range of up to 1500 m and consequently has the potential for localised disturbance of birds that may be flying over or foraging near the platform. Migratory shorebirds are reported to fly at an average height of 2 km (Richardson 1979 cited in Imbricata 2018) and so unlikely to be affected. Given the low numbers of any species expected to occur within the area of influence of the deterrence system and the absence of habitat or particular importance to birds in the area, the minor and localised alterations in behaviour that might result from operation of the bird deterrent system are considered to have no more than a Slight impact consequence on threatened or migratory birds (Magnitude: –1, Sensitivity: L).

9.5.2.5 Socioeconomic Features

9.5.2.5.1 Fishing Industry

The Noise Assessment Area intersects the authorised fishing zones (management areas) for several commercial fisheries. However, the proportion of any these management areas potentially affected by the localised and generally temporary nature of noise emissions associated with project activities is negligible.

9.5.2.6 Socioeconomic Values and Sensitivities

9.5.2.6.1 Fishing Industry

Assessment of the potential effects of activity noise on fish and invertebrates that may form part of the commercial stocks indicates (Sections 9.5.2.3 and 9.5.2.4.4) that impacts are likely to be highly localised and typically short lived. The sources of elevated underwater noise associated with the activity (i.e. vessels and HF acoustic sources) are similar to those used by the fishing industry. Potential impacts to commercially targeted fish resources are expected to be insignificant at a stock level. Therefore, it is unlikely there will be any impacts to commercial fisheries in the Noise Assessment Area from activity noise, given the scale of the fisheries and the size of the area of potential impacts from noise.

9.5.2.7 Heritage and Cultural Values and Sensitivities

9.5.2.7.1 Indigenous Cultural Heritage

Shell has not identified any cultural values, such as songlines, through desktop research or consultation during the preparation of this EP which may be impacted by the planned activities in this EP. Noise is unlikely to result in significant impacts to marine species of cultural significance with the proposed control measures in place. For the assessment of impacts to marine species that may be of cultural significance, see Section 9.5.2.4.4. Shell has adopted the precautionary principle, in accordance with the principles of ESD in order to manage potential impacts on intangible cultural values for this activity. Therefore, impacts to Indigenous cultural values are ranked as Slight (Magnitude: −1, Sensitivity: L).

9.5.2.8 Cumulative Impacts

The remoteness of the Activity Area and the NNM basis of Crux operations means that it is unlikely that there will be a cumulative impact above thresholds with other marine users during normal operations. The closest operating facility to the Crux platform is the Montara FPSO facility, which is located ~36 km north. The Ichthys

project offshore facilities are located ~164 km to the south-west of the Crux platform, and the Prelude FLNG facility is ~165 km to the south-west.

During well completions, hot commissioning and start-up operations, a number of vessels may be required at the platform location. It is also possible that multiple vessels are involved in periodic maintenance activities such as workovers at the platform. Under a worst-case scenario, the noise generated from simultaneous Crux vessel operations could overlap with the area around the Montara FPSO that is affected by noise from FPSO operations, particularly during offtake activities. The Montara Operations EP indicates these could result in effects up to several kilometres from the Montara FPSO (Jadestone Energy 2023). Due to the attenuation that would occur with distance from the Crux platform, additive effects on noise levels from the coincident sources in the open-ocean area of overlap are unlikely to materially alter the potential for physiological impacts to marine fauna. There are no BIAs for noise-sensitive fauna in the area of overlap, and any requirement for simultaneous operations of multiple vessels is expected to be infrequent and temporary. The Crux platform is located within the BIA for whale sharks, and the area of potential cumulative effects would overlap part of this BIA. However, whale sharks are not considered to be particularly sensitive to noise emissions and the risk of behavioural effects at distances of kilometres from operating vessels is low (Section 9.5.2.4.4).

IMR activities may occur within the vicinity of the Prelude FLNG facility. The IMR noise sources include vessels (see Section 6.12.3) and may involve acoustic surveys and positioning equipment, if required (see Section 6.11.3). Therefore, there is the potential for cumulative sound emissions during IMR activities toward the Prelude–end of the pipeline. Noise levels from Prelude operations fall below the relevant behavioural disturbance criteria for cetaceans at ranges beyond 9 km during offtake operations (cavitation noise) and 1.3 km during normal production operations (Shell 2020). Vessel-based IMR along the pipeline is expected to occur infrequently (e.g. annually or less frequent). The potential for behavioural disturbance due to cumulative noise effects will therefore be very short-term and relatively localised. There are no known BIAs for noise-sensitive fauna within the area that might be affected.

Notwithstanding the potential overlap of the spatial extent of noise effects from concurrent activities, the infrequent and relatively short duration of these activities, the absence of significant feeding, breeding or aggregations areas and noise-sensitive marine fauna BIAs within the predicted noise ranges, and the mobility of noise-sensitive fauna species that may transit through the area suggests there will be negligible additive and cumulative noise effects beyond those predicted for the activity, and no change to the overall consequence level for noise impacts is expected to result.

9.5.3 Impact Assessment Summary

Table 9-28 lists the highest residual impact consequence ranking of the relevant environmental receptor groups.

Table 9-28: Noise Evaluation of Residual Impacts

Environmental Receptor	Magnitude	Sensitivity	Residual Impact Consequence
Evaluation – Planned Impacts			
Protected Areas	N/A	N/A	N/A
Physical Features	0	L	No Impact
Physical Values and Sensitivities	−1	L	Slight
Natural Features	−2	L	Minor
Natural Values and Sensitivities	−2	M	Minor
Socioeconomic Features	0	L	No Impact
Socioeconomic Values and Sensitivities	0	L	No Impact
Heritage and Cultural Features	N/A	N/A	N/A
Heritage and Cultural Values and Sensitivities	−1	L	Slight

9.5.4 ALARP Assessment and Environmental Performance Standards

Table 9-29: ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
ALARP Assessment						
Elimination	Concept design simplification to eliminate or minimise noise emission sources from platform topsides.	Yes	The concept design eliminates or minimises unnecessary equipment and systems to support NNM operations which reduces noise emission sources, platform visitations and maintenance requirements offshore.	N/A	N/A	N/A
Substitution	N/A	N/A	No additional or alternative control measures have been identified.	N/A	N/A	N/A
Engineering	GTG will be maintained in accordance with the CMMS detailed in sections 10.4.7 and 10.4.8.	Yes	Maintenance of equipment by qualified people using the CMMS to manage the maintenance process for equipment such as key rotating equipment, such as the GTG's, which produces the most noise on the platform, will assist in reducing noise emissions from the platform to ALARP.	3.1	GTG equipment will be maintained in accordance with the CMMS.	SAP records demonstrate GTG equipment is maintained in accordance with the CMMS.
Administrative and Procedural	Vary the timing of the vessel campaigns and offshore activities to avoid fauna migration periods.	No	The Noise Assessment Area does not intersect any known cetacean (or noise-sensitive fauna) BIA. Consequently, it is expected that noise impacts would be limited to individuals, and it is not anticipated that there will be significant impacts on whale migratory or foraging behaviours. One known BIA—whale shark migration BIA—overlaps with the Noise Assessment Area. The BIA is a broad corridor along the northwest coast of WA spanning 140-170 km in width near the Activity Area. The Conservation Advice for Whale Sharks (*Rhincondon typus*) (DoE 2015e) does not identify sound emissions as a threat to the species. Furthermore, underwater noise studies undertaken on sharks indicate that underwater noise effects are likely to result in avoidance behaviours (Popper and Hawkins 2019, Smith and Popper 2023; Chapuis et al. 2019). Activities are planned based on manning modes and maintenance schedules and must also consider safety drivers, modifying the timing of activities is not considered technically feasible.	N/A	N/A	N/A
Administrative and Procedural	Vessels comply with EPBC Regulations 2000 Part 8, Division 8.1 Interacting with Cetaceans.	Yes	The EPBC Regulations 2000 – Part 8 Division 8.1 (Regulations 8.05 and 8.06) is recognised as the industry standard procedure for minimising disturbance due to physical presence and noise to whales and dolphins and will be applied to other species as relevant (i.e. turtles and whale sharks).	3.2	Vessel interactions with EPBC listed species to follow the EPBC Regulations 2000 – Part 8 Division 8.1 (Regulations 8.05 and 8.06). In particular: • Vessels will not deliberately approach closer than 50 m to a dolphin, turtle or whale shark; 100 m for an adult whale; 300 m for a whale calf; and 150 m for a dolphin calf. • If the whale, dolphin, turtle, or whale shark shows signs of being distressed, vessels will immediately withdraw from the caution zone at a constant speed of ≤6 knots (except in emergency conditions or when manoeuvring is not possible).	Induction records confirm that EPS 3.2 requirements are communicated to all vessel masters prior to mobilisation. Recorded marine fauna observations when in the vicinity of whales, dolphins, turtles and whale sharks demonstrate adherence to EPS 3.2 requirements. Incident report form used to record breaches of requirements outlined in the EPBC Regulations 2000.
Administrative and Procedural	Vessels shall not operate within 1 km of named Shoals adjacent to the Activity Area.	Yes	The Conservation advice for *Aipysurus fuscus* (dusky sea snake) (DCCEEW 2024h) lists constant marine noise from marine vessels as a threat to the dusky sea snake. The associated conservation action lists the development and implementation of minimal noise operating guidelines for vessels operating in waters where the dusky sea snake is known or likely to occur. Consistent with the Conservation Advice, their preferred habitat is reefs and shoals which do not occur within the Activity Area. Shoals adjacent to the Activity Area may support dusky sea snakes. This control is also consistent with a key management control outlined in the Crux OPP, to exclude vessels operating over any named shoals adjacent to the Activity Area.	2.3	Refer to EPS 2.3.	Refer to EPS 2.3.
Administrative and Procedural	Verification of noise levels through underwater noise monitoring.	No	Monitoring of underwater noise levels requires the use of vessels and deployment/recovery of specialist equipment, with associated costs and safety and environment risks, including additional emissions and spill risk. The Noise Assessment Area does not overlap any whale (or other noise-sensitive fauna) species BIA and activity-specific noise modelling indicates the risk of impacts is low. The proposed control measure will not, in itself, reduce impacts and the costs/risks are disproportionate to any potential benefit.	N/A	N/A	N/A

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
ALARP Demonstration Statement						
Based on the impact assessment outcomes and control measures adopted, Shell considers implementing the control measures appropriate to manage the potential impacts associated with activity noise emissions. No additional, alternative, or improved controls were identified that could further reduce the impacts—beyond negligible environmental benefits if any—without disproportionate effort and cost. Therefore, the impacts are considered to be reduced to ALARP.						

9.5.5 Acceptability of Impacts

Table 9-30: Acceptability of Impacts – Noise

Receptor		Acceptable Level of Impact	Acceptable?	Acceptability Assessment
Category	**Subcategory**			
Physical features, values and sensitivities	Underwater noise	No increase in underwater noise that will have a substantial adverse effect on a population of a marine species or cetacean including its lifecycle and spatial distribution.	Yes	Increases in ambient underwater noise levels will be localised and/or temporary, involving a small fraction of similar habitat in the region. There will be minimal adverse effects on any population of marine species, including cetaceans.
Natural features, values and sensitivities	Marine bioregions	No significant impacts to benthic habitats and communities. Impacts to non-sensitive benthic communities limited to a maximum of 5% of the Project Area (as defined in the OPP). No significant adverse effect on pelagic communities, populations, habitats, or spatial distribution of a species.	Yes	Experience elsewhere indicates the operating platform structure is likely to be colonised by encrusting biogrowth. Soft sediment benthic communities within areas potentially exposed to activity noise are broadly distributed in the wider region and are not considered to be unique or highly sensitive. It is considered that there is not a credible risk of underwater noise resulting in significant impacts to benthic communities within the Noise Assessment Area. Modelling indicates activity noise will have only localised and/or temporary affects on pelagic communities and plankton within the bioregion, with minor impact consequences.
	Threatened, migratory, marine and cetacean species	Management of aspects of the activity must align with Conservation Advice, recovery plans and threat abatement plans. No significant impacts to EPBC Act listed threatened, migratory, marine or cetacean species.	Yes	PTS in cetaceans or marine reptiles is not considered credible. Potential for TTS in LF cetaceans or marine reptiles would require animals to remain within hundreds of metres of operating vessels for an extended period; avoidance behaviours or a lack of preferred habitat with the Activity Area are expected to make this unlikely. Given the absence of aggregations or BIAs within areas where behavioural effects may occur, noise levels emitted from the activity have been assessed as potentially able to cause only a minor impact to marine mammals and turtles. No EPBC Act listed sharks and rays (including whale sharks) predicted to be exposed to underwater noise exceeding mortality or injury exposure thresholds. The relevant TTS criteria for fish is limited to within a 200 m radius of multiple, simultaneous vessel operations, which would be infrequent and temporary. Potential for masking vocalisation and changes to behaviour is temporary and localised, and not expected to have significant impacts on any species.

Receptor		Acceptable Level of Impact	Acceptable?	Acceptability Assessment
Category	**Subcategory**			
				Assessment of impacts and management requirements of relevant Conservation Advice, recovery plans and threat abatement plans and showed no misalignment. No significant impacts predicted to threatened, migratory, marine and cetacean species.

The assessment of impacts from underwater noise determined the worst-case residual ranking of Minor or lower (Table 9-28). The acceptability of the potential impacts from noise associated with the activity have been considered in the following context.

Principles of ESD

The potential impacts from underwater noise emissions are consistent with the principles of ESD because:

- The underwater noise emissions aspect does not degrade the biological diversity or ecological integrity of the Commonwealth Marine Area and significant impacts to MNES are not anticipated to occur.
- The precautionary principle has been applied, and the most recent scientific literature and international guidelines on noise impacts (Popper et al. 2014; NOAA 2024; NMFS 2024; Southall et al. 2019; Accomando et al. 2025) have been reviewed and referenced to ensure the latest research and knowledge was taken into account when evaluating environmental impacts.

Relevant Requirements

Managing the potential impacts from underwater noise emissions is consistent with relevant legislative requirements, including:

- Noise impact assessments are guided by the latest scientific research in defining impact thresholds.
- Policies, strategies, guidelines and Conservation Advice (see Table 9-31).
- Vessel interactions with cetaceans will follow the EPBC Regulations 2000 – Part 8 Division 8.1 (Regulations 8.05 and 8.06) and the Australian National Guidelines for Whale and Dolphin Watching 2017 (DoEE 2017), with additional requirements applied for turtles and whale sharks, including:
  - vessels will not deliberately approach closer than 50 m to a dolphin, turtle or whale shark; 100 m for an adult whale; 300 m for a whale calf; and 150 m for a dolphin calf.
  - if the whale, dolphin, turtle or whale shark shows signs of being distressed, the vessel will immediately withdraw from the caution zone at a constant speed of ≤6 knots.

Matters of National Environmental Significance

Threatened and Migratory Species

The evaluation of noise impacts indicates that no credible significant impacts to threatened and migratory species is predicted to result from underwater noise emissions during the activity. Table 9-31 summarises the alignment with management plans, recovery plans and Conservation Advice for threatened and migratory fauna.

Commonwealth Marine Environment

Any potential impact from the noise emissions of the activity on the Commonwealth marine environment are predicted to not exceed any of the significant impact criteria listed in Table 9-31; as such, it is considered that the aspect does not pose a credible risk to the Commonwealth marine environment.

Table 9-31: Summary of Alignment with Relevant MNES Considerations

MNES	MNES Acceptability Considerations	Demonstration of Alignment as Relevant to the Project
Threatened and Migratory Species – Marine Mammals	Significant impact guidelines for critically endangered, endangered, vulnerable and migratory species (Table 8-1).	The evaluation of environmental impacts indicates that potential impacts from noise emissions on threatened or migratory marine mammals are predicted to be Minor and would not constitute a significant impact. As such, the petroleum activities do not exceed any of the significant impact criteria for threatened and migratory marine mammal species, as listed in Table 8-1.
	Approved Conservation Advice *Balaenoptera borealis* (sei whale) (DoE 2015c)	Vessel interactions with threatened and migratory species will follow the EPBC Regulations 2000 – Part 8 Division 8.1 (Regulations 8.05 and 8.06).

MNES	MNES Acceptability Considerations	Demonstration of Alignment as Relevant to the Project
	Conservation Advice on fin whale (*Balaenoptera physalus*) (TSSC 2015b)	A noise assessment consistent with the recommendations of the Technical Guidance for assessing the effects of anthropogenic sound on marine mammal hearing (NMFS 2024) was undertaken.
	Conservation management plan for the blue whale: A recovery plan under the *Environment Protection and Biodiversity Conservation Act 1999* 2015–2025 (CoA 2015a)	
Threatened and Migratory Species – Marine Reptiles	Significant impact guidelines for critically endangered, endangered, vulnerable and migratory species (Table 8-1).	The evaluation of environmental impacts indicates that potential impacts from noise emissions on threatened or migratory marine reptiles are predicted to be slight and would not constitute a significant impact. As such, the petroleum activities do not exceed any of the significant impact criteria for threatened and migratory marine reptile species, as listed in Table 8-1.
	Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA 2017b)	Acute and chronic noise pollution has been identified as a threat in the Recovery Plan for Marine Turtles (CoA 2017b); however, there are no specific actions in the Plan in relation to noise pollution, except a recognised need to conduct additional research on the impacts of noise on turtles. A noise assessment consistent with the sound exposure level guidelines recommendations for marine turtles (McCauley et al. 2000; Finneran et al. 2017, Accomando et al. 2025) was undertaken.
	Conservation Advice for *Aipysurus fuscus* (dusky sea snake) (DCCEEW 2024h)	Excessive marine and constant vessel noise has been identified as a threat in the Conservation Advice for *Aipysurus fuscus* (dusky sea snake) (DCCEEW 2024h). A conservative noise impact assessment was adopted to include potential impacts to dusky sea snake habitat where the species may occur. Sound exposure guidelines for fish with a swim bladder was used as a proxy for the dusky sea snake to evaluate potential impacts from activity noise. Given the distance from the Activity Area to any potential dusky sea snake habitat (~8 km) and the water depth of the Activity Area (~160 m), the presence of and potential impacts to the dusky sea snake from constant vessel noise within the Activity Area is consider minor. However, given vessel may operate outside of the Activity Area (when in transit), Shell has adopted an additional control and performance standard to restrict vessel from operating within 1 km of named shoals (habitat where the dusky sea snake may occur) adjacent to the Activity Area. By further restricting vessels from operating near or transiting over named shoals adjacent to the Activity Area, consistent with the Conservation Advice, any potential impacts associated with constant marine vessel noise are reduced without the need to adopt noise-quieting technology. The assessment of the Conservation Advice for *Aipysurus fuscus* (dusky sea snake) demonstrates that Shell has given regard to the applicable Conservation Advice in accordance with NOPSEMA and DECEEW requirements under the Streamlining

MNES	MNES Acceptability Considerations	Demonstration of Alignment as Relevant to the Project
		Offshore Petroleum Environmental Approvals Program Report 2014[33].
Threatened and Migratory Species – Sharks and Rays	Significant impact guidelines for critically endangered, endangered, vulnerable and migratory species (Table 8-1).	The evaluation of environmental impacts indicates that potential impacts from noise emissions on threatened or migratory sharks and rays are predicted to be Minor and would not constitute a significant impact. As such, the petroleum activities do not exceed any of the significant impact criteria for threatened and migratory shark and ray species, as listed in Table 8-1.
	Conservation Advice on whale shark (*Rhincodon typus*) (DoE 2015e)	A noise assessment consistent with the recommendations of the sound exposure guidelines for fishes and marine turtles was undertaken. This considered the potential impacts of underwater noise on whale sharks.
Threatened and Migratory Species – Birds	Significant impact guidelines for critically endangered, endangered, vulnerable and migratory species (Table 8-1).	The evaluation of environmental impacts indicates that potential impacts from noise emissions on threatened or migratory seabird/ shorebirds are predicted to be slight and would not constitute a significant impact. As such, the petroleum activities do not exceed any of the significant impact criteria for threatened and migratory bird species, as listed in Table 8-1.
	Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (CoA 2017c)	
Commonwealth Marine Environment	Significant Impact Guidelines for the Commonwealth marine environment (Table 8-1)	The evaluation of environmental impacts indicates that any impacts from noise emissions aspect of Crux installation activities are predicted to not exceed the Commonwealth marine environment significant impact criteria, as listed in Table 8-1; as such, it is considered that the aspect does not pose a credible risk to the Commonwealth marine environment.

External Context

To date, no objections or claims about underwater noise have been raised by Relevant Persons. Shell's ongoing consultation program will consider feedback and claims or objections made by relevant persons throughout the life of this EP (see Section 5.13). Where new impacts or risks are established, these will be subject to the MOC process described in Section 10.3.5.

Internal Context

Shell also considered the internal context, including Shell's environmental policy and ESHIA requirements. The EPOs and the controls that will be implemented for the activity are consistent with the outcomes from consultation for the petroleum activity and Shell's internal requirements.

Acceptability Summary

The assessment of impacts and risks from noise determined the residual impact rankings were minor (Table 9-28). The acceptability of impacts from underwater noise have been considered in the context of:

- the established acceptability criteria.
- ESD.
- relevant requirements.
- MNES.

[33] www.dcceew.gov.au/sites/default/files/env/pages/06872cd4-b755-4ecf-a4e7-dd16145e1384/files/offshore-program-report.pdf

- external context (i.e. stakeholder claims).
- internal context (i.e. Shell requirements).

Shell considers residual impacts from noise of Minor or lower to be acceptable if they meet legislative and Shell requirements. The discussion above demonstrates that these requirements have been met in relation to noise. Shell considers the potential impacts from activity noise to be ALARP and acceptable.

9.5.6 Environmental Performance Outcome

EPO #	EPO	Measurement Criteria
2.2	Refer to EPO 2.2.	Refer to EPO 2.2.

9.6 Seabed Disturbance

9.6.1 Aspect Context

Seabed disturbance can alter habitat conditions, resulting in changes to epifauna and infauna (living on and in the sediment) communities (Newell et al. 1998). The seabed within the Activity Area is characterised by unconsolidated substrates (sand, gravel, mud etc.) interspersed with patches of hard substrate, which provide attachment points for sponges and molluscs. This habitat is widespread throughout the region and is not particularly unique or sensitive.

Seabed disturbance may be caused by the following activities:

- subsea maintenance and repair activities (including pipeline span rectification).
- temporary placement of structures on the seabed.

These activities are infrequent and at worst will result in a localised, temporary disturbance. Where the pipeline traverses' areas of soft sediments, scouring or deposition of sediments may also affect immediately adjacent areas of the seabed. Other activities and unplanned events that may result in seabed disturbance are discussed in Sections 9.13 and 9.14.

9.6.2 Description and Evaluation of Impacts

Table 9-32 identifies the environmental features and values and sensitivities potentially affected by the localised seabed disturbance that may result from the activities covered by this EP, with further evaluation of the impacts and/or risks to each potentially affected receptor category (including cumulative impacts) provided in Sections 9.6.2.1 to 9.6.2.6. Features or values and sensitivities which could not be credibly affected by seabed disturbance are not discussed further.

Table 9-32: Seabed Disturbance Receptor Impact Screening Summary

| | Protected Areas | | | Features | | | | | | | | | | | | | | | Values and Sensitivities | | | | | | | | | | | | | | |

9.6.2.1 Physical Values and Sensitivities

9.6.2.1.1 Water Quality

Subsea maintenance and repair activities may cause a localised increase in turbidity due to the resuspension of sediment and unconsolidated material. Sediment plumes from these activities will only slightly and temporarily decrease water quality.

9.6.2.1.2 Sediment Quality

Any seabed disturbance associated with temporary placement of equipment/materials will be within the Activity Area and limited to a very localised contact footprint on the seabed.

The overall residual impact consequence level to water and sediment quality is ranked as Slight (Magnitude: −1, Sensitivity: L).

9.6.2.2 Natural Features, Values and Sensitivities

9.6.2.2.1 Timor Province Bioregion

Sediment coating resulting from elevated turbidity/total suspended solids (TSS) can potentially cause clogging or damage to the physiological functioning of biota such as sea pens and polychaetes that rely on external respiratory and feeding structures. ROV disturbance will be the main cause of turbidity increase during operations, but will be a temporary and short duration activity causing very localised disturbance. Soft sedimentary communities are known to recover rapidly from temporary disturbance. The water depths in the Activity Area, and the highly localised nature of turbidity likely to be generated by activities associated with Crux operations, means that detrimental effects on mobile fauna, including demersal and pelagic fish, are not credible.

Given the widespread extent of similar habitat, the very low proportion potentially affected within the Activity Area, and the high likelihood that temporarily affected areas will recover rapidly, environmental effects will be of minimal ecological significance (Magnitude: −1, Sensitivity: L).

9.6.2.2.2 BIAs

The Crux platform and wells, and section of the pipeline (~41 km) fall within the ‘low density foraging’ BIA for whale sharks, which extends up the entire northwest coast of WA (Figure 7-20). This BIA relates to use of the water column by whale sharks, which generally remain nearer the sea surface than the near-bottom areas which may experience temporary increases in turbidity as a result of seabed disturbance. Given the nature and scale of potential effects to this BIA, no impacts to its value for whale sharks are anticipated (Magnitude: 0, Sensitivity: L).

9.6.2.2.3 KEFs

IMR activities may occur along a small section (~7 km) of the export pipeline falls within the Continental slope demersal fish communities KEF (see Figure 7-9). Disturbance to the seabed associated with IMR activities has the potential to affect the benthic bacterial and fauna communities that are thought to underpin the food web that supports the demersal fish (and other higher order) communities on the slope.

Given the small proportion of the Activity Area within the KEF, the relatively infrequent and low level of seabed disturbance associated with IMR activities and the high rate of recovery likely from localised, temporary disturbance, little or no negative impacts on the key values of the KEF are expected (Magnitude: −1, Sensitivity: M).

9.6.2.2.4 Threatened, Migratory, Marine and Cetacean Species

Habitat modification is identified as a potential threat to several marine fauna species in relevant recovery plans and Conservation Advice (Table 7-16). Table 7-10 lists the EPBC Act listed sharks and other fish that may occur within the Activity Area.

A whale shark foraging BIA overlaps the Activity Area; however, feeding patterns are unlikely to be affected by seabed disturbance. Due to the highly mobile nature and wide representation of these sharks and other fish as well as the limited seabed disturbance associated with the activity, it is considered unlikely that these species will be adversely impacted.

Table 7-10 lists the EPBC Act listed marine reptiles that may occur within the Activity Area. The Activity Area does not contain suitable turtle foraging or sea snake habitat (no submerged features and water depths are >95 m). Therefore, seabed disturbance within the Activity Area is considered unlikely to affect marine reptiles.

Direct disturbance to the seabed represents a negligible portion of the habitat available for EPBC Act listed species. As there is no significant benthic habitat and communities to be impacted; a reduction in food sources and thus disruption to threatened, migratory, marine and cetacean species is not anticipated (Magnitude: 0, Sensitivity: L).

9.6.2.3 Socioeconomic Features

9.6.2.3.1 Fishing Industry

The Activity Area intersects the authorised fishing zones (management areas) for several commercial fisheries. However, the proportion of any these management areas potentially affected by the highly localised and generally temporary nature of seabed disturbance associated with project activities is negligible (Magnitude: 0, Sensitivity: L).

9.6.2.4 Socioeconomic Values and Sensitivities

9.6.2.4.1 Fishing Industry

Potential impacts to the seabed, and subsequently to the associated commercially targeted fish resources—such as scampi—will be localised and the potential impact to, and displacement of, fish is expected to be insignificant at a stock level. Therefore, it is unlikely there will be any impacts (Magnitude: 0, Sensitivity: L) to commercial fisheries in the Activity Area from seabed disturbance, given the scale of the fisheries and the size of the Activity Area (see Figure 7- to Figure 7-Figure 7-34: Indigenous Protected Areas).

9.6.2.5 Heritage and Cultural Features

There are no known heritage or cultural features identified during relevant persons consultation within the Activity Area. If any are identified during ongoing consultations, the changes will be reviewed and any changes required to the EP are to be assessed and documented in accordance with the MOC process (see Section 10.3.5). The highly localised potential area affected by seabed disturbance will not overlap with any areas outside the Activity Area known to contain heritage or cultural features (Magnitude: 0, Sensitivity: L).

9.6.2.6 Heritage and Cultural Values and Sensitivities

There are no known heritage or cultural values known within the Activity Area or identified during relevant persons consultation. Cosmos Archaeology (2023) predicted that the activity will not impact any tangible First Nations UCH as the infrastructure locations are located below 130 m LAT which is the maximum extent of exposed land since humans have occupied the continent. The highly localised potential area affected by seabed disturbance means there will be no impacts (Magnitude: 0, Sensitivity: L) to heritage or cultural values from seabed disturbance.

9.6.2.7 Cumulative Impacts

When considering the absence of benthic-related BIAs and significant regional habitats within or near the Activity Area, and the limited potential extent and duration of seabed disturbance associated with IMR activities, additive and cumulative seabed disturbance effects are considered to be of minimal ecological significance and hence do not alter the assessed overall consequence level.

9.6.3 Impact Assessment Summary

Table 9-33 lists the highest residual impact consequence ranking of the relevant environmental receptor groups.

Table 9-33: Seabed Disturbance Evaluation of Residual Impacts

Environmental Receptor	Magnitude	Sensitivity	Residual Impact Consequence
Evaluation – Planned Impacts			
Protected Areas	N/A	N/A	N/A
Physical Features	N/A	N/A	N/A
Physical Values and Sensitivities	−1	L	Slight
Natural Features	−1	L	Slight
Natural Values and Sensitivities	−1	L	Slight
Socioeconomic Features	0	L	No Impact
Socioeconomic Values and Sensitivities	0	L	No Impact
Heritage and Cultural Features	0	L	No Impact
Heritage and Cultural Values and Sensitivities	0	L	No Impact

9.6.4 ALARP Assessment and Environmental Performance Standards

Table 9-34: ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
ALARP Assessment						
Elimination	Prohibit vessels from anchoring in the Activity Area except in emergency events.	Yes	The procedural measure of prohibiting vessel anchoring for the activity assists in reducing seabed disturbance to ALARP.	4.1	No vessel anchoring associated with the activities, except in emergency events.	Vessel logs confirm no vessels used anchors within the Activity Area or adjacent named Shoals.
Substitution	N/A	N/A	Substitution of seabed disturbance is not technically feasible.	N/A	N/A	N/A
Engineering	Do not use an ROV close to or on the seabed.	No	ROV operations close to or on the seabed are considered ALARP due to the water depths of the Activity Area and hence cannot be eliminated. Given the nature of the seabed, proximity of the pipeline to the seabed, disturbance from ROV operations will be negligible and implementing this control is considered technically unfeasible.	N/A	N/A	N/A
Administrative and Procedural	Lifting procedures and maintenance, including inspection of lifting equipment.	Yes	Lifting, maintenance and inspection procedures are implemented for all lifting operations on the Crux platform and vessels. Shell Australia has Lifting and Hoisting Standards (OPS_PRE_010176) and (OPS_GEN_010724) which are mandatory for all lifting operations on the Crux facility. The standards specify lifting requirements, performance standards and roles and responsibilities to reduce the risk of dropped objects impacting the seabed and sea infrastructure potentially resulting in damage or a loss of containment of hydrocarbons.	4.2	Lifting procedures include controls, as appropriate, to reduce the risk of dropped objects entering the marine environment: • lifting requirements • performance standards • defined roles and responsibilities.	The lifting procedures align with EPS 4.2 requirements. Incident reports demonstrate no incidents of spills or release of equipment, materials or waste to the ocean from lifting activities.
Administrative and Procedural Controls	Remove all structures, equipment and property that are no longer in use.	Yes	All structures, equipment and property will be designed and removed, if no longer required, in accordance with Section 572 of the OPGGS Act and aligned to Section 572: Maintenance and Removal of Property Policy (NOPSEMA 2022d). Implementing this control is a regulatory requirement and considered reduce the risks to ALARP. As detailed in section 6.11.5, throughout all activity phases, when equipment is replaced, an assessment of the redundant equipment will be undertaken to assess the feasibility and risks associated with removal. Where removal is deemed to pose an unacceptable risk to existing operational infrastructure, redundant infrastructure items may be left in-situ. Subsea items are recorded as part of the ROV as left survey and included in the asset register. The asset register is used to track equipment to enable planning for future removal consistent with section 10.4.7.1 and 10.4.12. Any redundant equipment left in-situ will be maintained in the asset register. These procedural, system, equipment and people control measures assist in Shell aligning to Section 572 of the OPGGS Act.	4.3	All temporary structures, equipment and property will be designed to be retrievable and removed if no longer required. Should Crux activities beyond the scope of this EP require the temporary structures, equipment or property will be recorded in an asset register to facilitate future removal.	Records demonstrate that temporary structures, equipment and property are removed if no longer required or logged within an asset register.
				4.4	Throughout all activity phases, when subsea equipment is replaced, an assessment of the redundant equipment will be undertaken to assess the feasibility and risks associated with removal. Where removal is deemed to pose an unacceptable risk to existing operational infrastructure, redundant subsea infrastructure items may be left in-situ.	Equipment recorded as part of the ROV as left survey and included in the asset register. The asset register is used to track equipment on the seabed to enable planning for future removal. Any redundant equipment left in-situ will be maintained in the asset register.
Administrative and Procedural	Underwater heritage chance find process.	Yes	In the event of a chance find, a designed process will be implemented to mitigate damage and protect potential heritage artefacts and sites. For example, if ad hoc evidence, such as ROV footage, might represent a potential cultural heritage artifact, seabed disturbance works will be stopped until a cultural heritage expert can confirm if the identified object is not a cultural heritage artifact. In the event the object is confirmed to be a cultural heritage artifact, works will be stopped within an appropriate exclusion area until such point that relevant approvals are obtained from DCCEEW under the UCH Act. If the object is confirmed not to be, or likely not to be, a cultural heritage artifact, works may resume. The benefit outweighs the cost associated with implementing this control. Shell's underwater heritage chance find process control measure, involving procedural, equipment and people components, will be implemented to reduce impacts to potential heritage	4.5	No interference[34] to underwater heritage to underwater or coastal cultural heritage without a relevant approval.	Underwater heritage chance find process. Underwater heritage chance find process training records of ROV operators. ROV operators logs demonstrate implementation of Underwater heritage chance find process as relevant to the scope. Relevant approvals records where required.

[34] "interference" — which includes actions such as removing, damaging, disturbing, or destroying underwater cultural heritage as defined in the Underwater Cultural Heritage Act 2018 or other heritage as defined in relevant Aboriginal or Maritime Heritage Acts.

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
			and cultural features and values to ALARP. This process will include stop work triggers and notification processes.			
ALARP Demonstration Statement						
Based on the impact assessment outcomes and control measures adopted, Shell considers implementing the control measures appropriate to manage the potential impacts associated with activity seabed disturbance. There are no feasible additional controls identified that could further reduce the impacts. Therefore, the impacts are reduced to ALARP.						

9.6.5 Acceptability of Impact

Table 9-35: Acceptability of Impact – Seabed Disturbance

Receptor		Acceptable Level of Impact	Acceptable?	Acceptability Assessment
Category	**Subcategory**			
Physical features, values and sensitivities	Water quality	No significant impacts to water quality. Impact not expected to result in a substantial change in water quality, which may adversely impact biodiversity, ecological integrity[26], social amenity or human health.	Yes	Seabed disturbance will be small scale, localised, infrequent and a small fraction of similar habitat in the region. Rapid recovery is expected. There will be minimal impact to water and sediment quality.
	Sediment quality	No significant impacts to sediment quality. Impact not expected to result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity[26], social amenity or human health may be adversely affected.	Yes	
Natural features, values and sensitivities	Marine bioregions	No significant impacts to benthic habitats and communities. Impacts to non-sensitive benthic communities limited to a maximum of 5% of the Project Area (as defined in the OPP). No significant adverse impact on demersal or pelagic communities, populations, habitats or spatial distribution of a species. No substantial adverse effect on a population of a marine species or cetacean including its lifecycle and spatial distribution.	Yes	The seabed in the Activity Area is broadly distributed and not considered unique or particularly sensitive. There will be minimal impact to benthic habitats and communities and a reduction in food sources is not anticipated. Therefore, negligible impacts to demersal and pelagic species from seabed disturbance are expected.

Principles of ESD

The potential impacts from seabed disturbance are consistent with the principles of ESD because:

- Seabed disturbance on such a small scale will not degrade the biological diversity or ecological integrity of the Commonwealth marine environment and therefore significant impacts to MNES will not occur.
- The health, diversity and productivity of the marine environment will be maintained for future generations.
- The precautionary principle has been applied, and studies were undertaken where knowledge gaps were identified. This knowledge was applied when evaluating environmental impacts.

Relevant Requirements

Managing the potential impacts from seabed disturbance is consistent with relevant legislative and other relevant requirements, including;

- OPGGS Act:
  - Section 460(2) – a person carrying on activities in an offshore area under the permit must carry out those activities in a manner that does not interfere with the conservation of the resources of the sea and seabed to a greater extent than is necessary for the reasonable exercise of the rights and performance of the duties of the first person.
  - Section 572 of the OPGGS Act and Section 572: Maintenance and removal of property policy (NOPSEMA 2022d) – places duties on titleholders in relation to maintaining and removing the structures, equipment and property brought onto the title.
- guidelines for the protection of MNES (Table 8-1).
- industry best practice.

Matters of National Environmental Significance

Seabed disturbance will not have a significant impact on MNES.

External Context

To date, no objections or claims about seabed disturbance have been raised by relevant persons. Shell's ongoing consultation program will consider feedback and claims or objections made by Relevant Persons throughout the life of this EP (see Section 5.13). Where new impacts or risks are established, these will be subject to the MOC process described in Section 10.3.5.

Internal Context

Shell also considered the internal context, including Shell's environmental policy and ESHIA requirements. The EPOs and the controls that will be implemented for the activity are consistent with the outcomes from consultation for the petroleum activity and Shell's internal requirements.

Acceptability Summary

The assessment of impacts and risks from seabed disturbance determined the residual impact rankings were Slight (Table 9-33). The acceptability of impacts from seabed disturbance have been considered in the context of:

- the established acceptability criteria.
- ESD.
- relevant requirements.
- MNES.
- external context (i.e. stakeholder claims).
- internal context (i.e. Shell requirements).

Shell considers residual impacts of Minor or lower to be acceptable if they meet legislative and Shell requirements. The discussion above demonstrates that these requirements have been met in relation to seabed disturbance.

Shell considers impacts from seabed disturbance to be ALARP and acceptable.

9.6.6 Environmental Performance Outcome

Table 9-36: Environmental Performance Outcomes and Measurement Criteria

EPO #	EPO	Measurement Criteria
4.1	No planned impacts to cultural heritage features within the Activity Area as a result of the petroleum activities.	Underwater heritage chance find process implementation records.
4.2	Direct impacts to benthic habitats from the Crux infrastructure installation and subsea maintenance activities will be limited to <25 hectares of the total Project Area.	Report(s) confirm ongoing subsea activities and the Crux infrastructure does not exceed a total direct disturbance footprint of <25 hectares.
4.3	No incidents of spills or the release of equipment, materials or waste to the ocean from the activity.	Incident reports demonstrate no incidents of spills or the release of equipment, materials or waste to the ocean from the activity.

9.7 Vessel Movements

9.7.1 Aspect Context

A range of vessel types will be needed to carry out the activity (see Section 6.12.2). The type and number of vessels within the Activity Area at any one time, and how long they will be present, will differ depending on the work being undertaken. Typically, vessels will either be periodically transiting to/from the Crux platform, temporarily stationary at/near the platform, or moving at low speed at subsea infrastructure locations during IMR activities, including along the export pipeline, for short periods.

The physical presence and movement of vessels within the Activity Area presents a hazard to marine fauna that dwell at or near the sea surface, including threatened or migratory mammals, turtles and whale sharks; however, the abundance of such fauna in and around the Activity Area has been observed to be low. The distance of the activity from the nearest areas that support seabird or shorebird roosting or nesting means there is no credible potential for disturbance due to vessel movements. Vessels may collide with marine fauna, potentially resulting in injury or death. Factors influencing the likelihood and severity of impacts from collisions include vessel type, vessel speed, water depth, the time of year and the behaviours of animals present (CoA 2017).

The potential environmental impacts associated with the risk of collisions with other vessels are assessed in Section 9.14.

9.7.2 Description and Evaluation of Risks

Table 9-37 indicates the environmental features and values and sensitivities that have been identified to be potentially affected by vessel movements during the activities covered by this EP, with further evaluation of the impacts and/or risks to each potentially affected receptor category provided in Section 9.7.2.10. Features or values and sensitivities which could not be credibly affected are not discussed further. As outlined in Section 9.2.4, the assessment considers only the residual risks following the application of controls.

Table 9-37: Vessel Movements Receptor Impact Screening Summary

	Protected Areas			Features															Values and Sensitivities																							
				Physical		Natural				Socioeconomic								Heritage and Cultural			Physical				Natural							Socioeconomic							Heritage and Cultural		
Receptor	Marine Conservation Reserves	Wetlands of International and National Importance	Commonwealth and National Heritage Places	Marine Regions	Australian Environment	Northwest Shelf Province Bioregion	Northwest Shelf Transition Bioregion	Northwest Transition Bioregion	Timor Province Bioregion	People and Communities	Fishing Industry	Tourism and Recreation	Defence	Shipping	Scientific Research/Restoration	Oil and Gas Industry	Indonesian and Timor-Leste Coastlines	Underwater Cultural Heritage	Traditional Indonesian Fishing	Indigenous Cultural Connections	Air Quality	Water Quality	Sediment Quality	Underwater Noise	BIAs	Critical Habitat	Shoals and Banks	Offshore Reefs and Islands	Coastal Reefs and Islands	KEFs	Threatened, Migratory, Marine and Cetacean Species	Fishing Industry	Tourism and Recreation	Defence	Shipping	Scientific Research/Restoration	Oil and Gas Industry	Indonesian and Timor-Leste Coastlines	Underwater Cultural Heritage	Traditional Indonesian Fishing	Indigenous Cultural Heritage
Aspect																														×											

Legend:		
		Potentially affected
	×	Predicted impact

9.7.2.1 Natural Features, Values and Sensitivities

9.7.2.1.1 Timor Province Bioregion

Vessel movements can result in collisions between the vessel (hull and propellers) and pelagic marine fauna, potentially resulting in superficial injury, serious injury that may affect life functions (e.g. movement, reproduction), or death. Smaller marine fauna are also at risk of injury or death if caught in thrusters used for DP during station keeping operations, and/or via entrapment in vessel water intakes.

There are no aggregation sites for marine fauna within the Activity Area and the pelagic species that may be affected by vessel movements have widespread distributions in the bioregion. The number of individuals of any marine fauna species that may be affected is low, representing a negligible proportion of its regional population and therefore no impacts on pelagic (or any) communities within the region are anticipated.

9.7.2.1.2 Threatened, Migratory, Marine and Cetacean Species

The Activity Area does not contain and is not near any aggregation sites for threatened or migratory species. The abundance of threatened or migratory species in the Activity Area is expected to be low and their presence transient.

In the event of vessel/fauna collision, the severity of injury is influenced by vessel speed—the greater the speed on collision, the greater the risk of death (Jensen and Silber 2004; Laist et al. 2001). Vessels shall not exceed 10 knots when operating within the Activity Area during the whale shark migration period. Vessels at/near the platform or undertaking IMR activities will generally be stationary or very slow moving (<8 knots), reducing both the risk of collision and the impact if collision occurs. The risk of megafauna getting caught in operating thrusters or water intakes is considered to be very low, given the size of individuals, combined with their likely avoidance of DP operations due to factors such as noise emissions. Therefore, the risk of adverse impact through fauna collision during vessel movements relates primarily to vessels transiting to/from the platform.

Given the low density of EPBC Act listed species within the Activity Area, the relatively small area within which collisions could occur and the generally low number of vessel movements associated with the activity, the worst-case consequences are considered to be Minor.

Marine Mammals

There are no BIAs for marine mammals within the Activity Area and the numbers of any species of pinnipeds or cetaceans that may coincide with the presence of a transiting vessel are expected to be very low. Of the species that may occur, whales are expected to be the most vulnerable to collisions with vessels due to their large size and the relatively high proportion of time they spend at or near the sea surface. The likelihood and consequence of vessel collisions with whales are influenced by both vessel size and speed; the greater the speed at impact, the greater the risk of mortality (Jensen and Silber 2004; Laist et al. 2001). Vanderlaan and Taggart (2007) found that the chance of lethal injury to a large whale as a result of a vessel strike increases from 20% at 8.6 knots to 80% at 15 knots. According to the data of Vanderlaan and Taggart (2007), it is estimated that the risk is less than 10% at a speed of 4 knots. Although dolphins are at much lower risk from collision due to their small size, manoeuvrability and echolocation abilities compared to whales, they are still included in this assessment given they surface to breathe and are known to feed near the surface at times.

Vessels will be required to comply with the EPBC Regulations 2000 (Part 8) within all of the Activity Area, including not exceeding 6 knots if/where a whale is observed in proximity to the vessel. They will generally be travelling at low speeds (<8 knots) in the vicinity of infrastructure and vessels supporting routine visits to the platform will typically be less than 80 m length.

Given the relatively low frequency of vessel movements that may involve elevated speeds or large vessels, and the low inherent probability of a marine mammal occurring near the surface within a transiting vessels route (and draught), the likelihood of collisions causing injury or death of an individual marine mammal and resulting in Minor consequences to threatened or migratory species is considered to be Unlikely (C).

Marine Reptiles

The Activity Area does not represent important habitat for marine turtles, being distant from emergent land with water depths (~90–260 m) that are deeper than typical foraging dives by marine turtles (e.g. Hays et al. 2001; Polovina et al. 2003) or sea snakes given the absence of shallow reefs or shoals. Therefore, the presence of marine reptiles within the Activity Area is likely to be restricted to relatively low numbers of

individuals transiting the area. The risk of collisions between turtles and vessels increases with vessel speed (Hazel et al. 2007). The typical response from turtles on the surface to the presence (including noise) of vessels is to dive (a potential 'startle' response), which decreases the risk of collisions (Hazel et al. 2007). Given the speed restrictions on vessels operating in the Activity Area, combined with the expected low numbers of turtles and sea snakes in the area, the likelihood of collisions between vessels resulting in Minor consequences is assessed as Unlikely (C).

Sharks and Rays

Whale sharks are the only species of fish or elasmobranchs (sharks and rays) with a BIA that overlaps the Activity Area and expected to be the most susceptible to vessel strikes due to their tendency to spend time near the surface, particularly when feeding (Womersley et al. 2022). The probability of collision impacts to other populations of threatened or migratory sharks and rays that may occur in the Activity Area is considered very low given their generally high mobility, behaviour patterns and the absence of habitat features that might support substantive numbers of any species.

Whale sharks are at greatest risk of mortality from vessel strikes through interactions with fast moving, large vessels (>300 t) with smaller and/or slower moving vessels more likely to result in survivable injuries (Womersley et al. 2022). The Conservation Advice for the whale shark (DoE 2015e) also lists large vessel strikes as a threat, although the Species Profile and Threats Database for this species (DoE 2024a) indicates there are no substantial current threats in Australian waters.

Whale sharks have been observed at low numbers in the Activity Area and are expected to seasonally traverse the area, but are not likely to occur at high densities given the distance from the nearest aggregation areas at Ningaloo and Christmas Island. The Activity Area overlaps with only a very small proportion of the BIA through the region. Although listed as a 'low density foraging' BIA, studies of whale shark movements (e.g. Meekan & Radford 2010) which show continual movement of whale sharks in deeper, open offshore waters suggest the BIA is unlikely to be a dedicated foraging area; rather, it is likely to be a broad area within which migratory movements can be expected. This is consistent with the Conservation Advice (DoE 2015e) for this species, which indicates this BIA up the north-west coast of Australia is a migration corridor rather than significant foraging habitat.

Given the typically low speeds of vessel movements associated with the activity, the temporary and typically infrequent nature of vessel movements, and the low numbers of any threatened or migratory species of shark or rays that might be impacted, the likelihood of Minor impact consequences is considered to be Unlikely (C).

Therefore, overall the residual risk to threatened, migratory, marine and cetacean species from vessel movements is assessed as Dark Blue (Table 9-38).

9.7.3 Risk Assessment Summary

Table 9-38 lists the highest residual risk ranking of the relevant environmental receptor groups.

Table 9-38: Vessel Movement Evaluation of Residual Risk

Environmental Receptor	Consequence	Likelihood	Residual Risk
Evaluation – Unplanned Risks			
Protected Areas	N/A	N/A	N/A
Physical Features	N/A	N/A	N/A
Physical Values and Sensitivities	N/A	N/A	N/A
Natural Features	No Impact	-	**Light Blue**
Natural Values and Sensitivities	Minor	C	**Dark Blue**
Socioeconomic Features	N/A	N/A	N/A
Socioeconomic Values and Sensitivities	N/A	N/A	N/A
Heritage and Cultural Features	N/A	N/A	N/A
Heritage and Cultural Values and Sensitivities	N/A	N/A	N/A

9.7.4 ALARP Assessment and Environmental Performance Standards

Table 9-39: ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
ALARP Assessment						
Elimination	None identified	No	N/A	N/A	N/A	N/A
Substitution	Vessel speed restrictions within the Activity Area.	Yes	Several EPBC Act management publications identify vessel collision as a threat to the marine fauna species, including whale sharks, cetaceans, and turtles. Although vessel movements within the Activity Area are generally at low speeds and are unlikely to result in injury or significant impacts, a conservative management measure will be adopted. Vessels will implement a speed limit of no more than 10 knots year–round within the Activity Area. This speed limit is also consistent with that applied by NOAA as a seasonal management measure to protect whales in areas of high vessel traffic of the eastern seaboard, United States. A study undertaken by Conn and Silber (2013) indicated a significant (>80%) vessel strike and mortality risk reduction for whales associated with the speed restriction of 10 knots introduced by NOAA. The environmental benefits of this procedural and personnel control measure outweigh the cost associated with implementing this control except where vessel Ship Energy Efficiency Management Plan (SEEMP) fuel efficiency measures include recommended speeds for optimal fuel efficiency which exceed this. These typically would not exceed ~12-15 knots for the types of vessels used in these activities. Therefore, for the few vessels which do have SEEMP recommendations which exceed the 10 knots, their speeds will not be significantly over 10 knots (up to ~15 knots), and this will provide the best of both fuel efficiency and reducing risk of collision with marine fauna.	5.1	Vessels shall not exceed 10 knots when operating within the Activity Area, except if it conflicts with a vessel's efficiency measures within the SEEMP.	Vessel logs confirm vessel speeds did not exceed 10 knots when operating within the Activity Area, except where it conflicts with SEEMP (EPS 9.11). Vessel navigation systems or charts have Activity Area boundary including speed limit warning on it.
Engineering	None identified.	N/A	No appropriate control measures have been identified to reduce collision likelihood through engineering means.	N/A	N/A	N/A
Administrative and Procedural	Vessels comply with EPBC Regulations 2000 Part 8, Division 8.1 Interacting with Cetaceans.	Yes	The EPBC Regulations 2000 – Part 8 Division 8.1 (Regulations 8.05 and 8.06) are recognised as the industry standard for minimising disturbance due to physical presence to whales and dolphins and will be applied to other species as relevant (i.e. turtles, whale sharks). Implementing this procedural and personnel control measure, is based on legislative requirements and hence adopted to ensure compliance with legislation.	3.2	Refer to EPS 3.2.	Refer to EPS 3.2.
Administrative and Procedural	Dedicated marine fauna observers on all vessels.	No	The cost to have dedicated trained marine fauna observers on all vessels represents a disproportionate cost given the low environmental risk with existing controls on vessel movements within the Activity Area.	N/A	N/A	N/A
Administrative and Procedural	Vessels shall not operate within 1 km of named Shoals adjacent to the Activity Area.	Yes	Prohibiting vessels from operating within 1 km of named Shoals adjacent to the Activity Area will reduce the risks posed by vessel movements over the Shoals and species which rely on them.	2.3	Refer to EPS 2.3.	Refer to EPS 2.3.
ALARP Demonstration						
Based on the impact assessment outcomes and control measures adopted, Shell considers implementing the control measures appropriate to manage the potential impacts associated with vessel movements. No additional or alternative controls were identified that could further reduce the impacts without disproportionate effort and cost. Therefore, the impacts are considered to be reduced to ALARP.						

9.7.5 Acceptability of Risks

Table 9-40: Acceptability of Risks – Vessel Movements

Receptor		Acceptable Level of Impact	Acceptable?	Acceptability Assessment
Category	**Subcategory**			
Natural features, values and sensitivities	Threatened, migratory, marine and cetacean species.	No mortality or injury of cetaceans. Management of aspects of the activity must align with Conservation Advice, recovery plans and threat abatement plans (Table 7-13). No significant impacts to EPBC Act listed threatened, migratory, marine or cetacean species.	Yes	The assessment of potential impacts to fauna from vessel strike and the controls on vessel movements and speeds, including the reduction in vessel movements as a result of the NNM operations basis for the Crux platform, are considered to be aligned with conservation actions outlined in the relevant Conservation Advice, recovery plans and threat abatement plans, including the whale shark Conservation Advice aim to 'reduce transit times of large vessels in areas along the northward migration route'. With the proposed extension in application of EPBC Regulations 2000 – Part 8 to turtles and whale sharks, and to implement additional (US NOAA) controls during the whale shark migration period, the potential risk of injury or mortality to threatened fauna has been reduced to ALARP and acceptably low levels and no significant impacts to EPBC Act listed species is predicted.

The assessment of risks from vessel movements determined the residual ranking of Dark Blue (Table 8-4), deemed as inherently acceptable. The acceptability of risks to marine biota from vessel movements associated with the petroleum activities has been considered in the following context.

Principles of ESD

The potential risks of impacts from vessel movements are consistent with the principles of ESD because:

- The vessel movements aspect does not degrade the biological diversity or ecological integrity of the Commonwealth Marine Area in the Browse Basin. Significant impacts to MNES are highly unlikely.
- The health, diversity and productivity of the marine environment will be maintained for future generations.
- The precautionary principle has been applied, and studies were undertaken where knowledge gaps were identified. This knowledge was applied when evaluating environmental risks.

Relevant Requirements

Managing the potential risks of impacts from vessel movements is consistent with relevant legislative requirements, including:

- Vessel interactions with cetaceans to follow the EPBC Regulations 2000 – Part 8 Division 8.1 (Regulations 8.05 and 8.06) and the Australian National Guidelines for Whale and Dolphin Watching 2017 (DoEE 2017), with additional requirements applied for turtles and whale sharks, including:
  - Vessels will not deliberately approach closer than 50 m to a dolphin, turtle or whale shark; 100 m for an adult whale; 300 m for a whale calf; and 150 m for a dolphin calf.
  - If the whale, dolphin, turtle or whale shark shows signs of being distressed, vessels will immediately withdraw from the caution zone at a constant speed of ≤6 knots (except in emergency conditions or when manoeuvring is not possible).
- Policies, strategies, guidelines, Conservation Advice, and recovery plans for threatened species (see Table 9-41).

Matters of National Environmental Significance

Threatened and Migratory Species

The evaluation of risks indicates significant impacts to threatened and migratory species will not credibly result from the vessel movements aspect of the petroleum activities.

An unplanned collision between a vessel and threatened or migratory fauna is considered unlikely to occur; however, if it does occur, it may result in injury to or death of an individual animal. This unplanned event is not considered to have the potential for significant impacts to threatened or migratory species at the population level.

Table 9-41 summarises the alignment with management plans, recovery plans and Conservation Advice for threatened and migratory fauna.

Commonwealth Marine Environment

The potential impacts and risks from the vessel movements aspect of petroleum activities on the Commonwealth marine environment will not credibly exceed any of the significant impact criteria, as listed in Table 8-1; as such, it is considered that the aspect does not pose a credible risk to the Commonwealth marine environment.

Table 9-41: Summary of Alignment with Relevant MNES Considerations

MNES	MNES Acceptability Considerations	Demonstration of Alignment
Threatened and Migratory Species – Marine Mammals.	Significant impact guidelines for critically endangered, endangered, vulnerable and migratory species (Table 8-1).	The risk assessment indicates that the likelihood of vessel collisions with threatened or migratory marine mammals is considered unlikely, and the consequence of any such collision would be restricted to an individual animal. As such, the petroleum activities do not exceed any of the significant impact criteria for threatened and migratory marine species, as listed in Table 8-1.
	National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (CoA 2017).	Vessel movements will be aligned to 'Objective 3: mitigation' of the National Strategy by: • maintaining separation of vessels and whales. • maintaining slow vessel speeds. • avoidance manoeuvres. This will be met by the vessels adhering to Part 8 (interacting with cetaceans and whale watching) of the EPBC Regulations. Note: The other objectives of the Strategy relate to actions for government agencies.
	Approved Conservation Advice *Balaenoptera borealis* (sei whale) (DoE 2015c).	The risk of vessel strikes will be managed by adhering to the EPBC Regulations 2000 – Part 8 Division 8.1 (Regulations 8.05 and 8.06).
	Conservation Advice on fin whale (*Balaenoptera physalus*) (TSSC 2015b).	
	Conservation management plan for the blue whale: A recovery plan under the *Environment Protection and Biodiversity Conservation Act 1999* 2015–2025 (CoA 2015a).	
Threatened and Migratory Species – Marine Reptiles	Significant impact guidelines for critically endangered, endangered, vulnerable and migratory species (Table 8-1).	The risk assessment indicates that the likelihood of vessel collisions with threatened or migratory marine reptiles is considered remote, and the consequence of any such collision would be restricted to an individual animal. As such, the petroleum activities do not exceed any of the significant impact criteria for threatened and migratory marine species, as listed in Table 8-1.
	Recovery Plan for Marine Turtles in Australia 2017-2027 (CoA 2017b).	Vessels colliding with turtles is considered unlikely due to the offshore location (and resultant low densities of turtles), slow speeds of the vessels and diving startle response of turtles. Furthermore, the risk of a vessel collision with a turtle will be further reduced by implementing EPBC Regulations 2000 – Part 8 Division 8.1 (Regulations 8.05 and 8.06).
	Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) (TSSC 2008a).	

MNES	MNES Acceptability Considerations	Demonstration of Alignment
Threatened and Migratory Species – Sharks and Rays	Significant impact guidelines for critically endangered, endangered, vulnerable and migratory species (Table 8-1).	The risk assessment indicates that the likelihood of vessel collisions with threatened or migratory sharks and rays is considered remote, and the consequence of any such collision would be restricted to an individual animal. As such, the petroleum activities do not exceed any of the significant impact criteria for threatened and migratory marine species, as listed in Table 8-1.
	Conservation Advice on *Rhincodon typus* (whale shark) (DoE 2015e).	The Activity Area intersects a recognised foraging whale shark BIA. The Conservation Advice recommends minimising offshore developments close to marine features that may aggregate whale sharks and cites Ningaloo Reef and Christmas Island as examples. Studies of whale sharks tagged while aggregating at Ningaloo Reef have shown individuals transiting through the Timor Sea (Meekan and Radford 2010) but showed no evidence of aggregation around particular marine features in the open offshore waters within or near the Activity Area. The NNM basis for platform operations and optimising vessel movements to/from the platform are also consistent with the recommendation of reducing transit time of large vessels in the migration route.
Commonwealth Marine Environment	Significant impact guidelines for the Commonwealth marine environment (Table 8-1).	The impact assessment indicates that any impacts from vessel movements are predicted to not exceed the Commonwealth marine environment significant impact criteria, as listed in Table 8-1; as such, it is considered that the aspect does not pose a credible risk to the Commonwealth marine environment.

External Context

To date, no objections or claims about vessel movements have been raised by relevant persons. Shell's ongoing consultation program will consider statements and claims made by relevant persons when further assessing the risks (see Section 5.13).

Internal Context

Shell also considered the internal context, including Shell's environmental policy and ESHIA requirements. The EPOs, and the controls which will be implemented, are consistent with the outcomes from consultation for the petroleum activities and Shell's internal requirements.

Acceptability Summary

The acceptability of the associated risks from vessel movements have been considered in the context of:

- the established acceptability criteria.
- ESD.
- relevant requirements.
- MNES.
- external context (i.e. stakeholder claims).
- internal context (i.e. Shell requirements).

The residual risks have been assessed as Dark Blue (Minor). Shell considers residual risks of Minor or lower to be acceptable if they meet legislative and Shell requirements. The discussion above demonstrates that these requirements have been met in relation to vessel movements.

Shell considers the risks to marine biota from vessel movements associated with the activity to be ALARP and acceptable.

9.7.6 Environmental Performance Outcome

EPO #	EPO	Measurement Criteria
2.2	Refer to EPO 2.2.	Refer to EPO 2.2.

9.8 Introduction of Invasive Marine Species

9.8.1 Aspect Context

IMS are non-indigenous marine fauna or flora that have been introduced into an area beyond their natural geographical range, and may have the ability to survive, reproduce and establish a population such that they threaten native species through increased competition for resources and/or increased predation.

Vessels and some of the subsea equipment (e.g. ROVs) used during the activity have the potential to introduce or translocate IMS within the Activity Area. There are two primary mechanisms which may cause the inadvertent introduction and spread of IMS; biofouling and ballast water discharges. Successful IMS colonisation requires these stages (Marine Pest Sectoral Committee 2009):

- the potential IMS must be present on (e.g. biofouling) or in (e.g. ballast water) the vector.
- the potential IMS must be released into the environment (e.g. ballast water discharge, release of propagules from biofouling).
- the potential IMS must survive, reproduce (either sexual or vegetative reproduction) and subsequently persist in the environment.

The introduction of IMS is recognised globally as a threat to marine biodiversity, and the IMO has developed guidelines for managing the IMS risk from biofouling and ballast water. Commonwealth, State and Territory authorities also regulate the risk of IMS from biofouling and ballast water. Vessels operating in Australia are required to meet these requirements, and vessels meeting these requirements pose a much lower risk of harbouring IMS or releasing IMS into the environment.

During the activity, operational vessels will transit to and from the Activity Area, primarily associated with visits to the Crux platform. Most of these vessels are expected to be already operating in WA waters but some may have arrived from interstate/territory or international ports. Requirements to discharge ballast water in the Activity Area are expected to be limited. However, all operational vessels are subject to marine fouling whereby organisms attach to the vessel hull, particularly if/when vessels spend time stationary (e.g. in ports) and in areas of the vessel where organisms can readily attach (e.g. seams, strainers, unpainted surfaces, sea chests). If IMS become established in the Activity Area, such as on the Crux platform substructure or Prelude FLNG, vessel movements may subsequently provide vectors for translocation to new areas (NOPSEMA 2024b) or increase the impact of IMS already established in the wider region (Department of Fisheries 2017). The relatively low frequency and volume of vessel traffic associated with ongoing operations, and relatively short periods that vessels will typically be near the substructure or Prelude FLNG, restricts the inherent risk of IMS translocation.

Most native fouling species likely to be encountered within the Activity Area are widely distributed, as similar habitats are broadly represented in the Timor Sea and Browse Basin. An IMS may compete with these native species if it becomes established in the Activity Area or wider region. This may decrease the species diversity of benthic communities. Typically, IMS are extremely difficult to eradicate once established and reproducing in an area.

All known and potential introduced marine pests listed by Australian agencies are nuisance foulers, predators, invasive seaweeds, or noxious dinoflagellates and tend to inhabit ports, harbours, embayments, estuaries, shorelines and shallow coastal waters, although some species can survive in waters up to 200 m deep (Hayes et al. 2004, Barry et al. 2006). The risk of an IMS being able to successfully establish itself will depend on the depth of water, distance from the coast, water movement and latitude. The probability of successful IMS settlement and recruitment decreases in well-mixed, deep ocean waters away from coastal habitats. An IMS travelling through several latitudes also must survive significant temperature and salinity changes. The relatively deep, oligotrophic (nutrient-poor) oceanic waters of the Activity Area and general lack of hard seabed substrates reduces the potential for successful settlement and establishment of any IMS in the unlikely event of being released into the Activity Area.

9.8.2 Description and Evaluation of Impacts and Risks

Table 9-42 indicates the environmental features and values and sensitivities that have been identified to be potentially affected by the introduction of IMS during the activities covered by this EP, with further evaluation of the impacts and/or risks to each potentially affected receptor category provided in Sections 9.8.2.1 to 9.8.2.4. Features or values and sensitivities which could not be credibly affected by IMS are not discussed further.

The consequences for any given receptor of IMS establishing in the marine environment may vary considerably depending on a number of factors, including the characteristics of the IMS involved, the vulnerability of the receptor to impacts from those characteristics, and the interactions. However, in a worst-case the establishment of marine pests may result in significant impacts to the marine environment, potentially causing widespread ecological changes and/or compromising the viability of socio-economic or heritage values associated with environmental resources. Therefore, for the purposes of risk assessment Shell has conservatively assumed that the establishment of IMS in the Activity Area would have potentially Major consequences for all affected receptors.

Table 9-42: Introduction of IMS Receptor Impact Screening Summary

	Protected Areas			Features															Values and Sensitivities																							
				Physical		Natural				Socioeconomic								Heritage and Cultural			Physical				Natural							Socioeconomic								Heritage and Cultural		
Receptor	Marine Conservation Reserves	Wetlands of International and National Importance	Commonwealth and National Heritage Places	Marine Regions	Australian Environment	Northwest Shelf Province Bioregion	Northwest Shelf Transition Bioregion	Northwest Transition Bioregion	Timor Province Bioregion	People and Communities	Fishing Industry	Tourism and Recreation	Defence	Shipping	Scientific Research/Restoration	Oil and Gas Industry	Indonesian and Timor-Leste Coastlines	Underwater Cultural Heritage	Traditional Indonesian Fishing	Indigenous Cultural Connections	Air Quality	Water Quality	Sediment Quality	Underwater Noise	BIAs	Critical Habitat	Shoals and Banks	Offshore Reefs and Islands	Coastal Reefs and Islands	KEFs	Threatened, Migratory, Marine and Cetacean Species	Fishing Industry	Tourism and Recreation	Defence	Shipping	Scientific Research/Restoration	Oil and Gas Industry	Indonesian and Timor-Leste Coastlines	Underwater Cultural Heritage	Traditional Indonesian Fishing	Indigenous Cultural Heritage
Aspect																																									

Legend:		Potentially affected
	×	Predicted impact

9.8.2.1 Protected Areas

9.8.2.1.1 Marine Conservation Reserves

The nearest AMPs—Kimberley and Cartier Island—are ~80 km away from the Activity Area. Direct introduction of IMS to these areas is therefore not credible. For IMS to impact the values of AMPs, a species would need to be introduced to the Activity Area, become established and reproduce in the Activity Area, and then be translocated to an AMP and successfully establish and spread in the AMP. Within the context of potential sources of IMS associated with the activity (i.e. relatively low volume vessel activity involving predominantly local vessels for relatively short periods) and the controls in place to minimise the potential for IMS to be translocated by activities covered by this EP, introduction of IMS to the Activity Area is highly unlikely. Given that the water depths and substrates within the Activity Area are very different to those within the Kimberley AMP and at Cartier Island, and the separation distances to these areas, the likelihood of IMS being introduced and establishing viable populations within an AMP is considered Remote.

9.8.2.2 Natural Features, Values and Sensitivities

9.8.2.2.1 Timor Province and Northwest Shelf Transition Bioregions

Benthic communities are the natural features most at risk from IMS. If IMS are introduced into a new area that can support their needs, they can reproduce and establish a population in that area. In addition to affecting biodiversity in the immediate area, newly established populations of IMS can spread to nearby areas because many IMS produce larval stages that can be transported by ocean currents. The introduction and subsequent establishment of IMS could result in changes to the structure of benthic communities leading to a change in ecological function due to predation of native marine organisms and/or competition for resources.

Benthic communities within the Activity Area are characterised by low-density macrobenthic communities of deposit feeders and filter-feeders on bare sediments. The seabed within the Activity Area does not receive sufficient sunlight to support benthic primary producer habitat, such as macroalgae and zooxanthellate corals.

In the unlikely event that IMS species were introduced into the Activity Area, they would not be expected to survive or become established on benthic substrates. Based on the information within the Australian Marine Pest Monitoring Manual (DAFF 2010), very few IMS (aside from planktonic oceanic species such as dinoflagellates) could credibly survive in the deep waters of the Activity Area. The few species (e.g. European clam and Northern Pacific seastar) that can potentially survive in deep waters (up to 200 m) are generally unable to settle and establish successfully in deep–water ecosystems (Geiling 2014), most likely due to a lack of light and suitable habitat (e.g. hard substrate for attachment and nutrient-poor water) to sustain growth and survival. Therefore, most IMS are found in tidal and subtidal zones, with only a few species known to extend into deeper waters of the continental shelf (Bax et al. 2003). Most IMS introduced (via ballast water) to an area outside of their natural range will not survive to establish or subsequently become invasive or a pest (Wells et al. 2024).

With the stated controls in place, the likelihood of introducing IMS that could establish and impact benthic communities is considered Extremely Remote.

9.8.2.2.2 Shoals and Banks; Offshore Reefs and Islands

Shoals and banks in the region around Crux are shallower than the Activity Area and may therefore be more vulnerable to introduction of IMS, although the shoals and banks are generally beyond the preferred depth range of many potential IMS and translocation from the Activity Area would require spread across open areas of deep water.

The closest reef or island to the Activity Area is Seringapatam Reef (~135 km west) and Browse Island (~42 km south-south-east). The nearest shoals or banks are ~8 km from the Activity Area and even further from the Crux platform location—Goeree Shoal is ~13 km to the northwest and Eugene McDermott Shoal ~18 km to the southeast. Direct introduction of IMS to these areas is therefore not credible. Given that the water depths and substrates within the Activity Area are very different to the shallower water environments at shoals/banks, reefs and islands, the likelihood that any IMS that could establish viable populations within the Activity Area could also successfully colonise these environments is low. With the stated controls in place to minimise the potential risk of translocating IMS during the activity, the likelihood of IMS being introduced to the Activity Area, becoming successfully established and subsequently spreading and establishing at a shoal, bank, reef or island is considered Remote.

9.8.2.2.3 KEFs

The platform substructure location is ~30 km from the nearest KEF (Ancient coastline at 125 m depth contour) and the export pipeline intersects the Continental slope demersal fish communities KEF (Figure 7-9; Table 7-9). Activities within the KEF that could potentially introduce IMS are limited to IMR along the pipeline, which are expected to be relatively infrequent and short duration at any location. The demersal fish that comprise the values of the Continental slope demersal fish communities KEF comprise two distinct demersal community types, associated with the upper slope (water depth of 225–500 m) and the mid–slope (water depth of 700–1,000 m) respectively (DSEWPaC 2012). As there are no potential IMS considered to be able to credibly establish in water depths greater than 200 m (DSEWPaC 2012a), the values of this KEF are unlikely to be affected by IMS. Therefore, the likelihood of IMS being introduced and establishing viable populations that affect the values of any KEF as a result of the activity is considered Remote.

The residual risk to natural values and sensitivities is ranked Yellow (see Table 9-43).

9.8.2.3 Socioeconomic Features, Values and Sensitivities

9.8.2.3.1 Fishing Industry

The establishment of IMS has the potential to impact fishing activities in the area affected through indirect effects, such as changes to the distribution and/or abundance of fisheries target species, reducing catch rates or volumes. A worst-case scenario would require an IMS to become widely established and effectively displace a habitat type or food source important for commercially fished species. However, the likelihood of IMS introduction, establishment, and spread to the extent that regional fishery stocks were impacted is Extremely Remote with the stated controls in place.

9.8.2.3.2 Tourism and Recreation

There is no tourism or recreation activity within the Activity Area that might be affected by IMS, but nature-based activities occur at some of the shoals, banks and offshore reefs and islands in the region. Some of these activities relate to aspects of the environment potentially affected by IMS, such as diving visits to significant coral communities. As discussed in Section 9.8.2.2, the likelihood of significant impacts to these areas due to IMS being introduced to the Activity Area is considered Remote.

9.8.2.3.3 Scientific Research and Restoration

Certain locations within the region(s) surrounding the Activity Area support long-term scientific research programs that could be adversely affected by the establishment of IMS. Studies concentrating on benthic communities, such as corals, could be directly impacted if habitats or species of interest were affected and indirect impacts to other research topics could result through changes to biodiversity or ecosystem function. Typically, most long-term studies are focused in relatively shallow areas such as at shoals, banks, reefs or around islands. As discussed in Section 9.8.2.2, the likelihood of significant impacts to these areas due to IMS being introduced to the Activity Area is considered Remote.

9.8.2.3.4 Oil and Gas Industry

A number of operating oil and gas developments exist within the region of the Activity Area, including the Prelude FLNG, the Ichthys Offshore Facilities and the Montara platform and FPSO facilities. These operating facilities are located ~165 km, ~164 km and ~36 km from the Crux platform respectively. Potential impacts from IMS include damage to associated marine infrastructure, such as blocking water intakes or proliferating on vessel hulls or subsea structures, affecting operating efficiency and/or maintenance requirements. Generally, areas susceptible to marine fouling that may affect operating efficiency on oil and gas facilities are subject to ongoing prevention and/or maintenance programs, such as routine chemical dosing in subsea water intakes. Consequently, the likelihood of IMS that is potentially introduced into the Activity Area by the activity subsequently spreading and colonising infrastructure that would affect the operations of any of these facilities is considered Extremely Remote.

Overall, the residual risk to socioeconomic features, values and sensitivities is ranked Dark Blue (see Table 9-43).

9.8.2.4 Heritage and Cultural Features, Values and Sensitivities

9.8.2.4.1 Traditional Indonesian Fishing

Indonesian fishers are permitted to access areas within the MOU Box using traditional fishing techniques, including for target benthic species such as trepang and clams in the areas around reefs and islands. The MOU Box is located ~70 km from the Crux platform at its nearest and although the western (Prelude) part of the Activity Area intersects the MOU Box, the much shallower habitats that support the target species most susceptible to IMS impacts are very different to the predominantly deeper water habitats in the Activity Area. As outlined above for shoals, banks, reefs and islands, with the controls that are proposed to be implemented to reduce the likelihood of IMS being introduced to the Activity Area, the establishment of IMS at these distinct environments due to the activity is highly unlikely and hence the risk of impacts to traditional fishing is considered Remote.

Therefore, the residual risk to heritage and cultural features, values and sensitivities is ranked Yellow (see Table 9-43).

9.8.3 Risk Assessment Summary

Table 9-43 lists the highest residual risk ranking of the relevant environmental receptor groups.

Table 9-43: IMS Evaluation of Residual Risks

Environmental Receptor	Consequence	Likelihood	Residual Risk
Evaluation – Unplanned Risks			
Protected Areas	Major	A	**Dark Blue**
Physical Features	N/A	N/A	N/A
Physical Values and Sensitivities	N/A	N/A	N/A
Natural Features	Major	A	**Dark Blue**
Natural Values and Sensitivities	Major	B	**Yellow**
Socioeconomic Features	Major	A	**Dark Blue**
Socioeconomic Values and Sensitivities	Major	A	**Dark Blue**
Heritage and Cultural Features	Major	B	**Yellow**
Heritage and Cultural Values and Sensitivities	Major	B	**Yellow**

9.8.4 ALARP Assessment and Environmental Performance Standards

Table 9-44: ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
ALARP Assessment						
Elimination	Prohibit discharge of ballast water.	No	Vessels may be required to adjust their ballast to maintain stability, draft and trim to undertake activities. Given the low residual risk, prohibiting standard vessel ballast water discharge would provide little additional environmental benefit compared to the increase in safety risk for vessels.	N/A	N/A	N/A
Substitution	Vessels shall not operate within 1 km of named Shoals adjacent to the Activity Area.	Yes	Prohibiting vessels from operating within 1 km of named Shoals adjacent to the Activity Area reduces the risk of IMS being introduced to the area.	2.3	Refer to EPS 2.3.	Refer to EPS 2.3.
Engineering/ Administrative and Procedural	Anti-foul coating/system compliant with marine order 98	Yes	Anti-foul coating/system on the vessels will reduce biofouling accumulation on the hull which will reduce the likelihood of IMS introduction. Implementing this equipment control measure is required under the International Convention on the Control of Harmful Antifouling Systems on ships and the *Protection of the Sea (Harmful Anti-fouling Systems) Act 2006* (Cth), hence must be adopted.	6.1	Vessels (as appropriate for size, type and class) will have an antifoul coating applied in accordance with the International Convention on the Control of Harmful Antifouling Systems on Ships and the *Protection of the Sea (Harmful Anti-fouling Systems) Act 2006* (Cth), including Marine Order 98 (Marine Pollution – Anti-fouling Systems) including (as appropriate for size, class and type): • a valid international Anti-fouling system certificate, or • anti-fouling declaration.	A copy of a valid international anti-fouling system certificate or a declaration on antifouling system (as appropriate for class, type and size).
Engineering/ Administrative and Procedural	Vessel specific biofouling management and/or risk assessment in accordance with section 10.8.5.1.5.	Yes	Reduces the likelihood of introducing IMS by implementing proactive biofouling management options recommended under the Australian Biofouling Management Requirements (DAFF 2023) and Australian National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee 2009). Implementing this system control measure is required under the legislative requirements; hence, it must be adopted. However, for vessels not entering Australian territorial seas it is seen as best practice. The implementation of this control is necessary to comply with legislative requirements, so it must be adopted.	6.2	Vessels (as appropriate for size, type and class) entering Australian territorial seas [12 nm limit] from international locations, prior to entering the Activity Area, will apply the Australian Biofouling Management Requirements (DAFF 2023), including: • an effective biofouling management plan and record book; or • vessel cleaned of all biofouling within 30 days prior to arriving in Australian waters; or • implementation of an alternative biofouling management method.	A copy of the Biosecurity Status Document (issued via Maritime Arrivals Reporting System) showing an approved biofouling status.
				6.3	Vessels (as appropriate for size, type and class) entering the Activity Area directly from international locations will implement the following requirements derived from the Australian National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee 2009): • conduct a biofouling risk assessment using an industry recognised IMS inspector; and • undertake IMS risk reduction measures as guided by an industry recognised IMS inspector if a vessel is not considered low risk; and • only vessels classified as low risk will be permitted entry into the Activity Area.	IMS Inspection Report that classifies the vessel as low risk, and if required, evidence of the mitigation measures implemented to reduce the risk to low.

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
				6.4	Locally sourced vessels (as appropriate for size, type and class) entering the Activity Area from Australian domestic locations, will implement the following requirements derived from the Australian National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee 2009): • conduct a biofouling risk assessment using an industry recognised IMS inspector or using a Shell endorsed IMS risk assessment tool; and • undertake IMS risk reduction measures if a vessel is not considered low risk (either guided by an IMS inspector or using risk assessment tool outcomes); and • only vessels classified as low risk will be permitted entry into the Activity Area.	IMS risk assessment and supporting records which demonstrate implementation actions have been carried out as required, that classifies the vessel as low risk.
Engineering/ Administrative and Procedural	Vessel specific ballast management.	Yes	The likelihood of introducing IMS via ballasting activities is reduced by implementing the recommendations outlined in the Australian Ballast Water Management requirements (DAWE 2020), and aligned with the *Biosecurity Act 2015* (Cth) and the International Convention for the Control and Management of Ships' Ballast Water and Sediments (as appropriate for size, type and class). The implementation of this control is necessary to comply with legislative requirements, so it must be adopted.	6.5	Ballast water discharges are aligned with the Australian Ballast Water Management Requirements (DAWE 2020), the *Biosecurity Act 2015* (Cth) and the International Convention for the Control and Management of Ships' Ballast Water and Sediments (as appropriate for size, type and class of vessel).	Records demonstrating a Ballast Water Management Plan is in place (as appropriate for size, type and class). Records demonstrating a ballast water record system is maintained (as appropriate for size, type and class). A copy of the International Ballast Water Management Certificate to demonstrate the principle ballast water management method is in accordance with D–2 standards. If the vessel cannot demonstrate it meets D–2 standards, records of ballast water discharge logs confirm no discharge within 12 nm of coastlines including any ports. Biosecurity Status Document (issued via Maritime Arrivals Reporting System) showing an approved ballast status (for vessels arriving from international locations and entering the Australian territory [12 nm limit] or a low-risk exemption through a domestic ballast water risk assessment (for domestic vessels and other international vessels).
Administrative and Procedural	Conduct environmental DNA (eDNA) water sampling within ports visited by vessels going to and from the Activity Area.	No	Due to the number of users in the port, eDNA analysis of water samples from the port will be inconclusive as to whether the risk has originated from the petroleum activities. As agreed by the state marine biosecurity agencies, this is the responsibility of state agencies. Consequently, any additional benefit gained through the implementation of this control is considered outside the control of Shell and hence not feasible.	N/A	N/A	N/A

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
Administrative and Procedural	Develop specific IMS response plans and carry out training and drills to prepare for the need to respond to an IMS incident.	No	The resources and time needed to implement this control are significant and considered grossly disproportionate to the benefit gained. The Marine Pest Response Manual (Marine Pest Sectoral Committee 2024) was revised and National Control Plans for six species have been developed as part of the National Strategic Plan for Marine Pest Biosecurity 2018–2023 (DAWE 2018) (Marine Pest Sectoral Committee 2024). Consequently, any additional benefit gained through implementing this control is considered outside the control of Shell and hence not feasible.	N/A	N/A	N/A

ALARP Demonstration Statement

Based on the risk assessment outcomes and control measures that have been adopted, Shell considers that implementing the control measures are appropriate to manage the potential risks of introducing IMS associated with the activity. No feasible additional or alternative controls were identified that could further reduce the impacts and risks. Therefore, the impacts and risks are considered to be reduced to ALARP.

9.8.5 Acceptability of Risks

Table 9-45: Acceptable Levels of Risks – IMS

Receptor		Acceptable Level of Impact	Acceptable?	Acceptability Assessment
Category	**Subcategory**			
Protected areas	Marine conservation reserves	No impacts to the values of marine parks.	Yes	The likelihood of impacts due to establishment of an IMS as a result of the activity is considered remote, given the application of the control measures, including adherence to relevant legislation and regulations, to reduce the likelihood of introducing IMS into the Activity Area, and that the deep offshore open waters in the Activity Area are not conducive to the settlement and establishment of IMS. The impact assessment has been based on conservative assumptions, including that conditions are conducive to IMS establishment and that the vessels mobilised are vectors for IMS. Therefore, Shell considers the residual risk associated with IMS to be reduced to ALARP and an acceptable level.
Natural features, values and sensitivities	Marine bioregions	No significant impacts to benthic habitats and communities. Impacts to non-sensitive benthic communities limited to a maximum of 5% of the Project Area (as defined in the OPP). No known or potential pest species become established in the Commonwealth Marine Area.		
	Shoals and banks	No direct impacts to named banks and shoals. No loss of coral communities at named banks or shoals as a result of indirect/offsite impacts[27]. No known or potential pest species become established in the Commonwealth Marine Area.		
	Offshore reefs and islands	No impacts to offshore reefs and islands. No known or potential pest species become established in the Commonwealth Marine Area.		
	KEFs	No significant impacts to environmental values of KEFs.		
Socioeconomic features, values and sensitivities	Fishing industry	No negative impacts to targeted fisheries resource stocks that result in demonstrated loss of income for commercial fisheries.		
	Tourism and recreation	No negative impacts to nature-based tourism resources resulting in demonstrated loss of income.		
	Scientific research and restoration	No impacts resulting in abandonment of long-term established scientific research or restoration programs.		
	Oil and gas industry	Temporary displacement/interruption of petroleum exploration activities and operations within the Activity Area (excluding PSZs) is acceptable.		

Receptor		Acceptable Level of Impact	Acceptable?	Acceptability Assessment
Category	**Subcategory**			
Heritage and Cultural features, values and sensitivities	Traditional Indonesian fishing	No negative impacts to exploited fisheries resource stocks.		

The assessment of risks from IMS determined a highest residual risk ranking of Yellow (Table 9-43). The acceptability of the potential risks of impacts from the introduction of IMS associated with the petroleum activities has been considered in the following context.

Principles of ESD

EPOs are aligned with the principles of ESD:

- The introduction of an IMS poses a risk to the diversity and ecological integrity of the Activity Area and the wider region.

However, Shell will apply a range of controls to ensure that the risk of IMS introduction is reduced to a level that is acceptable and ALARP. Following successful application of these controls, Shell considers the residual risk to be consistent with the principles of ESD.

Relevant Requirements

Managing the risks is compliant with relevant legislative and guidelines requirements, including:

- Compliance with international maritime conventions, including:
  - International Convention for the Control and Management of Ships' Ballast Water and Sediments.
  - International Convention on the Control of Harmful Anti-Fouling Substances.
- Guidelines for the control and management of ships' biofouling to minimise the transfer of invasive aquatic species (IMO 2011).
- Compliance with Australian legislation and requirements, including:
  - *Biosecurity Act 2015* (Cth):
    - Chapter 4 (Managing biosecurity risk).
    - Chapter 5, Part 3 (Management of discharge of ballast water).
  - *Protection of the Sea (Harmful Anti-fouling Systems) Act 2006* (Cth):
    - Part 2 (Application or use of harmful anti-fouling systems).
    - Part 3 (Anti-fouling certificates and anti-fouling declarations).
  - Marine Order 98 – Marine pollution prevention – anti-fouling systems.
  - *Fish Resources Management Act 1994* (WA), *Fish Resources Management Regulations 1995* (WA) and the *Aquatic Resources Management Act 2016* (WA)

Control measures are consistent with these guidelines and requirements:

- Reducing Marine Pest Biosecurity Risks Through Good Practice Biofouling Management Information Paper (NOPSEMA 2022b).
- National Biofouling Management Guidelines for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee 2009).
- Australian Biofouling Management Requirements (DAFF 2023).
- Australian Ballast Water Management Requirements: Version 8 (DAWE 2020).
- MarinePestPlan 2018–2023: The National Strategic Plan for Marine Pest Biosecurity (DAWE 2018).
- Offshore Installations–Biosecurity Guide: Version 1.4. (DAWE 2020b).
- WA's Biofouling Biosecurity Policy[35] (Department of Fisheries 2017).

Strict controls are in place to prevent the introduction of IMS into Australian waters, which the project will abide by. Biosecurity is regulated under the *Biosecurity Act 2015* (Cth). The Australian Ballast Water Management

[35] This policy's objective is to minimise the adverse impacts of aquatic pests and diseases in WA through '1. Preventing the establishment of aquatic pests and diseases in new locations' and '2. Minimising the impact of established aquatic pests and diseases'. As such, the acceptable level of risk for IMS (stated in the EPO) is consistent with this policy.

Requirements (DAWE 2020) provides Australia's commitment to the International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Convention). The National Biofouling Management Guidelines for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee 2009) gives recommendations to the petroleum industry for managing biofouling hazards. The control measures adopted in Table 9-44 are aligned with these guidelines, which vessel operators must abide by.

Matters of National Environmental Significance

Threatened and Migratory Species

The policies, strategies, guidelines, Conservation Advice and recovery plans for MNES that may occur within the potential area affected by an IMS do not identify IMS as a threat.

Commonwealth Marine Area

With the controls that will be implemented, the activity is not likely to result in the introduction of IMS that causes impacts that exceed any of the significant impact criteria for the Commonwealth Marine Area listed in Table 8-1; as such, it is considered that the aspect is not likely to result in significant impact to the Commonwealth marine environment.

Table 9-46: Summary of Alignment with Relevant MNES Considerations

MNES	MNES Acceptability Considerations	Demonstration of Alignment
Threatened and Migratory Species	The threatened and migratory species within the Activity Area are all highly mobile. Benthic species are generally more susceptible to the effects of IMS and there are no EPBC Act listed benthic species in the Activity Area.	N/A
Commonwealth Marine Area	Significant impact guidelines for the Commonwealth marine environment (Table 8-1).	The risk assessment indicates that this aspect of the activity is not likely to result in any impacts that exceed the Commonwealth marine environment significant impact criteria, as listed in Table 8-1; as such, it is considered that the aspect does not pose an unacceptable risk to the Commonwealth marine environment.

External Context

To date, no objections or claims about IMS have been raised by relevant persons. Shell's ongoing consultation program will consider statements and claims made by Relevant Persons when further assessing the risks (see Section 5.13).

Internal Context

Shell also considered the internal context, including Shell's environmental policy and ESHIA requirements. The EPOs and the controls that will be implemented for the activity are consistent with the outcomes from consultation for the petroleum activity and Shell's internal requirements.

Acceptability Summary

The assessment of risks from IMS determined the highest residual risk rankings were Yellow (Table 9-43). The acceptability of the impacts and risks from IMS associated with the activity has been considered in the context of:

- the established acceptability criteria.
- ESD.
- relevant requirements.
- MNES.
- external context (i.e. stakeholder claims).

- internal context (i.e. Shell requirements).

Given the water depth (>90 m within the Activity Area and >130 m at proposed infrastructure location), potential IMS species which may be present on equipment and vessels used for the activity would be unlikely to settle and establish on the available natural substrate. The export pipeline intersects Continental slope demersal fish communities KEF and the nearest shoals or banks are ~8 km from the Activity Area—Goeree Shoal north-north-west and Eugene McDermott Shoal east-south-east. Considering all of the controls which are in place, the residual risk of potential IMS being introduced to the Activity Area, spreading, attaching to vessel hulls and establishing in new areas such as high value areas and/or inshore coastal waters of Australia such as at ports following a long-distance vessel transit is Yellow or less.

Shell considers residual risks of Yellow to be acceptable with controls if they meet legislative and Shell requirements. The discussion above demonstrates that these requirements have been met in relation to the IMS aspect of the petroleum activities.

Shell considers the risk of IMS introduction associated with the activity to be ALARP and acceptable.

9.8.6 Environmental Performance Outcome

EPO #	EPO	Measurement Criteria
6.1	No IMS of concern[36] introduced in the Activity Area as a result of the activities.	No confirmed and externally reported instances of IMS within in the Activity Area as a result of the activities.

9.9 Produced Water Discharge

9.9.1 Aspect Context

Produced Water (PW) is water which has permeated into the gas reservoir over time, and which may comprise condensed water (water vapour present within gas/condensate that condenses when brought to the surface) and saline formation water. PW is separated from the hydrocarbons extracted from the reservoir in the platform facilities and, following treatment to ensure it meets required standards, is discharged directly into the marine environment. Crux PW will be discharged via a dedicated outlet, located ~20 m above the sea surface to minimise marine growth fouling (and eliminate the need for hypochlorite dosing) and maintenance.

The characteristics of the PW discharge will transition during the operational life of the Crux platform. Discharges are expected to comprise mostly condensed water (water condensed out of the gas phase through the process) with minimal formation water produced during the early operations phase (i.e. pre-formation water breakthrough). This is predicted to be ~8-9 years, which is outside the period of operations covered by this EP. It is predicted by reservoir modelling that at ~9 years of operation the water produced may commence transitioning to a mixture of condensed water and formation water (i.e. post-formation water breakthrough). The amount of formation water is expected to gradually comprise a greater proportion of the discharge as the field nears end of life, as is typically the case for maturing hydrocarbon fields. During the early years of operations up to ~235 m^3/day of PW is expected to be discharged, increasing up to ~287 m^3/day after around 5-6 years of production and up to ~3,029 m^3/day in a high-water case (late life including formation water). The system is designed for the full range of flows, pressures, and temperatures to remove dispersed hydrocarbons from the produced water to a concentration of ≤ 30 mg/L daily average dispersed oil-in-water for all design cases (underpinned by a vendor guarantee); and an operational target concentration of 20 mg/L daily average for normal conditions which constitutes periods where the flows are considered stable and excludes start-up and transient/variable flow conditions. It is important to note that these represent design cases. Production profiles (Operating Plan profiles) are based on production forecasts based on reservoir outcome probabilities which retain the risks of uncertainty through variable reservoir outcomes (flow rates, slug behaviours, emulsions, composition, solids, sludge, sand, debris content, etc). Once operations commence, Shell will utilise actual production data to better optimise and manage future water generation profiles, in doing so, providing greater certainty on the risk of the high-water design case scenario being realised.

[36] IMS of concern are species that are listed on the WA Prevention List for Introduced Marine Pests or Commonwealth National Introduced Marine Pest Information System and could survive in the natural environment beyond the Crux installed infrastructure.

In addition, the platform has also been designed with space and weight provision on the cellar deck for the installation of additional produced water treatment packages (such as hydrocyclones) should this be required to meet committed discharge performance standards. The design case and operational plan is based on the successful treatment of produced water to the required performance standards with the equipment installed at day one for the full facility lifecycle. This provision for an additional treatment package is therefore a contingency in the event that the actual system/reservoir performance is outside the design basis and/or does not achieve forecast predictions, design outcomes. Operational data ensures any future installations can be designed on empirical rather than theoretical data, hence increasing efficacy and efficiency of the treatment.

The PW is predicted to contain hydrocarbons (such as BTEX, PAHs including e.g. naphthalene, phenanthrene and dibenzothiophene (NPD) compounds), metals, and residues from production chemicals. The assumed concentrations of the key constituents in the PW (based on nearby analogue information) are provided in Table 9-47. For operations within the duration of this EP, the PW composition is predicted to include condensed water only. This condensed water is expected to contain less impurities than the formation water produced during later operations, and hence the assumed constituent concentrations in Table 9-47 are conservative for the PW discharge covered by this EP.

Naturally occurring hydrocarbons in the PW stream can be considered as two discrete categories:

- partially soluble hydrocarbons – low molecular weight hydrocarbons that are partially soluble in water, such as BTEX (e.g. benzene) and light weight PAHs (e.g. naphthalene). These compounds can be harmful when introduced into the marine environment, and are not significantly reduced by primary or secondary PW treatment.
- insoluble hydrocarbons – non-polar hydrocarbons that are not significantly soluble in water. Most hydrocarbon compounds fall within this category. The PW treatment system that will be used on Crux is intended to remove these compounds from the PW stream, however small amounts of very fine droplets of insoluble hydrocarbons may remain after treatment. These will be discharged with the PW stream.

Mercury (modelled to be predominantly in the form of elemental mercury) may occur naturally in the Crux reservoir and therefore carry through in the produced water. During the 2007-2008 Crux exploration campaign, onsite mercury measurements showed mercury concentrations between 0.2 to 0.8 ug/Sm^3 based on Drill Stem Test (DST) samples. Whilst this provides a useful datapoint, it is difficult to accurately ascertain the concentration of mercury until the Crux wells commence production[37]. Sampling of the Crux production fluids allows larger fluid volumes to be analysed based on more representative fluids (rather than fluids local to the well bore). Noting this uncertainty, Shell's Geochemist in consultation with a Thermodynamics Principal Technical Expert were consulted to establish an uncertainty range for the design mercury concentration of the Crux fluids during the concept select phase. The mercury concentration uncertainty range for the Crux field was established as 150 µg/Sm^3 (base case) to 240 µg/Sm^3 (high case) for incorporation into basis of design, which subsequently impacts engineering materials specifications for equipment such as piping, valves, flanges and seals (etc). This was based primarily on the maximum mercury concentration from regional analogues including exploration data. The principal species of mercury present at the inlet is expected to be elemental mercury, as measured in exploration well samples and consistent with regional analogues.

Mercury is known to have the potential for bioaccumulation and/or biomagnification in the marine environment. Biomagnification of mercury in marine fauna, particularly fish, can result in impacts to higher trophic levels and presents the potential for human health concerns. Accordingly, Shell assessed engineering alternatives for the control of any mercury that may partition into the produced water discharge during the design process. This included assessment of Best Available Techniques (BAT) and Best Environmental Practices (BEP) in alignment with the Guidance on Best Available Techniques and Best Environmental Practices – Minamata

Convention on Mercury (United Nations Environment Program, 2019) which references to emission point source and facilities listed in Annex D of the Minamata Convention, updated by the more recent Guidance on Best Available Techniques and Best Environmental Practices to Control Releases of Mercury from Relevant Sources (UNEP/MC/2024/3, October 2024) ('Minamata Guidelines').

[37] Mercury is a highly volatile element that has a strong affinity for organic matter. It is soluble in natural gas and condensates and present in hydrocarbon basins globally, exhibiting a wide range of concentrations. The physical, chemical and geochemical properties of mercury create complex distributions in hydrocarbon systems. Through the process of thermal evolution, mercury concentration in hydrocarbons can be influenced by source rock origin, migration pathway and fluid chemistry (Lawer *et al* 2023). Even when in production, mercury may be limited to pockets or zones in the reservoir and therefore not uniformly produced to the platform, or results may be highly variable or spurious. Mercury monitoring therefore is often unpredictable with a high degree of uncertainty.

The assumed concentration of mercury partitioning into the PW system is ~1.3 to 2.3 µg/L (ANZG guideline value for 99% species protection in marine waters is 0.1 µg/L, 80% level of species protection is 1.4 µg/L) (also refer Table 9-61). The mercury present is expected to be predominantly elemental based on Shell partition modelling, which have low bioavailability. At these rates, assuming constant composition, the predicted discharge loading of mercury into the marine environment commingled with the produced water discharge would be ~0.1 kg/year at early field life (~235m^3/d produced water) to ~2.6 kg/year at maximum design case (~3,029 m^3/d produced water). The intent of the Minamata Guidelines has been considered in the ALARP analysis throughout the design phase as it applies to all potential produced water contaminants. This included assessment of good practice, BAT, and BEP in system concepts and designs, documented through engineering phases, and was considered against factors such as uncertainty of produced water volume and composition outcomes, safety, health, NNM, operability, cost and waste minimisation drivers alongside dispersion modelling which indicates rapid dispersion of trace metals to levels that pose a low risk to the receiving environment. The assessment was conducted in design phase and revalidated for this EP and summarised in Table 9-50.

9.9.1.1 Start-up and Operations

During start-up and operations, prior to discharge, the produced water will be treated by the degasser and dissolved gas flotation (DGF) technology to remove dispersed hydrocarbons from the produced water to a concentration of ≤ 30 mg/L daily average dispersed oil-in-water for all design cases (underpinned by a vendor guarantee); and an operational target concentration of 20 mg/L daily average for normal conditions which constitutes periods where the flows are considered stable and excludes start-up and transient/variable flow conditions. DGF uses fuel gas to extract additional hydrocarbons from the produced water and provide a higher degree of separation than can be performed by a degasser alone. See Section 6.7.8 for a description of the PW treatment facilities. Mercury also has the potential to enter the PW degasser via the fuel gas used to provide flotation gas. The fuel gas is modelled to have a mercury concentration of between 0.183 mg/m^3 and 0.202 mg/m^3. Partition modelling however predicts that the quantity entering the degasser at these concentrations is insignificant at less than 30 grams per year annual loading, and likely that trace mercury will follow the flash gas from the degasser to the LP flare (refer section 6.7.8). ~99% of any mercury generated on the facility is modelled to partition to the gas and condensate export streams to Prelude FLNG, determined primarily by the temperature regulation of the separation process as per design.

9.9.1.1.1 Operational monitoring

The performance of the treatment system will be monitored by an OIW analyser (two are installed) and a flowmeter to enable measurement and comparison with the discharge limit, along with a manual sampling point for periodic validation activities. Operators will monitor OIW discharge readings and will retain flexibility to operate the OIW analysers in various online, standby/idle, and offline modes. The OIW analyser data is sent via transmitter and reported to the Distributed Control System (DCS) and is also captured within the Plantwide Event Historian (PEH). The DCS facilitates visibility in the Prelude FLNG control room or IOC, for manual or automated process control changes to be made, and/or alarms enunciated (e.g. high OIW specification). PEH information is available for analysis and trending. During planned / specific scheduled platform visits, operators will manually sample PW and send onshore for analyser checks at the onshore lab as required. The results are sent back to the operator to allow validation of both analysers.

PW discharge activities and problem solving will be directed by Crux operating procedures, which provide strategies for problem solving and rectifying high OIW readings in manned and unmanned/remote operating modes, start-up and non-routine modes, and decision pathways for monitoring formation water breakthrough and any additional treatment requirements. Potential causes of OIW fluctuations and high readings may relates to several root causes, such as:

- Analyser faults (such as faulty or spurious readings, malfunction, signal loss, or other offline conditions).
- Formation water breakthrough (not expected in five-year EP timeframe).
- Condensate underflow through liquid separator (Section 6.7.4).
- Condensate underflow from coalescer filter separator (Section 6.7.7).
- Dissolved gas flotation system faults (Section 6.7.8).

Potential mitigations for high readings may include proactive technical monitoring (PTM, see Section 10.4.5.1), analyser inspections and reset, monitoring water cut of well fluids (Section 6.7.3), changes to well production

rates, checking level interface instrumentation (e.g. liquid separator and condensate coalescers), operating both DGF tubes online (Section 6.7.8, and longer term actions such as installation of water clarifier/demulsifier chemical injection (Section 6.7.8), or initiating a brownfields secondary treatment project (such as hydrocyclone installation) which is not likely in the five-year EP timeframe.

9.9.1.1.1.1 Analysers Offline (Manned Operation)

If there is a loss of signal or malfunction from both OIW analysers, operators will attempt to reset the analysers, and if successful will resume normal operational monitoring in accordance with the operating procedures. If both analyser(s) cannot be reset, manual sampling will be undertaken, and operators will use proactive technical monitoring (PTM) to monitor process stability for changes with the potential to result in an increase in the OIW concentration. If PTM indicates there are no observable changes to a stable operating process, PTM will continue to be deployed until laboratory results are returned (and the next scheduled platform visit will include repairs of the analysers to restore condition).

9.9.1.1.1.2 Analysers Offline (Unmanned/Remote Operation)

If there is a loss of signal from both OIW analysers, operators attempt to reset the analysers remotely, and if successful, will resume normal operational monitoring in accordance with the Crux operating procedures. If analyser(s) cannot be reset remotely, operators will use proactive technical monitoring (PTM) to monitor process stability for changes with the potential to result in an increase in the OIW concentration. If PTM indicates there are no observable changes to a stable operating process, PTM will continue to be deployed and the next scheduled platform visit will include restart of the analysers to restore condition. If PTM indicates there is a lack of confidence around results, thereby risking OIW measurements exceeding 30 mg/L average for more than twelve consecutive hours, and a risk of OIW exceedance (24-hour average) is anticipated, the asset may undertake a ‘react’ visit to investigate and verify results when safe to do so and undertake further actions.

9.9.1.1.1.3 High OIW Management (Unmanned/Remote Operation)

If the analyser(s) are online and the OIW measurements exceeds 30 mg/L average for more than twelve consecutive hours, and a risk of OIW exceedance (24-hour average) is anticipated, the asset may undertake a ‘react’ visit to verify results when safe to do so.

9.9.1.2 Well Completions (Second Stage Clean-Up, Future Workovers)

During the second stage well clean-up activity and subsequent well clean-ups associated with well workovers or interventions, temporarily higher OIW concentrations (predicted to vary but average may be ~95 mg/L based on analogous industry data) may be discharged for short durations after opening or re-opening the wells, during these specific activity periods. The higher concentrations may be attributable to variable or unexpected flowrates/slugging, compositions, temperature, pressures, viscosity, or densities; presence of emulsions, solids, sludge, sand or other foreign particles such as debris from perforations or after well workovers/interventions. Operators will require time to monitor and optimise operating system performance in such conditions. The water will also be treated prior to discharge by the degasser and dissolved gas flotation (DGF) technology (with the addition of a temporary sand management skid for second stage well clean-up) and monitored using the same OIW analysers and flow meter as operations phase (Section 9.9.1.1).

9.9.1.3 Well Completions (First Stage Clean-Up)

During well completions (after perforation), first stage well clean-up will be undertaken with well fluids (from all five wells) directed through temporary water treatment facilities. The well test package is designed to separate and dispose of gun debris and liquid contaminants that remain from the drilling activity. The first stage clean-up may also result in discharge of condensed water and potentially formation water (although unlikely). The temporary well test package is a spread of equipment that enables three phase separation of the well constituents. It will remove well effluent and completion fluids, including liquid and solid contaminants, from the wellbore and MEG used for hydrate inhibition. It is intended that under normal conditions, water and oil (condensate, condensed water, and base oil completions fluid returns) from the separator will be recombined after metering and incinerated in the oil burner mounted on the flare boom (see Section 6.8.2). Any residual water that is not incinerated in the flare boom will be filtered and disposed overboard in batches by piping which discharges at an elevation above the sea surface. These water discharges may contain residual oil in water (not captured by the three-phase separator) and any residual fluids (such as MEG), which will be measured by an analyser, with all discharge volumes recorded based on tank level readings. The batch PW discharge is predicted have measured OIW content not exceeding 30 mg/L daily average for volumes of less

than 540 bbls per well (the design basis). However, if water volumes exceed the design basis (greater than 540 bbls per well), measured OIW content may be up to 95 mg/L daily average for short periods (based on analogue industry data, however predicted to vary). The same circumstances may apply to re-starts after any future well workovers during the clean-up of wells post workover maintenance activity.

9.9.1.4 Overview of PW Discharge Modelling

A numerical modelling study was commissioned by Shell to determine the behaviour of the PW following discharge into the sea and inform the assessment of impacts and risks from PW discharges. The modelling incorporated the measured values of PW constituents derived from Shell's Auriga West-1 exploration well, which targeted hydrocarbons that may be produced by the Crux platform and is considered a representative analogue for the fields that may be developed within the Crux in-field development area, both in terms of physico-chemical properties and water content. Three different rates (and salinities) of discharge were modelled; 235 m^3/day (and 0 ppt salinity) to represent the maximum expected discharge during early years of operations (condensed water only), 287 m^3/day (and 30 ppt salinity) to represent discharge after initial formation water breakthrough in at least one well and 3,029 m^3/day (92.2 ppt salinity) to reflect the higher rates and salinities of formation water that may occur during later phases of operations. Consequently, the PW modelling results are considered to provide an appropriate representation of the nature and scale of the PW stream that would be discharged from the Crux platform over the life of operations based on design cases and operating plans forecasted and assumed during the design and execute phase. As formation water breakthrough is not expected until >8-9 years of production based on current forecasts and design case assumptions, the PW modelling results are considered to provide a conservative representation of the nature and scale of the PW plume that could be discharged from the Crux platform over the life of operations covered by this EP.

The PW discharge was remodelled in 2024 based on the context provided in Section 9.9.1, with discharge locations, characteristics, and volumes consistent with the design of the facilities. Table 9-47 provides the key assumed constituents in the PW and the dilutions required to achieve 95% and 99% species protection levels (SPL), based on measured PW concentrations of contaminants for which reliable species protection concentration thresholds (Default Guideline Values) have been published by ANZG (2018).

Table 9-47: Key Assumed Constituents of the PW Discharge and Required Dilutions to Achieve ANZG (2018) DGVs (RPS 2024a)

Constituent	Assumed Concentration (mg/L[38])	Dilutions Required	
		95% SPL	99% SPL
Benzene	240	342.9	480.0
Naphthalene, phenanthrene, dibenzothiophene (NPD)	10.7	152.9	214.0
Phenol	0.757	1.9	2.8
Cadmium (Cd)	4.6×10^{-3}	0.8	6.6
Chromium (III/IV) (Cr)	2.48×10^{-2}	0.9	3.2
Copper (Cu)	9.2×10^{-3}	7.1	30.7
Lead (Pb)	4.6×10^{-3}	1.1	2.1
Nickel (Ni)	1.91×10^{-2}	0.3	2.7
Zinc (Zn)	2.94×10^{-2}	3.7	8.9
Mercury (Hg)	2.4×10^{-3}	6.0	24.0

The modelling determined the mixing generated by discharge into the receiving water and any subsequent buoyancy interactions (collectively named near-field dilution), followed by an investigation of dilution that would be generated by oceanic dispersion beyond the near-field (far-field dilution). Different modelling approaches were employed for calculating near-field and far-field dilutions due to the differing hydrodynamic scales involved. The near-field mixing and dispersion of the outfall was simulated using the three-dimensional flow

[38] Concentrations of contaminants are often expressed in parts per million (ppm). The ppm and mg/L units are interchangeable if ppm is referring to a mass per unit volume.

model, CORMIX. Subsequent mixing and dispersion of the discharges was predicted using the three-dimensional discharge and plume behaviour model, CHEMMAP. CHEMMAP predicts the movement and fate of a wide variety of chemical products, including floating, sinking, soluble/insoluble chemicals and product mixtures (French-McCay & Isaji 2004).

The far-field modelling used a stochastic modelling approach, where the release was repeatedly simulated using different metocean conditions that could affect the distribution of constituents. This approach involves multiple (200 per scenario) simulations of a given discharge scenario, with each simulation being carried out under a randomly selected period of currents. This methodology ensures that the calculated movement and fate of each discharge is representative of the range of prevailing currents at the discharge location.

The predicted dilution values for PW constituents of concern were then compared with recognised impact thresholds to determine an area (mixing zone) within which water quality may be adversely affected by PW discharge, and thereby inform assessment of the nature and scale of potential impacts.

The ANZG (2018) guidelines recognise three ecosystem conditions used to identify appropriate impact thresholds, namely:

- high conservation/ecological value systems – effectively unmodified or other highly-valued ecosystems, typically (but not always) occurring in national parks, conservation reserves or in remote and/or inaccessible locations
- slightly to moderately disturbed systems – ecosystems in which aquatic biological diversity may have been adversely affected to a relatively small but measurable degree by human activity. The biological communities remain in a healthy condition and ecosystem integrity is largely retained
- highly disturbed systems – these are measurably degraded ecosystems of lower ecological value.

While remote, the Crux project area does not overlap any marine protected areas. As noted in the OPP, for impact assessment purposes the ecosystem condition of the Activity Area corresponds to the 'slightly to moderately disturbed' category of the ANZG guidelines, containing existing disturbance due to the existing fishing in the region, shipping and operating Prelude FLNG at the western end of the export pipeline as well as the drilling and construction disturbance associated with installing the Crux wells, pipelines, and platform. The ANZG (2018) guidelines suggest that 95% species protection are generally appropriate for monitoring programs in slightly to moderately disturbed ecosystems, with a 99% species protection value applied to contaminants with potential for bioaccumulation, such as mercury.

Based on the impact threshold concentrations defined in the ANZG (2018) guidelines, the required dilution factor to reach the 95% species protection level trigger for all constituents is <1:350, with a <1:500 dilution required to reach the 99% species protection level (Table 9-47). Stochastic modelling results indicate that dilutions of ~1:350 and ~1:500 would respectively be achieved within ~20 m and ~40 m horizontally of where the discharge enters the sea for the highest rate of discharge expected during Crux operations (Figure 9-4; RPS 2024a).

Modelling done for the Crux PW outfall in the Crux OPP showed more conservative results to recent modelling studies carried out. "Based on the threshold concentrations for these constituents, as defined in the ANZECC & ARMCANZ) (2000) guidelines, the required dilution factor to reach the 99% species protection level trigger for all constituents is < 1:500. Stochastic modelling results indicated that a 1:500 dilution (i.e. reaching 99% species protection level trigger) to occur within 999 m from the discharge point." Regardless, Shell has decided to adopt the RPS 2024 model for early PW prediction purposes given it is likely to be more accurate.

9.9.2 Description and Evaluation of Impacts

Table 9-48 indicates the environmental features and values and sensitivities that have been identified to be potentially affected by the PW discharge that may occur during the activities covered by this EP, with further evaluation of the impacts and/or risks to each potentially affected receptor category (including cumulative impacts) provided in Sections 9.9.2.1 to 9.9.2.5. Features or values and sensitivities which could not be credibly affected by PW discharges are not discussed further.

Table 9-48: PW Discharge Receptor Impact Screening Summary

	Protected Areas			Features															Values and Sensitivities																							
				Physical		Natural				Socioeconomic								Heritage and Cultural			Physical				Natural								Socioeconomic								Heritage and Cultural		
Receptor	Marine Conservation Reserves	Wetlands of International and National Importance	Commonwealth and National Heritage Places	Marine Regions	Australian Environment	Northwest Shelf Province Bioregion	Northwest Shelf Transition Bioregion	Northwest Transition Bioregion	Timor Province Bioregion	People and Communities	Fishing Industry	Tourism and Recreation	Defence	Shipping	Scientific Research/Restoration	Oil and Gas Industry	Indonesian and Timor-Leste Coastlines	Underwater Cultural Heritage	Traditional Indonesian Fishing	Indigenous Cultural Connections	Air Quality	Water Quality	Sediment Quality	Underwater Noise	BIAs	Critical Habitat	Shoals and Banks	Offshore Reefs and Islands	Coastal Reefs and Islands	KEFs	Threatened, Migratory, Marine and Cetacean Species	Fishing Industry	Tourism and Recreation	Defence	Shipping	Scientific Research/Restoration	Oil and Gas Industry	Indonesian and Timor-Leste Coastlines	Underwater Cultural Heritage	Traditional Indonesian Fishing	Indigenous Cultural Heritage
Aspect									×													×	×							×											

Legend:		
		Potentially affected
	×	Predicted impact

9.9.2.1 Natural Features

9.9.2.1.1 Timor Province Bioregion

Benthic Communities

The discharge of PW is to the sea surface and is predicted to mix rapidly upon release, and modelling indicates benthic communities will not be directly contacted by the PW plume. Potential effects are therefore limited to those associated with the build-up of contaminants on the seafloor through sedimentation.

The condensed water discharged over the duration of this EP may contain sands and fines that may also be present in production fluids during later phases of operation. Sands and fines will mostly be removed during processing on the platform, with the total cumulative volume discharged in PW over the life of the Crux field expected to be <3 m^3, and to involve very fine particles with low settling velocities. Although production outcomes are uncertain, this is considered a highly conservative estimate as it is based on sands and fines partitioning into the degasser, not carry over into the overboard stream (most sand and fines will be collected as waste during turnarounds). The potential for residual dissolved materials in the PW stream to cause changes in sediment quality is expected to be limited (see Section 9.9.2.2.2).Therefore, any build-up of sediments and/or associated contaminants on the seabed and resultant effects on benthic fauna communities would be restricted in nature and scale. These potential impacts are expected to be concentrated around the Crux platform, where the benthos is predominantly soft sediments supporting benthic communities anticipated to have low abundance and diversity (Section 7.6.4). Effects are likely to be restricted to areas of previous disturbance (e.g. physical disturbance during installation of the Crux platform, export pipeline and subsea integration system and discharge of drilling fluids and cuttings).

Consequently, potential impacts to benthic communities are anticipated to be Slight (Magnitude: –1, Sensitivity: L).

Pelagic Communities

Pelagic communities in the area surrounding the Crux platform include plankton and pelagic fish and invertebrates. EPBC Act listed species of fish (including sharks and rays) are discussed in Section 9.9.2.3.3.

The decrease in water quality from potential contaminants in the treated PW discharge stream may, depending on exposure duration, result in highly localised acute impacts to plankton. Research indicates that zooplankton exposed to low molecular weight hydrocarbons can exhibit acute toxic effects (Almeda et al. 2013; Jiang et al. 2010). In particular, PAHs are of concern due to their solubility, toxicity and relative persistence compared to BTEX. The potential exposure to concentrations and durations of contaminants required to induce such effects on plankton communities will be highly localised to the discharge location due to the rapid dilution and decay of PW constituents in the well mixed open offshore ocean environment. Given the small area of reduced water quality as a result of the PW discharge (Section 9.9.1.4) relative to the ubiquitous regional distribution of planktonic communities, the dynamic nature of the plume location and the ability of plankton to recover from disturbance due to fast growth rates and/or dispersal and mixing of communities (Richardson et al. 2017) inside and outside of the PW plume, impacts on planktonic populations are expected to be insignificant.

Pelagic fish attracted to any organisms attached to the platform structure may be exposed to low but potentially toxic concentrations of contaminants within the PW mixing zone, including hydrocarbons and metals. Some contaminants can bioaccumulate. However, by their nature pelagic fish are highly mobile and unlikely to remain for extended periods within the discharge plume, which will vary in spatial extent and location depending on metocean conditions. Free-swimming species may also be able to detect and move away from an area of reduced water quality. The buoyant nature of the plume precludes impacts to benthic or demersal species.

Given the very small area around the release point within which contaminants are predicted to exceed impact concentrations (Section 9.9.1.4), and the low numbers of any pelagic fish species expected to occur within the area of those concentrations, the potential for adverse impacts to fish communities is very low. Bakke et al. (2013), who reviewed individual, population and ecosystem level biological responses to PW, concluded that the spatial scale of impact from PW discharge was insufficient to impact populations of marine organisms.

In summary, exposure of pelagic communities to PW, could result in localised environmental effects on individual organisms, but with no ecosystem function changes or chronic level impacts to populations. The impact on pelagic communities is therefore assessed to be Slight (Magnitude: –1, Sensitivity: L).

9.9.2.2 Physical Values and Sensitivities

9.9.2.2.1 Water Quality

PW discharged from the Crux platform will contain a range of potential residual contaminants, expected to include salts, hydrocarbons, metals, and production chemicals, which will have a localised effect on water quality. The likely PW discharge constituents and their concentrations were informed by Shell's Auriga West-1 exploration well, which targeted the Crux field, and Prelude operational experience. Based on operational experience in the region (e.g. Prelude FLNG facility), potential contaminants such as naturally occurring radioactive materials (NORMs) and organic acids (e.g. acetic acid) are not expected to occur in quantities that may result in environmental impacts.

To inform evaluation of the effects of these potential constituents on water quality, the PW discharge was modelled (RPS 2024a) for both early and later operations discharge rates (Section 9.9.1.4). Constituent concentrations in the receiving environment were then determined based on the dispersion and dilution predicted by the modelling, for comparison to relevant impact criteria, notably ANZG marine and freshwater quality guidelines (ANZG 2018). Concentrations predicted by the modelling are highly conservative for the PW discharge during early operations, when much lower initial concentrations of contaminants will be present in the condensed water.

The PW discharge over the duration of this EP will be positively buoyant as a result of being warmer and less saline than the receiving seawater. The relatively low flow rate and elevated discharge point (~20 m above sea level) will result in high initial dispersion rates. It will also result in a reduction in content of the volatile aromatic compounds that contribute to the toxicity of PW through exposure to air prior to entering the marine environment, however the modelling does not allow for this process and so has additional conservatism.

After entering the ocean, the produced water would initially sink and undergo turbulent mixing. Due to the highly buoyant nature of the discharge during early operations (condensed water discharge), the modelling indicates this would be restricted to the surface 1-2 m with no significant vertical mixing predicted. Discharge during later operational phases will result in a higher velocity (~0.5 m/s) stream of denser (higher salinity) water that would plunge and sink due to momentum and negative buoyancy, undergoing dilution with increasing depth until neutral density is achieved at depths of between 30-50 m from the sea surface (RPS 2024a).

The modelling results show that high dilutions are expected to be achieved for PW discharges during all seasons (RPS 2024a), exceeding 1:3,000 well within the PSZ surrounding the platform. No named shoals or KEFs are predicted to be exposed to dilutions lower than 1:30,000 under any conditions for any PW discharge scenarios.

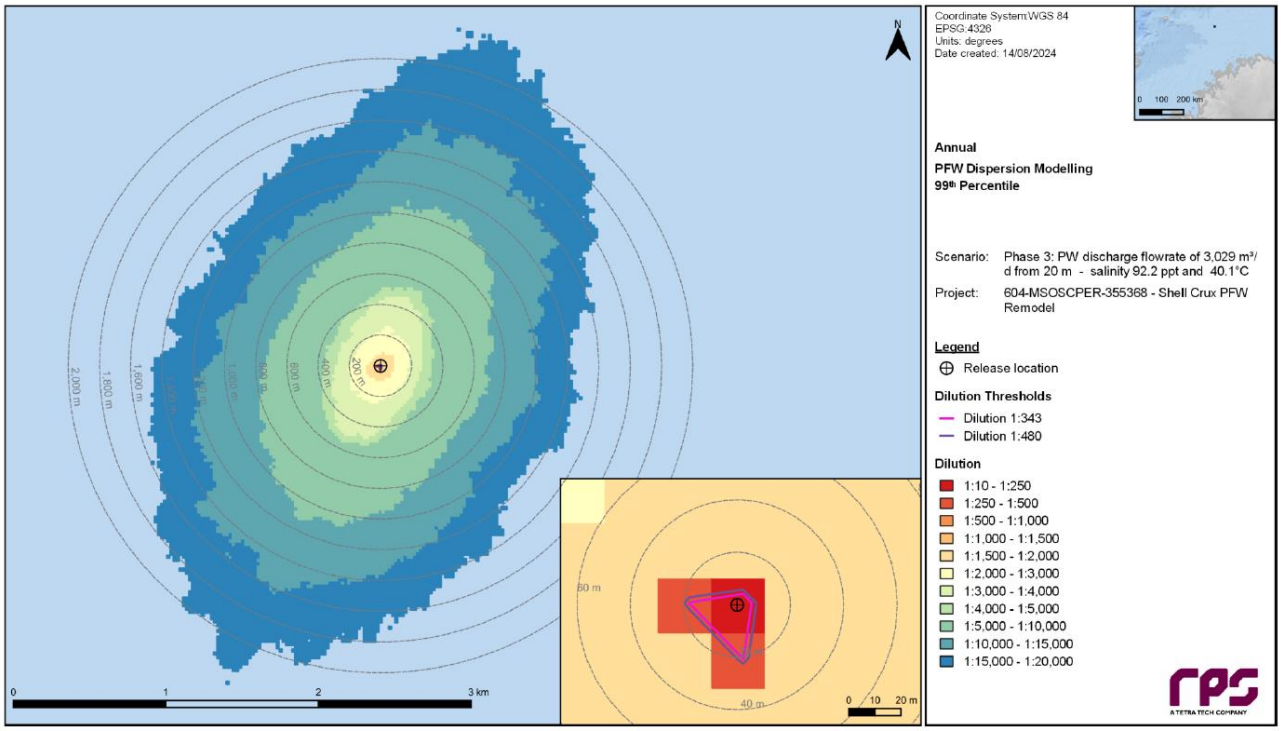


Figure 9-4: Predicted Annualised Minimum Dilutions for 3,029 m^3/day PW Discharge (Formation Water Breakthrough, Late Life)

There is no ANZG guideline value for dispersed OIW, however the Oslo Paris Convention Commission (OSPAR Commission) has established a predicted no-effects concentration (PNEC) of 70.5 µg/L (OSPAR Commission 2014). This PNEC was developed from toxicity data from marine species from five taxonomic groups (OSPAR 2014; Smit et al. 2009). Based on the modelling results, the 30 mg/L average dispersed OIW concentrations in Crux PW would be reduced to below the PNEC within <40 m of the platform during late phase operations involving the high-water case (i.e. 3,029 m^3/day) (predicted to be late life, outside the 5-year duration of this EP) and <20 m of the platform (during the operations covered by this EP).

Component hydrocarbons in the PW OIW will consist of both relatively low and high molecular weight compounds. Hydrocarbon solubility generally decreases with increasing molecular weight, and aromatic hydrocarbons also tend to have increased water solubility compared to non-aromatic hydrocarbons of equivalent molecular weight (Neff et al. 2011). As such, low molecular weight aromatic hydrocarbons are typically the most available in PW. These compounds include BTEX, low-molecular weight PAHs, which include NPD, and phenols. Low molecular weight hydrocarbons are of particular interest, as these tend to have the greatest potential for toxicity (Neff et al. 2011). Higher molecular weight compounds typically pose less environmental risk and are largely recovered during the production and PW treatment processes onboard the Crux platform. Residual high molecular weight hydrocarbons will occur as very fine entrained oil droplets.

BTEX compounds are the most common hydrocarbon component of PW. However, BTEX are highly volatile and do not persist in the marine environment, with evaporation and dilution rapidly reducing concentrations following discharge (Ekins et al. 2005; IOGP 2024; Neff et al. 2011) and subsequent biodegradation and photodegradation processes expected to further reduce residual BTEX levels in the environment (Neff et al. 2000). Benzene is likely to comprise the predominant BTEX compound in the Crux PW, with expected concentrations one to two orders of magnitude higher than other BTEX compounds. The PW modelling indicates that benzene concentrations in the PW discharge would only exceed ANZG 99% species protection levels (recommended for slight to moderately disturbed ecosystems to address potential chronic toxicity) within ~40 m horizontally of where the discharge enters the sea. As such, potential impacts on water quality due to BTEX will be highly localised to the Crux platform.

PAHs are less volatile and soluble than BTEX and have greater potential to accumulate in the marine environment (Neff et al. 2011). PAHs can be broadly divided into two types; low molecular weight and those of high molecular weight. PAHs dissolved in PW are predominantly low molecular weight with high molecular weight PAHs rarely prevalent in treated PW due to their low aqueous solubility (IOGP 2024). These compounds are primarily associated with dispersed oil which is largely removed by the production process and produced water treatment system (Neff et al. 2011; Schmeichel 2017). Residual PAHs in the discharge are generally subsequently lost from the water column through volatilisation to the atmosphere upon reaching the sea surface, particularly the lower molecular weight fractions (Schmeichel 2017). PAHs can also degrade in the water column with half-lives ranging from less than a day to several months, with the more abundant and lower molecular weight compounds being more degradable (IOGP 2002). The PW discharge modelling indicates that the low molecular weight PAHs (e.g. naphthalene) in the Crux PW discharge would fall within ANZG reliable 99% species protection levels (recommended for slight to moderately disturbed ecosystems because of potential to bioaccumulate) within <20 m of the release location. Volatilisation of PAHs during the initial fall to the sea from the elevated discharge location would further limit the potential for impacts beyond the immediate vicinity of the platform.

The various trace metals that may be present in low concentrations in the PW stream are generally in a low oxidative state and on release to the marine environment rapidly oxidise and precipitate into solid forms, which will be transported away from the discharge location while suspended in the water column (discussed further in Section 9.9.2.2.2). While concentrations of trace metals in PW can be significantly greater than those in the marine environment, they are rapidly reduced through dilution and mixing processes, and other physicochemical reactions, to levels that pose a low risk to the receiving environment. As with PAHs, ANZG (2018) recommends application of higher levels of species protection for some metals with elevated potential to bioaccumulate, such as mercury. Based on the PW discharge modelling results, the levels of all the metals expected to be present in the Crux PW would be dispersed/diluted to concentrations below the respective 99% species protection threshold values within <30 m of the release point.

MEG is planned to be introduced into the Crux production system for valve pressure equalisation during start-ups and restarts and be subsequently discharged to sea in the treated PW. MEG is anticipated to require injection rates of ~0.2 – 1.5 m^3/hr during these activities, depending on the scenario, with a predicted annual

MEG usage of ~40.9 m^3. MEG is ranked as E (lowest hazard) under the Offshore Chemical Notification Scheme (OCNS) Chemical Hazard and Risk Management (CHARM) non-CHARM products ranked list of notified chemicals and is considered readily biodegradable and non-bioaccumulative (Centre for Environment, Fisheries and Aquaculture Science 2019). The OSPAR Commission lists MEG as a substance considered to pose little or no risk to the environment (PLONOR). There is no ANZG marine water guideline value for MEG, but the World Health Organization (WHO 2000) recommends a PNEC of 859 mg/L. However, based on AIMS studies completed for Shell, a PC95 for MEG is advised to be 92.1 mg/L and PC99 is 6.1 mg/L (Fisher *et al* 2025). Assuming that MEG is diluted to ~20% in the PW system, based on conservative predictions of well fluids passing through during the start-up/restart, temporary residual MEG concentrations in the discharge plume are predicted to fall below the PC95 within <200 m and PC99 within <500m of the discharge point.

If required to optimise OIW treatment performance of the PW system, demulsifiers and/or clarifiers might be introduced into the processing system and small (trace) amounts carried over into the PW discharge. TEG, used for gas dehydration, could also be recycled back into the PW process in trace amounts. The concentrations of these chemicals in the discharge are likely to be below those which are toxic to marine fauna, or to fall below those levels within very close proximity of the discharge point based on the modelling results. There is a high degree of uncertainty as to how chemicals which could enter the PW process may cause additive, synergistic, antagonistic, potentiation or inhibition effects. All process chemicals that may be discharged in PW will be subject to the Shell Australia Chemical Change Process which requires the chemicals to be substitution warning free and rated Gold, Silver, D, or E through the OCNS, listed by the OSPAR Commission as PLONOR, or have a completed ALARP assessment. When considering the generally small contribution of PW process chemicals to the overall toxicity of PW (as cited in Schmeichel 2017), it is expected the dilutions required to meet the relevant species protection levels trigger will not be significantly affected by any anticipated process chemical use and, consequently, the spatial extent of the mixing zone is not expected to be substantially different.

Shell has recently completed Direct Toxicity Assessment (DTA) of PW discharge from the Prelude FLNG, located immediately adjacent to the Activity Area. The testing utilised the currently accepted methodology for the derivation of water quality criteria in Australia and New Zealand (ANZECC/ARMCANZ 2000, ANZG 2018), with measured toxicity to 11 different marine species applied to derive the dilutions required to ensure a defined level of ecosystem protection. Until the Crux PW DTA has been completed, the Prelude DTA results are considered to represent a reasonable analogue for the Crux PW discharge because of the expected similar hydrocarbon and reservoir properties. The DTA indicates the dilution required to achieve PC95 is achieved within ~40 m and PC99 in ~600 m of where the Crux PW discharge enters the sea.

After start-up commences and the PW can be sampled, the characteristics (including ecotoxicity and any associated effects of chemical additives) of the actual PW discharge will be determined as part of the monitoring and adaptive management framework that will be implemented for platform discharges (see Section 10.7.1) to ensure the potential effects of PW discharge continue to be managed to ALARP and acceptable levels. This will include the use of DTA of PW to confirm the required dilutions to achieve PC80, PC95 and PC99. This approach takes account of all PW constituent's effects.

Considering the different lines of evidence Shell has considered, for conservatism and to take account of uncertainty that Crux DTA results (or other elements of the monitoring) may indicate a requirement for greater dilution/dispersion to achieve the PC80, PC95 and PC99 in accordance with the defined EPO 7.1, the evaluation of potential impacts of PW discharge has assumed up to 1 km from the discharge location is required to meet PC99 from Crux PW, consistent with the accepted OPP (refer to Section 10.7.1 for further details). Given the degree of variation between Crux OPP PW modelling and revised modelling carried out for this EP, this increases the uncertainty of the modelled prediction, Shell will implement an environmental monitoring program and adaptive management framework for PW, to be informed by environmental monitoring and DTA (see Section 10.7.1).

Overall, the potential consequences to water quality from the PW discharge that will occur over the duration of operations with a <1 km (and 20m for mercury) mixing zone, based on RPS 2024 modelling, are considered to be Slight (Magnitude: –1, Sensitivity: L), with changes beyond relevant guideline levels for the conservation of ecological values predicted to be restricted to waters within very close proximity of the Crux platform.

9.9.2.2.2 Sediment Quality

The PW discharge will contain a range of potential residual constituents. Processes by which these may become incorporated into seabed sediments include:

- sedimentation of solids in the PW.
- dissolved contaminants forming precipitates, which settle to the seabed, and
- adsorption of contaminants onto natural suspended solids, which settle to the seabed.

The condensed water discharged during the operations covered by this EP will not contain solids and the production process onboard the Crux platform will remove most solids from other sources (e.g. well clean-up fluids) prior to discharge. Therefore, the mass of solids discharged in the PW managed under this EP is expected to be very low. Under steady state operations, sand fine volumes discharged overboard are anticipated to range between 0.01 m^3 - 3 m^3 over the cumulative life of the Crux field (which is considered highly conservative as this represents sand and fines flow into the degasser, not directly overboard as the majority will be collected as solid waste during turnarounds). The remaining solids in the PW discharged will be very fine in size, and hence will have low settling velocities. Given the water depth at the discharge location, the predicted behaviour of the plume, the above-surface discharge point, and the low settling velocities, residual solids are expected to disperse widely and are unlikely to result in a decrease in sediment quality at the discharge location.

Dissolved materials (particularly metals) in the PW may form precipitates once released into the environment due to changes in pH and availability of reactants (e.g. oxygen, sulphide etc.). Precipitates are initially very small and will have low settling velocities. As described above for solids in the PW stream, precipitates are likely to become widely dispersed at very low concentrations and if/where they ultimately settle to the seabed are unlikely to accumulate at levels that discernibly decrease sediment quality.

Some of the constituents in the PW, such as metals and hydrocarbons, may become adsorbed onto the surface of suspended solids present in the receiving environment. However, water quality studies in the Project Area have shown that natural suspended sediment levels are very low (AECOM 2016). This is consistent with the low observed rates of natural deposition in the region (Glenn 2004). The results of Glenn (2004) also showed that sediments locally derived from the water column are generally very fine (i.e. silt and clay sized particles). The low natural suspended sediment load in the waters surrounding the Crux platform suggests that the potential for adsorption of residual contaminants is limited. Furthermore, the small particle size and the water depths at the platform location indicates that any particles with adsorbed contaminants are likely to be effectively dispersed and diluted in the water column, with limited build up in seabed sediments around the platform and no measurable impact to sediment quality in the region. It is therefore predicted there will be no exceedance of toxicant DGV for sediment quality beyond the impact zone which is 1km, consistent with Crux OPP produced water EPOs and other studies such as Bakke *et al* (2013).

The volume of PW discharged from the Crux platform is expected to be relatively low for the majority of the production period, particularly over the first five years of operations covered by this EP. Each of the mechanisms discussed above by which contaminants in the PW may be incorporated into sediments is considered to result in no more than a Slight effect on sediment quality (Magnitude: –1, Sensitivity: L). This is consistent with monitoring results for other offshore facilities, which generally show that natural dispersion processes appear to control the concentrations of potential contaminants from PW in sediments to slightly above background concentrations (Neff et al. 2011).

9.9.2.3 Natural Values and Sensitivities

9.9.2.3.1 BIAs

There are no critical habitats that fall within the area where the PW discharge may discernibly alter habitat quality. The only BIA that overlaps the area potentially affected by PW is the whale shark BIA, which relates to the seasonal migration of whale sharks to/from the Ningaloo aggregation area that is centred on the 200 m isobath along the north-west Australian coast. In the Timor Province where the Crux platform is located, this BIA covers an area of ~8,785 km^2, and has a mapped width of ~170 km at the Crux platform location. Based on the results of the (conservative) modelling of PW discharge and direct toxicity assessment (DTA) data, the resulting plume could potentially reduce water quality from a pristine level to one that protects 99% of species over an area of <1.5km^2 surrounding the discharge location, or <0.013% of the regional extent of the BIA, at any one time. Even assuming a mixing zone of up to 1 km in radius, this would involve <0.036 of the regional BIA. Given the very small proportion of the BIA affected by the PW discharge and the ability for whale sharks to continue a migration within the BIA even if entirely avoiding the PW plume, the discharge is considered to have negligible impact on the functional value of the BIA for whale sharks.

9.9.2.3.2 Shoals and Banks

The nearest shoal or bank to the Crux platform is Goeree Shoal, located ~13 km to the north-west (Table 7-7). The RPS 2024a modelling of PW discharge indicates that at a distance of 1 km, the PW plume would be at/near surface and have been diluted over 20,000-fold, with all constituents of potential concern within the plume substantially below the respective 99% species protection concentrations. Given that Goeree Shoal is at its shallowest 20-40 m below the sea surface and beyond the range of any adverse changes in water or sediment quality due to the PW discharge, no adverse impacts to the natural values of any shoals or banks are anticipated.

9.9.2.3.3 Threatened, Migratory, Marine and Cetacean Species

As the PW discharge will occur to the sea surface, is expected to be positively buoyant for most of field life and not predicted to affect water quality at depths beyond 50 m at any stage, pelagic fauna that are at or near the sea surface are most likely to be exposed to the PW plume.

Most EPBC Act listed species within the area predicted to be influenced by the PW discharge are air breathing vertebrates (e.g. marine turtles and mammals), which are unlikely to be directly affected as their skin is relatively impermeable and they do not possess gill structures that facilitate cellular uptake of dissolved seawater constituents. Hence, significant direct impacts to these fauna are not considered credible. Indirect effects, such as via altered prey abundance or ingestion of bioaccumulated toxic compounds, are not considered to have the potential for adverse impacts to marine turtles or mammals given the localised area predicted to be influenced by PW, the absence of feeding BIAs within this area, the typically temporary or transitory presence of threatened fauna species, and the nature and scale of impacts to the marine ecosystem within the PW discharge plume (e.g. Slight impacts to plankton).

Other EPBC Act listed species (e.g. pelagic sharks) are not expected to have significant exposure to high concentrations of PW and may actively move away from areas of reduced water quality, which will be localised to the vicinity of the release location. There are no known aggregation areas for these species within the area potentially affected by PW discharge. Although the whale shark 'low density foraging' BIA that extends up the northwest coast of WA overlaps the platform location (Figure 7-20), this BIA is generally recognised to be important for migration rather than feeding (DoE 2015e). Studies of migrating whale sharks in north-western Australian waters (including this BIA) indicate average movements of >25 km/day, as well as significant vertical changes in distribution during migration (Reynolds et al. 2017). The mapped BIA in the vicinity of the Crux platform is ~170 km wide. Consequently, the likelihood of a substantive proportion of the whale sharks that transit the region remaining within the relatively small area of surface/shallow waters around the platform that is influenced by PW discharge for long enough to suffer adverse effects is very low. Therefore, potential impacts to threatened, migratory, marine and cetacean species are expected to be Slight at worst (Magnitude: –1, Sensitivity: L).

9.9.2.4 Socioeconomic Features, Values and Sensitivities

9.9.2.4.1 Fishing Industry

The PW discharge plume overlaps the authorised fishing zone of several commercial fisheries, however, catch data and consultation indicate only activity in the WA-managed Mackerel and Northern Demersal Scalefish fisheries may occur in the waters surrounding the Crux platform. No unauthorised vessels, including fishing vessels, will be permitted to access the 500 m PSZ around the platform during the operational life of the facility, and therefore there will be no access to the area immediately surrounding the PW discharge location over the duration of this EP. While the discharge of PW may lead to the introduction of contaminants with the potential for bioaccumulation, this is not expected to occur in organisms beyond the immediate area of the Crux platform (e.g. organisms that have colonised the platform jacket). The PW discharge modelling (RPS 2024a) indicates that, for the PW discharged over the duration of this EP, elevated (i.e. above guidelines) levels of contaminants will be restricted to near surface waters <40 m, or up to 1km based on RPS 2018, from the discharge point.

The Northern Demersal Scalefish fishery does not target species that may occur in the near surface waters in the vicinity of the platform that are potentially affected by the PW discharge. The highly mobile and widely dispersed pelagic fish targeted by the Mackerel Fishery are unlikely to remain within the discharge plume for sufficient time and/or in sufficient numbers for the fishery to be adversely affected. Therefore, no impacts to these fisheries are anticipated. However, moderate uncertainty remains, and therefore the uncertainty will be managed appropriately.

9.9.2.5 Cumulative Impacts

The discharge of PW has the potential for cumulative effects due to other planned discharges to the marine environment associated with the Crux operations, such as platform deck drainage and effluent streams (Section 9.10), and/or through combination with discharges from other users or facilities in the immediate region.

The other Crux project discharges from or in the vicinity of the platform typically involve relatively low volumes and/or do not contain constituents that would result in cumulative impacts with PW. For example, BTEX, an aromatic hydrocarbon component of the PW discharge that may also be present in deck or bilge waters, will rapidly degrade and does not significantly bioaccumulate (Neff 2002).

The potential for PW discharge to interact with other users or facilities in the immediate region is limited by the rapid dispersion and associated reduction in contaminant concentrations that will occur following discharge. Conservative modelling of the PW discharge for early Crux operations predicts that the concentrations of the identified key contaminants in the PW (Table 9-47) would fall below ANZG guideline 99% species protection thresholds within a radius of <40 m (RPS 2024a) or <1km (RPS 2018) from the discharge location (Section 9.9.2.2.1) and DTA results suggest effects on water quality are unlikely to extend beyond 1 km of the platform. Bakke et al. (2013) states that typically no impacts are detected beyond 2 km from offshore facilities around the world. Non-project related usage within this area is expected to be minimal, particularly noting that there will be a 500 m radius vessel exclusion zone around the operating Crux platform. The Montara FPSO facility, the nearest facility to the Crux platform, is located ~36 km from the Crux platform. Planned discharges from the Montara facility are reported to disperse rapidly within close proximity of discharge points, with no adverse effects on ecological receptors at distances of <1 km from the facility (Jadestone Energy 2023). In a broader context, the liquid discharges from the operating Prelude FLNG (~165 km away) and Ichthys (~164 km away) facilities similarly have localised zones of influence and the combined area within the region potentially affected by liquid discharges from all of these facilities represents a negligible proportion of the regional open ocean environment.

A monitoring program will be established to verify that contaminant concentrations in PW discharges will meet relevant ANZG guidelines (or within natural variation or background concentration) beyond the predicted localised mixing zone(s). Considering this, no significant cumulative impacts from planned discharges of PW are expected for the activity, and no change to the overall consequence level identified for PW discharge is expected to result.

9.9.3 Impact Assessment Summary

Table 9-49 lists the highest impact consequence rating in the relevant environmental receptor groups.

Table 9-49: PW Discharge Evaluation of Impacts

Environmental Receptor	Magnitude	Sensitivity	Residual Impact Consequence
Evaluation – Planned Impacts			
Protected Areas	N/A	N/A	N/A
Physical Features	N/A	N/A	N/A
Physical Values and Sensitivities	−1	L	Slight
Natural Features	−1	L	Slight
Natural Values and Sensitivities	−1	L	Slight
Socioeconomic Features	0	L	No Impact
Socioeconomic Values and Sensitivities	0	L	No Impact
Heritage and Cultural Features	N/A	N/A	N/A
Heritage and Cultural Values and Sensitivities	N/A	N/A	N/A

9.9.4 ALARP Assessment and Environmental Performance Standards

Table 9-50: ALARP Assessment and Environmental Performance Standards – Stage 2 Well Clean-up, Start-up, and Operations

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
ALARP Assessment						
Elimination	Reinjection of PW to reservoir.	No	Reinjection requires additional wells to be drilled, and additional equipment to be installed and operated, with substantial additional development timelines and costs, increases in other Project discharges/emissions (e.g. GHG, drill fluids and cuttings, vessel/rig discharges) and increases in HSE risks, including oil spill. Reinjection was evaluated as part of the Crux OPP and found to not be feasible since: • the Crux NNM platform basis of design significantly limits the space available for equipment required for re-injection, such as water treatment, pumps, and chemical storage. • the Crux NNM platform concept delivers significant operational safety benefits through reduced personnel time on the platform. Operation of a re-injection system would likely require the platform to be manned and would increase maintenance requirements. • re-injection into the Crux production reservoir poses risks to reservoir integrity and hydrocarbon recovery. Methods to mitigate reservoir risks by increased treatment of the PW are not consistent with the Crux NNM platform operating philosophy. • no suitable geological formations for re-injection that do not hold potentially commercial hydrocarbons have been identified within the Crux in-field development area. Given the slight residual impact predicted for PW discharge, the overall costs (including HSE impacts/risks) are considered grossly disproportional to any environmental benefit.	N/A	N/A	N/A
	Collection and storage of PW for onshore disposal.	No	Requires substantial onboard/onsite storage and transfer capacity to be installed and operated, and frequent vessel/vehicle transport to mainland disposal sites. Introduces substantial additional costs and increases in discharges/emissions (e.g. GHG, vessel discharges) and increases in HSE risks, including oil spill. Negligible or no environmental benefit given the PW would still need to be disposed elsewhere and the low impact associated with Crux platform discharge of treated PW. Not feasible for the Crux Project.	N/A	N/A	N/A
Substitution	PW discharge via Prelude or Montara facilities.	No	Transporting PW to another facility would require the installation of a dedicated subsea pipeline. Neither Prelude nor Montara have been designed to receive PW from Crux and may reduce their production capacities. Transporting PW would require additional infrastructure to be installed on the facilities, including pumps, valves etc on the Crux platform for flow assurance. Additional chemical treatment may be required to address pipeline corrosion/hydrate formation issues. Transporting PW also introduces substantial additional development timelines, costs, and other Project HSE impacts/risks. There is negligible or no net environmental benefit given the PW would still be discharged to sea and disposal of treated PW at the Crux platform is assessed to have low impact. Transporting PW to Prelude or Montara for discharge via the PW systems on those facilities was evaluated as part of the Crux OPP and not considered feasible because: • the Crux NNM platform basis of design significantly limits the space available for equipment required for PFW flow assurance, such as pumps and chemical storage. • the Crux NNM platform concept delivers significant operational safety benefits through reduced personnel time on the platform. Operation of a PFW transport pipeline may require the platform to be manned and would increase maintenance requirements.	N/A	N/A	N/A

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
Engineering	Produced water treatment system includes; • Bulk separation • PW degasser • Dissolved Gas Floatation (DGF) technology • Monitoring of PW discharge by an operator and alarm support • Produced Water OIW Off-Specification Playbook • Proactive technical monitoring (PTM) • Space provisions on platform to allow additional treatment technologies • OIW analyser with built in redundancy • Spare OIW analysers onshore to improve availability • Elevated PW discharge outlet to aid mixing and dilution.	Yes	The Crux Produced water treatment system includes; • Bulk separation. • PW degasser. • Dissolved Gas Floatation (DGF) technology. • Monitoring of PW discharge by an operator and alarm support. • Produced Water OIW Off-Specification Playbook. • Proactive technical monitoring (PTM). • Space provisions on platform to allow additional treatment technologies. • OIW analyser with built in redundancy. • Spare OIW analysers onshore to improve availability. • Elevated PW discharge outlet to aid mixing and dilution. **Bulk Separation, PW Degasser and DGF** Technically simple and reliable equipment for separation of the bulk water and condensate streams. For the Crux platform, a liquid separator will be used to remove floating oil and entrained oil droplets from the PW. The PW treatment equipment facilitates the removal of oil droplets from the PW stream. High reliability and mechanically simple, reducing space and maintenance requirements. The DGF system supplements the degasser and is designed to extract additional hydrocarbons from the produced water and provide a higher degree of oil water separation than the degasser alone. The basis of design and vendor guarantee is to achieve ≤30 mg/L dispersed OIW content (daily average) for Crux PW under all design cases and most operating conditions (i.e., normal conditions where the flows are considered stable which excludes start-up and transient/variable flow conditions). Shell has set the performance standard initially to not exceed 30 mg/L (daily average) in accordance with the basis of design and vendor guarantee. In the absence of operational data, trending and technical monitoring, and in recognition of the uncertainty associated with actual reservoir production outcomes (such as flow rates, slug behaviours, emulsions, composition, solids, sand, sludge, debris content, etc) it is not appropriate for Shell to deviate from the basis of design for this system. The PW treatment system also has an operational target oil in water discharge concentration of 20 mg/L (daily average) under normal conditions stated above. There is a risk this may not be achievable; therefore, a performance standard has not been set to this effect. Further, committing to a more stringent performance standard will not change the performance of the DGF system, therefore there is no incremental benefit in adopting a lower OIW target from day 1 of start-up and operations. When operational data, trending and technical monitoring is available after production commences, Shell plans to establish ongoing review of the OIW discharge target as a demonstration of commitment to achieving ALARP impact potential from OIW. During the second stage well clean-up or well clean-ups associated with well workovers or interventions it is anticipated (based on analogue data) that the OIW content levels may be up to 95 mg/L for periods because of factors such as reservoir uncertainty, varying flow rates, temperatures and pressures which may impact separation, and potential impurities (e.g., base oil emulsifications, sand/debris, etc, carried over from the first stage clean-up) which may directly or indirectly cause increased dispersed OIW readings. The PW discharge at these concentrations during this phase may be up to 36 hours per well (the remaining three deviated wells), however, this may be spread over approximately 14 days (as there may be stop/start activities). For the second stage well clean-up, best available temporary desander package equipment will be installed to minimise the potential for solids/debris to interfere with oil water separation performance in the degasser and DGF. The second stage cleanup is produced for export (refer EPS 10.6) whereas the first stage clean-up is sent to flare. The GHG emissions from flaring during first stage clean-up are correspondingly reduced, in the order of ~10,000 tCO_2-e per well (~0.05 $MtCO_2$-e total), in addition to the associated incremental reduction in noise and light emissions. Therefore, a	7.1	Produced water dispersed oil content of the discharge shall not exceed 30 mg/L (daily average) during start-up and operations.	DCS records demonstrate dispersed OIW levels do not exceed 30 mg/L (daily average) as required.
				7.2	Review produced water dispersed oil content performance following 12 months of commencing NNM Phase 1, but not more than 24 months following start-up. Purpose of the review is to take actions to reduce EPS 7.1 toward the operational target 20 mg/L (daily average).	Note for File (or similar) documenting the review and recommended actions. This review outcome will include revising EPS 7.1 and other associated equipment changes, where required.
				7.3	Produced water dispersed oil content shall not exceed 95 mg/L (daily average) during second stage well clean-up or well clean-ups associated with well workovers or interventions, for up to 36 discharge hours per well.	DCS records demonstrate dispersed OIW levels do not exceed 95 mg/L (daily average) as required.

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
			higher OIW limit for a short duration is a positive trade-off for reducing GHG, noise and light emissions made possible by the decision to use a two-stage clean-up.			
			Monitoring of PW discharge by an Operator Monitoring of PW discharge by an operator via the Distributed Control System (DCS) / PI data allows PW treatment performance to be confirmed during operations. These equipment and personnel control measures are implemented 24/7. Two independent OIW analysers with high alarms are provided, to monitor the daily average OIW concentration in PW discharged overboard. This is all recorded in the DCS which the operator monitors.	7.4	PW discharge will be monitored via DCS by an operator with assistance of a PW dispersed OIW high alarm.	Operator monitoring DCS/PI records of PW discharge trends. DCS / PI records of PW discharge trends and responses to PW OIW high alarm. Alarm register shows high alarm in place on the PW OIW analysers consistent with EPS 7.1.
			Produced Water OIW Off-Specification Playbook and Proactive Technical Monitoring (PTM) In the event of increasing OIW concentration trends or off-specification OIW readings after startup, online monitoring and/or procedural controls will be in place to monitor and control PW discharge volume, OIW concentration, and prevent discharge of PW with high OIW concentration by implementing the Crux Produced Water Off-Specification Playbook (Section 10.7.1) (in development). This Playbook will include response measures for (i) increasing or off-specification OIW readings (ii) sustained loss of signal for the OIW analysers. The Playbook is managed by the PTM engineering surveillance/support team personnel (refer Section 10.3.2.2), and site instructions are conveyed to panel operators in Daily Instructions (Section 10.11.1). Panel operators will utilise Operating Procedures to adjust settings or process parameters as recommended in Daily Instructions. Examples of immediate measures that will be considered are listed in Section 10.7.1 and include immediate monitoring and rectification measures such as ongoing proactive technical monitoring, react visit planning when in unmanned mode, switchover to offline OIW analyers, transmitter and instrumentation fault checks, operation of both dissolving gas tubes online, and instigation of manual sampling program. Problem solving actions may include assessment of condensate underflow in liquid separator and coalescer filters, water pump and gas dissolving tube inspections. Longer term engineering solutions will also be detailed. Proactive technical monitoring (PTM), as detailed in section 10.4.5.1, is Shell's process control measure to ensure early detection of threats through structured proactive monitoring of process and equipment, which will enable the ability to 'find small, fix small' leading to sustained optimal operations and minimised risks.	7.5	If both OIW analysers are unavailable or impaired; proactive technical monitoring (PTM) will be used to confirm that operational data is consistent with achieving 30 mg/L dispersed oil content (daily average).	PTM records confirm that daily average PW dispersed oil concentration remains within defined limits as evidence that 30 mg/L (daily average) is being achieved through stable operating history/parameters which support this. PTM tests of historical operating data with operating OIW analyser through start-up/early operations provide verification and evidence that PTM records are reliable when OIW analysers are unavailable.
				7.6	If PTM indicates OIW measurements exceeding 30 mg/L (daily average) for more than twelve consecutive hours; initiate a react visit in accordance with Produced Water OIW Off-Specification Playbook.	PTM evidence indicates a risk of OIW exceedance (24-hour average) is anticipated. Record of react visit authorisation by the Operations Manager (or delegate) Helicopter or vessel records demonstrate a react visit commenced within 5 days, weather and time-of-day permitting, following the authorisation (by Operations Manager) to undertake the react visit. Produced Water OIW Off-Specification Playbook. Produced Water OIW Off-Specification Playbook implementation records.

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
			PTM will be an important tool if both OIW analysers are unavailable or malfunctioning due to unforeseen circumstances, as it will be used to confirm performance of the PW treatment system complies with EPS 7.1. If PTM indicates there are no observable changes to a stable operating process, PTM will continue to be deployed, and the next scheduled platform visit will include restart of the analysers in an attempt to restore condition. If PTM indicates there is a lack of confidence around results, thereby risking OIW measurements exceeding 30 mg/L average for more than twelve consecutive hours, and a risk of OIW exceedance (24-hour average) is anticipated, the asset may undertake a 'react' visit to investigate and verify results when safe to do so and undertake further actions under the Crux operating procedures. A react visit authorisation by the Operations Manager is expected to take up to 48 hours, plus up to 5 days after authorisation for a helicopter or vessel to be deployed to the platform (weather and time-of-day permitting) to undertake the react visit. PW is expected to comprise condensed water only for the first ~8-9 years of discharge. However, PTM will be used to continually monitor for early identification of saline formation water breakthrough using well fluid water cut and volumes of PW discharged which may inform the potential need for additional PW treatment.	7.7	Water cut meter and discharge rates are monitored via PTM during operations in order to inform adaptive management actions (AMF step 6, Trigger #1) associated with formation water breakthrough, consistent with the AMF.	PTM records of water cut and PW discharge rate trends using DCS / PI systems. DTA full suit records following trigger #1 being activated.
			Space Provisions for future technology Space provisions and tie-ins for future produced water treatment allows responsive installation of additional secondary treatment equipment/facilities if adaptive monitoring and management framework indicates further treatment is necessary. Shell requires operational data to ascertain reservoir performance and determine the likelihood of high aquifer water production scenarios. Shell will monitor production forecasts and aquifer outcomes to plan if (and when) a high aquifer water production scenario may eventuate and plan accordingly to ensure compliance 30 mg/L (daily average) for the lifecycle of the facility. A high-water case (where formation water production is up to 3,029 m^3/day) may not ever eventuate owing to factors such as performance of the wells, intentional avoidance of relevant wells and/or more moderate reservoir outcomes). If additional treatment is predicted to be required to maintain compliance with EPS 7.1 for the lifecycle of the asset, a project will be initiated (Section 10.7.1). Utilisation of technology and space will include consideration of commitments for mercury management. The drivers for this may emanate from either field monitoring or OIW specification management. Discharges are expected to comprise mostly condensed water (freshwater condensed out of the gas phase through the process) with minimal formation water produced during the early operations phase. Based on current Operating Plan data formation water breakthrough is predicted to be ~8-9 years after startup.	7.8	Crux platform design provides for future installation of additional PW treatment equipment/technology.	Platform As Built drawings show provision for future PW treatment equipment.
				7.9	Shell will initiate a project to install OIW treatment equipment/ technology (such as hydrocyclone) if produced water dispersed oil content of the discharge exceeds 25 mg/L (daily average) for 80% of the days over a 12-month rolling period from NNM Phase 1 onward.	Records demonstrate approval decision to initiate the project. Platform As Built drawings show installation of treatment equipment/technology.
			Two OIW analysers which are maintained **Spare OIW analysers onshore** Two OIW analysers have been designed for the PW discharge to maximise availability for the measurement instrument. The OIW analysers provide information on the performance of the PW treatment system needed to help ensure discharge limits are being achieved. Validation and maintenance of the OIW analyser ensures that the equipment is operating within an acceptable tolerance of accuracy. To achieve required performance, maintenance of the analyser will be completed in accordance with the Computerised Maintenance Management System (CMMS) detailed in section 10.4.7 and 10.4.8. The frequency of the validation is increased to monthly when first brought online during commissioning and initial start-up until confidence in the system's accuracy is achieved. Spare parts for this equipment, which are stored in Darwin supply base, is detailed in EPS 7.13. This ensures 'downtime' is minimised for an impaired analyser, in the event this were to occur.	7.10	During routine operations, the OIW analysers shall be validated in accordance with the CMMS.	CMMS records of OIW analyser validation confirm validation done consistent with Preventative Maintenance Library (PML).
				7.11	During initial facility start-up, the OIW analysers will be validated monthly until confidence in the system's accuracy is achieved.	During initial facility start-up the CMMS records of OIW analyser show validation was carried out, consistent with PML, monthly until confidence in the systems accuracy was achieved.
				7.12	During routine operations, a minimum of one operational PW OIW analyser shall be online and actively monitoring whenever PW is being discharged.	DCS shows at least one OIW is available and in service (where required).
				7.13	OIW analyser spare parts are warehoused in Australia to enable expedited shipment to the facility in the event of failure of critical components.	Procurement records of OIW analyser critical components (purchase order or manifest). Warehouse inventory records.

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
			PW elevated discharge point Discharging PW from height above the sea surface: • enhances initial dispersion rates, reducing distances required to achieve effective dilution of constituents. • avoids requirement for chemical dosing to control marine fouling.	7.14	PW discharge point located ~20 m above the sea surface.	Platform As Built drawings show location/height of PW discharge outlet.
Engineering	PW treated prior to discharge via hydrocyclones	No	Hydrocyclone treatment is not required to meet the basis of design or design target for the produced water system accounting for the design cases and operating plans assumed during the design and execute phases of Crux. There is limited additional environmental benefit given very low environmental risk on basis of expected performance of degasser with DGF and modelling results for assumed PW constituents and type/volumes PW discharged prior to formation water breakthrough. There is potential to retrofit if monitoring and adaptive management framework indicates requirement for further PW treatment. The platform has been designed with space and weight provision on the cellar deck for the installation of additional future produced water treatment packages (such as a de-oiling hydrocyclone) should this be required to meet committed discharge performance standards. The future allowance assumptions include piping tie-in points located between the liquid separator and the liquid level control valve upstream of the PW degasser. A future hydrocyclone is currently assumed that it will be sized to process the maximum formation water capacity, with an estimated size of 22-inch outside diameter and ~2 m in vertical orientation with required deck volume ~96 m^3. Separated oil will require new piping and routing to the LP flare KO drum or waste oil tank. A brownfield installation activity will require plant shutdown to tie-in water and reject outlet piping, associated piping, instrumentation and electrical cabling (etc) to connect the PSV tailpipe to the flare header. The installation activity would be timed to take place during a future turnaround and may take ~30 days to complete with the mobilisation of an offshore installation vessel. Hydrocyclones increase maintenance requirements and incrementally increases the potential for mechanical failures on the platform. The design case and operational plan is based on the successful treatment of produced water to the required performance standards with the equipment installed at day one for the full facility lifecycle. The provision for an additional treatment package is therefore contingency if the actual system/reservoir performance is outside the design basis and/or does not achieve forecast predictions, design outcomes. Operational data ensures any future installations can be designed on empirical rather than theoretical data, hence increasing efficacy and efficiency of the treatment. Refer EPS 7.8.	N/A	N/A	N/A
Engineering	PW treated prior to discharge via hydrocyclones and adsorbent filtration.	No	Potential to reduce aromatic hydrocarbon levels but filters that use consumable filter elements must be regularly cleaned (e.g. back flushed) or replaced to maintain performance, increasing maintenance requirements, waste volumes and costs. Hydrocyclones combined with absorbent filtration provides limited additional environmental benefit given the very low environmental risk on the basis of expected performance of the degasser with DGF and modelling results for the assumed PW constituents and the type/volumes of PW discharged prior to formation water breakthrough. There is potential to retrofit hydrocyclones combined with absorbent filtration if monitoring and adaptive management framework indicates requirement for further PW treatment.	N/A	N/A	N/A
Engineering	PW treated to further reduce OIW via tertiary treatment prior to discharge.	No	Installation of tertiary PW treatment was evaluated as part of the Crux OPP and not considered feasible because:	N/A	N/A	N/A

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
			• tertiary treatment systems, particularly Macro Porous Polymer Extraction, will require additional space. These systems may not fit within the space constraints of the Crux platform. • tertiary treatment systems will require greater maintenance, increasing the frequency and duration of personnel visits to the Crux platform. This increases the safety risks for Shell personnel as well as associated transport emissions and potential environmental impacts/risks. Given the slight residual impact predicted for PW discharge, the overall costs (incl HSE impacts/risks) are considered grossly disproportional to any environmental benefit.			
Engineering	Divert off-spec PW to buffer tanks for re-treatment or offsite disposal.	No	Onboard storage of off-spec PW was evaluated for the Crux OPP and found not to be feasible based on the expected PW flow rates and space constraints associated with NNM basis of Crux platform design. The selected design technology for PW treatment has low complexity and is expected to reliably achieve discharge specifications. Implementation of adaptive monitoring and management framework and is adequate to ensure no unacceptable impacts from PW discharge.	N/A	N/A	N/A
Engineering	Crux platform process and monitoring systems includes the following to assist in managing mercury; • Temperature regulation to maximise partitioning of mercury to gas and condensate export streams. • Differential Temperature Alarm • Maintenance of temperature controllers and differential alarms. • No continuous injection of hydrate inhibitor chemicals into Crux field wells as detailed in Crux operating procedure. • Sampling and analysis plan	Yes	Crux platform process system includes the following measures to manage mercury; • Temperature regulation to maximise partitioning of mercury to gas and condensate export streams. • Differential Temperature Alarm • Maintenance of temperature controllers and differential alarms. • no continuous injection of hydrate inhibitor chemicals into Crux field wells. Temperature management is a critical component in the Crux design. Temperature control is primarily used to ensure gas and condensate dehydration. However higher temperatures also reduce mercury content in the water stream. <u>Inlet Cooler temperature control</u> The multiphase wellstream is initially cooled from 120°C to ~50°C in the Inlet Cooler with an expected operating window of between 45°C-55°C with a high alarm trip set to 70°C. At these temperatures, ~ 40% of the mercury in the inlet stream is predicted remain in the gas phase. A temperature controller is installed upstream of the inlet separator, providing operators with surveillance of process temperatures prior to the bulk separation stage. <u>Liquids cooler differential temperature</u> The liquids (condensate and produced water) are separated and further cooled at the Liquid Cooler to ~40°C. To maintain production limits, a differential temperature alarm is set at ~8°C to maintain a minimum temperature differential between the outlet of the inlet cooler and outlet of the liquid cooler. The temperature management components will be maintained to ensure ongoing adherence to temperature control and differential temperature functionality. At these design and operational temperatures, the mercury has a much higher solubility in gas and condensate. Use of this system control in the Crux process system is predicted to result in ~99% of the mercury partitioning to the hydrocarbon phase and routed to the Prelude FLNG Mercury Removal Unit (MRU) (~95% in late life if there is formation water breakthrough). These temperature limits therefore maximise the partitioning of mercury to the gas and condensate streams and minimised mercury partitioning in water. It should be noted that in non-routine/unstable operations, ambient weather conditions (e.g., high ambient heat conditions) can impact the operation and efficiency of the temperature controller systems on these coolers (e.g., efficiency	7.15	The temperature will target the operating window of 45°C-55°C at the inlet cooler during stable operations and the temperature will not exceed the high trip limit of 70°C.	DCS/PI records of temperature trends. Master Alarm Database shows alarm configuration.
				7.16	Production limits will be maintained with deviation outside of the operating window indicated by a differential temperature alarm.	DCS/PI records of temperature trends. Master Alarm Database shows alarm configuration.
				7.17	Temperature controller and differential temperature alarm will be maintained in accordance with the CMMS.	Temperature controller and differential temperature alarm CMMS maintenance records.
				7.18	No continuous injection of hydrate inhibitors into the wells unless required for contingency measure as described within Section 10.7.1.	Crux Operating Procedures.

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
			of the cooling fans) and therefore some variation from these temperature setpoints is allowed for in the operating envelope. Continuous injection of chemicals such as MEG and methanol increases the solubility of mercury in water and can enhance mercury concentration in the produced water stream. Crux engineering has designed-out continuous chemical injection therefore eliminating the possibility of chemicals increasing mercury concentrations in the produced water stream. The need for chemical injection as a contingency measure is allowed for and measures to control this are further detailed in Section 10.7.1. Sampling and analysis plan will include mercury monitoring of the PW system in accordance with Shell SEAM standards. A temporary lab, including mercury monitoring capability will be included on the platform for ~12 months through the early part of the activity, including the start-up phase. One key aim of the temporary lab will be to verify mercury partitioning predictions, in particular on the liquid phases, used in the design of the Crux facility to help inform future adaptive management actions in accordance with the AMF (refer to control measures below).	7.30	Refer to EPS 7.30.	Refer to EPS 7.30.
Engineering	Mercury removal techniques (gas) – Mercury Removal Unit (MRU) at Prelude FLNG for exported streams.	Yes	Crux inherent design (temperature regulation and low temperature alarm) and reservoir characteristics ensure that ~99% of the mercury is directed through the gas and condensate streams primarily to the Prelude FLNG facility (~95% in late life if there is formation water breakthrough). An assessment of best available techniques and best environmental practices was undertaken during concept engineering. The existing mercury removal units on Prelude FLNG were assessed for capability to process Crux production alongside concept phase studies on other technologies detailed below. The Prelude MRU has the capability to treat mercury within gas from the acid gas removal unit and gas recovered from the condensate stabilisation system. This system control optimises the use of existing equipment, avoiding the need for additional MRUs on the Crux platform and thus preventing resource inefficiency. The design, operations, and maintenance of the Prelude MRU are detailed in the current Prelude FLNG EP, and the processing of Crux gas and condensate will only commence once a revised Prelude FLNG EP is accepted by NOPSEMA.	7.19	The Prelude FLNG Environment Plan revision will be accepted by NOPSEMA prior to Crux hydrocarbons coming onto the Prelude FLNG facility.	Records demonstrate that the revised Prelude FLNG EP covers the processing of Crux gas and condensate activities at Prelude FLNG facilities and has been accepted by NOPSEMA prior to directing hydrocarbons to Prelude FLNG.
Engineering	Mercury removal techniques (water) – mercury treatment technologies for produced water stream	No	The Crux Installation and Cold Commissioning Environment Plan (2200-010-HE-5880-00002), Rev 7, Appendix A - Annex A-1: Crux Environment in Design Outcomes for Mercury Treatment, included a full report on all considerations for mercury treatment technologies for Crux. For additional details, including the detailed engineering considerations, predicted costs and technical feasibility of mercury treatment technologies summarised below, please refer to this report[39]. Assessment of best available techniques and best environmental practices was undertaken during concept engineering for the removal of mercury from produced water streams. This assessment included the following technologies: Macro Porous Polymer Extraction (MPPE); Adsorbent Bed using Activated Carbon; Membrane Filtration; Chemical Precipitation and Ion Exchange Resin. Factors considered in the assessment included assessment of analogues and precedents (inside Shell and in industry); vendor case studies and technology demonstration. Engineering considerations included tolerance of mercury removal techniques to well solids and dispersed hydrocarbons; operating temperatures; requirement for inlet cooling and energy consumption; requirement for utilities replacement such as catalysts, chemicals, and adsorbents (with mercury management and waste generation trade-offs); and impacts on NNM operation such as membrane or media regeneration, redundancy and switching. Factors such as the capability of the Crux design to route mercury to the export streams and MRU treatment on Prelude FLNG, lack of specific analogue data and proven techniques for Crux operation conditions, uncertainty of produced water volume and composition outcomes, safety, health, NNM, operability, cost	N/A	N/A	N/A

[39] This information is referred to as information previously given under the OPGGS (E) Regulations, Part 6, Division 1, Regulation 56 and is available on the NOPSMEA website: A1176560 (105 MB) (link current on the 05/09/2025).

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
			and waste minimisation drivers alongside dispersion modelling showing rapid dilution of produced water discharge to levels that pose a low risk to the receiving environment contributed to the decision to not design and install mercury removal technologies directly on the produced water line. The project conclusion from all assessments and considerations was that the risks and impacts are acceptable; and the cost, effort and sacrifice is considered grossly disproportionate to the environmental benefit gained for the selection of any of these controls. Since concept engineering, a revalidated study has been undertaken utilising Guidance on Best Available Techniques and Best Environmental Practices - Minamata Convention on Mercury (United Nations Environment Program, 2019) which applies to emission point source and facilities listed in Annex D of the Minamata Convention, updated by the more recent Guidance on Best Available Techniques and Best Environmental Practices to Control Releases of Mercury from Relevant Sources (UNEP/MC/2024/3, October 2024) ('Minamata Guidelines'). The revalidation confirmed that all practicable design measures to reduce environmental impacts have been implemented and any further mercury treatment or recovery measures not implemented are demonstrated to be grossly disproportionate in cost and sacrifice when compared to the environmental benefit gained. Consistent with the Minamata Convention, these controls are deemed not to be practical to implement because of fiscal and technical constraints. Therefore, the impacts are considered to be reduced to ALARP.			

Administrative and Procedural	Shell Australia Chemical Change Process.	Yes	Shell has adopted a chemical selection and approval process in accordance with Shell's chemical selection and approval guidelines (as outlined in the Shell Australia Chemical Change Process and Shell Global Product Stewardship guidelines) to assess chemicals that may pose a risk of environmental impact via planned discharges.
			In addition, Shell complies with the Industrial Chemicals Environmental Management (Register) Act 2021 and associated legislative instruments, including the Industrial Chemicals Environmental Management (Register) Instrument 2022, which establish the Industrial Chemicals Environmental Management Standard (IChEMS). Under this framework, chemicals are scheduled according to their environmental risk, with Schedules 6 and 7 representing the highest concern. Chemicals that are prohibited or require specific risk management measures under these instruments are either excluded from use or managed in strict accordance with regulatory requirements.
			This approach ensures that environmental risks associated with chemical discharges are reduced to As Low As Reasonably Practicable (ALARP) and remain compliant with applicable Commonwealth legislation. Consideration is given to the schedule to which each chemical has been assigned under IChEMS, and all associated requirements are adhered to across the chemical lifecycle, including manufacturing, import/export, use, storage, and disposal, within Australia.
			Following the chemical change process (as detailed in Section 10.3.7), together with compliance with the ICEMR Act and the Register Instrument, minimises the impact of chemicals used and discharged to ALARP levels.
				7.20	Chemicals that are planned for discharge to sea meet the following criteria:
					• are substitution warning free and rated Gold, Silver, D, or E through the Offshore Chemical Notification Scheme (OCNS), or are considered to Pose Little or No Risk to the Environment (PLONOR) (listed by the Oslo and Paris Convention for the Protection of the Marine Environment of the North-east Atlantic [OSPAR] Commission),or have a complete ALARP assessment.
					• are screened against the IChEMS register with:
					  ○ no use, importation or discharge or chemicals listed in Schedule 7 unless exempted under Commonwealth Legislation.
					  ○ a complete ALARP assessment for chemicals listed in Schedule 6.
						Chemical change assessment process forms outlined in the Shell Australia Chemical Change Process showing chemicals that are planned for discharge to sea are:
						• substitution warning free and are rated Gold, Silver, D, or E through the Offshore Chemical Notification Scheme (OCNS), or are considered to Pose Little or No Risk to the Environment (PLONOR) (listed by the Oslo and Paris Convention for the Protection of the Marine Environment of the North-east Atlantic [OSPAR] Commission), or have a complete ALARP assessment.
						• screened against the IChEMS register with:
						  ○ no use, importation or discharge of chemicals listed in Schedule 7 unless exempted under Commonwealth Legislation
						  ○ a complete ALARP assessment for chemicals listed in Schedule 6

Administrative and Procedural	Produced Water Adaptive Management Framework (AMF). The AMF includes the following measures: • Triggers for further assessment of the impacts and risks of	Yes	The implementation of AMF for PW discharges (further described in Section 10.7.1) is a system control measure that allows for continuous improvement and ensures that PW management measures are updated appropriately based on new information and changing conditions, allowing for more effective and responsive management of the PW discharge. It also accounts for adaptive management actions; and potential changes in the PW characteristics which are likely to change in some respects over time. Mixing zones for PC80, PC95 and PC99 established for this EP may be revised in future EP revisions submitted to NOPSEMA where warranted based on operational and monitoring data. Monitoring for mercury, amongst other toxicants in the PW and in the marine sediments surrounding the Crux platform is critical to confirming PW EPO's are	7.21	PW discharge will not exceed the relevant threshold concentration set by Direct Toxicity Assessment (DTA) at the edge of the mixing zone boundaries set for PC80, PC95 and PC99. Until mixing zone boundaries are set by DTA results and outcomes of the mixing zone verification study, mixing zone boundaries will be: • PC80 at 100m of the platform. • PC95 at 500m of the platform. • PC99 at 1000m of the platform.	Records of implementation of the AMF, monitoring and adaptive management actions. Records of DTA results compared against modelling results as per AMF until mixing zone verification carried out (RPS 2024). Records of full suite DTA results, mixing zone verification study and conclusions for the establishment of a PC80, PC95 and PC99 mixing zone boundaries.

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
	PW (OIW, toxicity and bioaccumulation) • Actions to build confidence around impacts occurring • Actions to reduce mercury concentrations or toxicity in PW discharge • Assessment and maturation of mercury removal technology options • Triggers for installation of mercury removal technology.		being achieved and also monitoring trends towards any exceedance of these, which will trigger adaptive management actions. Details of this are outlined in Section 10.7.1. Until mixing zone verification study is completed, dilutions required will use RPS 2024 results. Field validation of PW discharge dilution is a complex undertaking requiring coordination with ongoing asset operations and infrastructure, often involving SIMOPs that introduce safety and logistical challenges. Planning and executing such campaigns safely and effectively takes significant lead time. Additionally, field sample analysis, including laboratory processing, QA/QC, and interpretation, can take several months. These results must then be integrated into broader technical reporting, reviewed, and compared against EP/RPS 2024 modelling predictions. Only then can mixing zone boundaries be refined to more accurately reflect actual field conditions. A two-year timeframe post-NNM Phase 1 allows for this process to be completed thoroughly and safely, ensuring that environmental risks are understood and managed to ALARP. Once mixing zone verification is complete and results are received, mixing zones associated with EPS 7.22 and 7.23 (and supported EPSs) will be updated in accordance with the AMF and subsequent dilutions required will be compared against an updated model based on the mixing zone verification study. Mixing zones are considered conservative, and therefore will not increase. Australian and New Zealand Food Standard (FSANZ) provide a conservative, health-protective guideline. Applying these values, where triggered by the AMF, ensures that mercury biomagnification remains within levels considered safe for human consumption and supports the protection of ecological and food web integrity, consistent with relevant acceptable levels and managing risks to ALARP. Note that mercury is a highly volatile element that has a strong affinity for organic matter. It is soluble in natural gas and condensates and present in hydrocarbon basins globally, exhibiting a wide range of concentrations. The physical, chemical and geochemical properties of mercury create complex distributions in hydrocarbon systems. Through the process of thermal evolution, mercury concentration in hydrocarbons can be influenced by source rock origin, migration pathway and fluid chemistry (Lawer *et al* 2023).	7.22	Mercury concentrations in the produced water discharge will not exceed the ANZG marine water quality 99% DGV for mercury (0.1 µg/L) beyond the edge of the mercury mixing zone boundary set. Until mercury mixing zone boundary are set by outcomes of the mixing zone verification study the mercury mixing zone boundary is set at 20m from the produced water outfall.	Average predicted water quality mercury concentrations at the mixing zone boundary or 20m as per AMF table 5. Mercury results compared against modelling results as per AMF until mixing zone verification carried out (RPS 2024). Monitoring and other supporting records of implementation of the AMF.
				7.23	Mercury concentrations in sediments from the produced water discharge will not exceed the; • ANZG marine sediment quality GV-High for mercury (1.0 mg/kg dry weight) anywhere; or • ANZG marine sediment quality DGV for mercury (0.15 mg/kg dry weight) beyond 250m; or • Site-specific GV for mercury, if triggered to be established, will not be exceeded beyond the impact zone.	Average of sediment mercury monitoring results at the location. Results from the establishment of Site-specific GV for mercury in accordance with the AMF. Monitoring and other supporting records of implementation of the AMF. Excludes any measured exceedances during pre-operations baseline monitoring.
				7.24	No biomagnification of mercury in fish or benthic fauna beyond Australian and New Zealand Food Standard (FSANZ) for fish known to accumulate mercury (1 mg/kg) and all other seafood (0.5 mg/kg) within the impact zone.	Where triggered by AMF (Trigger #4 and Trigger #5), monitoring records taken as an average for fish/fauna types as per AMF step 6.
				7.25	Implement adaptive management actions in accordance with the AMF (step 6).	Monitoring records of implementation of the AMF. Operational records such as the DCS or shift handover record demonstrate relevant operational actions are implemented as required by AMF step 6.
				7.26	Mixing zone verification study will be completed within 2 years of NNM phase 1 commencing and mixing zone boundaries updated within 9 months of completing the infield study.	Mixing zone verification study results, and timing of completion. Consultant reports on mixing zone verification study and interpretation against RPS 2024 modelling results. Updated mixing zones in relevant EP EPSs consistent with study findings.
				7.27	Implement monitoring of PW consistent with AMF operational and adaptive management indicators, table 3.	AMF monitoring and implementation records.
				7.28	Carry out pre-FEED and FEED for mercury removal technology in accordance with AMF trigger #5 (step 6).	Mercury treatment technology project pre-FEED documents and studies.
				7.29	Install mercury treatment technology, as soon as reasonably practicable, but within 4 years of being triggered, in accordance with the AMF mercury trigger #6 (step 6).	Monitoring records of implementation of the AMF. Mercury treatment technology project, design and as built documents.
			The AMF (Section 10.7.1) ensures mercury is reduced to ALARP throughout the life of the asset. It includes chemical characterisation and Direct Toxicity Assessment (DTA) of the PW discharge stream from topsides samples; and precipitation studies and sediment monitoring as a component of the in-field monitoring program. The ALARP assessment has been based on currently available information. As noted in the mercury design basis, there is uncertainty relating to actual mercury production concentrations and uniformity within the reservoir, partitioning and water chemistry; availability of proven technologies for mercury removal; and consideration of NNM operations. A conservative basis of design was set to allow for worst case outcomes and manage the uncertainties of mercury behaviour in the reservoir. The AMF assists in managing these uncertainties during operations. Note that mercury is a highly volatile element that has a strong affinity for organic matter. It is soluble in natural gas and condensates and present in hydrocarbon basins globally, exhibiting a wide range of concentrations. The	7.30	Within 12 months of start-up, verify mercury partitioning predictions within the EP (Table 9-61) through chemical characterisation (including using the temporary offshore lab) and further predictive modelling (where appropriate). If produced water outfall mercury concentrations or predicted mass rates of discharge per year exceed predicted mercury concentrations at the PW outfall in the EP (~1.3 to 2.3 µg/L and ~0.1 to 2.6 kg/year), apply adaptive management trigger #2 in accordance with the AMF (step 6).	Records of chemical characterisation monitoring. Records of mercury monitoring results from temporary lab onboard the platform. Records of predictive mercury partitioning modelling, where appropriate (on the gas phase). Where mercury concentrations exceed produced water outfall, that reference case mercury concentrations (Table 9-61), records demonstrate AMF trigger #2 was adopted.

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
			physical, chemical and geochemical properties of mercury create complex distributions in hydrocarbon systems. Through the process of thermal evolution, mercury concentration in hydrocarbons can be influenced by source rock origin, migration pathway and fluid chemistry (Lawer *et al* 2023). The AMF manages the risk of installing removal equipment based on assumed design data (i.e., avoids selecting a novel technology that may not work) whilst remaining compliant with legislation, standards and ALARP principles consistent with the OPGGS(E) Regulations.			
			Mercury removal technologies are improving gradually. The AMF recognises this and will therefore consider developments in technologies that may change what is ALARP in future. Undertaking an interim screening every four years, offset two years from the 'detailed review' exercise for new technologies, which have not previously been assessed is considered an appropriate mechanism to identify new technologies as they become available. A detailed review and revalidation every four years (with the first review occurring within 2 years from the facility start-up to account for verified mercury rates). Detailed reviews of technologies every 4 years is considered a reasonable basis as the cost of doing such a review is anticipated to be in excess of $250,000 on each occasion. Therefore, doing a detailed review more frequently is not warranted, especially considering interim screening reviews occur on every four years also, offset by about two years from the detailed review. This is further justified given the rate of change of this technology is not considered fast, more frequent reviews are considered grossly disproportionate to any potential benefit a more frequent review would provide. None the less, further screening or detailed reviews may be considered as a further adaptive management action as appropriate (refer to Section 10.7.1). For projects without significant complications (extensive modifications) and without technical feasibility concerns, it would be expected to take an estimated 3-4 years from a decision being made to implement the project. Therefore, Shell commits to seeking to mature a project as soon as is practicable, given the process constraints to ensure projects are delivered according to Shell's standards. The principles of ALARP must be adhered to for decision points as there are unknown future variables relating to availability of technology; utilities required to operate technology; cost (design, construct, install) and interrelationships and trade-offs with waste/health/hygiene; safety, operability and maintainability - all of which will influence the assessment of gross proportionality. Assessment of gross proportionality will be visible in the committed reviews as part of the principles of ALARP assessment.	7.31	Carry out periodic reviews of mercury removal technology for PW discharge source as relevant to the Crux facility. These reviews will include: • Interim screening every four years, offset about two years from the 'detailed review' below, for new or emerging mercury removal technology that has not previously been assessed for use on the Crux facility. • Where interim screening identifies new or emerging technology, progress to formal review to establish suitability. • A detailed review and revalidation every four years (with the first review occurring within 2 years from the facility start-up to account for verified mercury rates). Detailed reviews will include consideration of: • Maturation of existing technologies, checking for advancements in treatment capacities and cost efficiency. • Assessment of new technologies (when applicable). • Technical feasibility of available technology. • Engineering risk assessment. • Latest measured mercury monitoring results. • Assessment of related aspects (e.g., health, safety, operability & maintenance). • Economic viability. • Weighting of cost compared to environmental benefit gained for adopting technology. Reviews will include a decision point on whether to proceed with a front-end engineering design (FEED) mercury removal project.	Interim screening outcomes documented in the Crux Environment in Design Process Outcomes for Mercury Treatment (2200-010-PX-5721-00001). If new technology is identified in interim screening, document review of technology in updated Crux Environment in Design Process Outcomes for Mercury Treatment (2200-010-PX-5721-00001). Detailed reviews documented in updated Crux Environment in Design Process Outcomes for Mercury Treatment (2200-010-PX-5721-00001). Records (for both interim screening and detailed review) of decision point on whether to proceed with a front-end engineering design (FEED) mercury removal project based on principles of ALARP.
				7.32	If the decision is taken to progress with FEED, within 6 months of completing FEED, a final investment decision will be made, which will take into account the principles of ALARP. Installation will occur as soon as practicable within the appropriate planned major turnaround (shutdown maintenance program) for Crux.	Financial Investment Decision (FID) based on principles of ALARP dated within 6 months of FEED completion. Where triggered, as-built records showing installation of selected mercury removal technology.

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
ALARP Demonstration Statement						
Based on the outcomes of the environmental impact assessment, including detailed modelling, treatment system performance, and adaptive management measures, Shell considers that the control measures implemented for produced water discharge are appropriate and effective in reducing environmental risks. The treatment system is designed to achieve ≤30 mg/L dispersed oil-in-water, with an operational target of 20 mg/L under normal conditions, and incorporates dissolved gas flotation for enhanced separation. Mercury partitioning and trace metal risks have been assessed and are predicted to be negligible. Adaptive monitoring and management frameworks, including trigger-based actions and performance standards, are in place to ensure ongoing compliance and continuous improvement. No additional controls were identified that would materially reduce impacts without disproportionate cost or effort. Therefore, the impacts and risks associated with produced water discharge are considered to be reduced to ALARP and acceptable levels.						

Table 9-51: ALARP Assessment and Environmental Performance Standards – Stage 1 Well Clean-ups and Well Interventions/Workovers

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	Environmental Performance Standard	Measurement Criteria
ALARP Assessment						
Elimination	PW during well clean-up is collected and taken onshore for disposal.	No	Storage, handling, and transport of PW would generate additional emissions and HSE risks. Given the very small volumes and the low environmental risk with discharge of treated PW, the costs (including HSE) are disproportionate to the potential environmental benefit.	N/A	N/A	N/A
Substitution, Engineering and Administrative and Procedural	Temporary well test package system design.	Yes	Temporary well test package system includes: temporary flare for PW incineration, bulk separation – 3-Phase Separator, temporary surge tank and oil block filters, Off-spec PW recirculated for re-treatment before disposal, Off-spec PW recirculated, Elevated PW discharge, validated by monitoring and discharge rates and volumes monitored.	7.33	Temporary well test package contains temporary flare for combustion of PW OIW content.	Temporary well test package design records.
	Temporary flare for PW incineration.		Primary disposal option for PW with high OIW content is incineration in the temporary flare therefore minimising discharge to sea (except where it cannot be combusted) and with negligible contribution to project air emissions.			
	Bulk separation – 3-Phase Separator, temporary surge tank and oil block filters.		It is intended that under normal conditions, water, and oil (condensate, condensed water, and base oil completions fluid returns) from the separator will be recombined after metering and incinerated in the oil burner mounted on the flare boom. Any residual water that is not incinerated in the flare boom will be filtered and disposed overboard in batches by piping which discharges at an elevation above the sea surface. Water discharges may contain residual oil in water (not captured by the three-phase separator). Inclusion of separation capacity in temporary well test package (or equivalent) provides for OIW content in PW discharge to be reduced prior to start-up of PW treatment system. The expected water production per well is 78 bbls, and the design temporary equipment performance is set to achieve performance of 30 mg/L daily average for up 540 bbls per well (which significantly exceeds the predicted volumes) by allowing for multiple passes through the oil filtration system. If the volume of water exceeds 540 bbls (e.g., due to unforeseen production of formation water), multiple passes are no longer possible due to capacity. In the unplanned event of water volumes exceeding 540 bbls, the OIW content levels may be up to 95 mg/L daily average. Given this is not a predicted outcome (i.e., design flow rate is 78 bbls per well), it is not feasible for larger tank capacity to be installed to provide for storage and multiple pass circulation for these short duration activities. Shell has set the performance standard at 95 mg/L daily average for flows greater than 540 bbls per well.	7.34	During stage 1 clean-up and workover activities, batch PW discharge shall have measured OIW content not exceeding 30 mg/L daily average for volumes of less than 540 bbls per well. During stage 1 clean-up and workover activities, batch PW discharge shall have measured OIW content not exceeding 95 mg/L daily average for volumes greater than 540 bbls per well.	Records of OIW content in each PW batch discharge maintained to validate that the concentration of oil meets requirements.
	Off-spec PW recirculated for re-treatment before disposal.		Capturing and retreating off-spec PW ensures OIW content in discharge achieves required OIW content limit.			
	Elevated PW discharge outlet to aid mixing and dilution.		Discharging from height above the sea surface enhances initial dispersion rates, reducing distances required to achieve effective dilution of constituents.	7.35	PW discharge point to be located above the sea surface.	Temporary well test package (or equivalent) specifications/drawings show location/height of PW discharge outlet.
	PW treatment system is validated by monitoring of dispersed OIW concentration.		Measuring OIW content in PW provides information on the performance of PW treatment and assurance that discharge limits are achieved.	7.36	During Stage 1 well clean-ups and workovers, PW OIW content measured prior to each batch discharge.	Records of sampled PW OIW content.
	PW discharge rates and volumes monitored by temporary well test package (or equivalent) operator using procedure.		Monitoring of tank levels and/or via flow meter in temporary well test package (or equivalent) allows determination of PW discharge rates and volumes. This is implemented by the operator following the well test package operator procedure.	7.37	Temporary well test package operator procedure implemented and included measurements of PW discharge rates and volumes.	Records demonstrate measurements of PW discharge rates and volumes undertaken by temporary well test package operator.
ALARP Demonstration Statement						
Based on the outcomes of the environmental impact assessment and the control measures adopted, Shell considers that the implemented controls are appropriate to manage the potential impacts and risks associated with produced water discharge during Stage 1 well clean-ups and well interventions. The treatment system design, operational procedures, and discharge monitoring are consistent with regulatory expectations and Shell's internal standards. No feasible additional or alternative controls were identified that would further reduce the impacts and risks without disproportionate cost or effort. Therefore, the impacts and risks are considered to be reduced to ALARP and acceptable levels.						

9.9.5 Acceptability of Impacts

Table 9-52: Acceptability of Impacts – PW Discharge

Receptor		Acceptable Level of Impact	Acceptable?	Acceptability Assessment
Category	**Subcategory**			
Physical features, values and sensitivities	Water quality	No significant impacts to water quality. Impact not expected to result in a substantial change in water quality, which may adversely impact biodiversity, ecological integrity[26], social amenity or human health.	Yes	EPO 2.2, EPO 7.1, EPO 7.2 and EPO 7.3 have been established to ensure acceptable levels of impact are maintained for water and sediment quality and risks of bioaccumulation of mercury associated with produced water (PW) discharge. These objectives are informed by professional judgement and supported by multiple lines of evidence, including: • Original PW modelling results from the Crux OPP. • Updated EP modelling and contaminant toxicity assessments. • Peer-reviewed literature (e.g. Bakke et al. 2013). • Acceptable impact and risk thresholds outlined in Section 8.2 of the EP. • PW Direct Toxicity Assessment (DTA) results from the Prelude FLNG facility. There is no predicted exceedance of toxicant DGVs for sediment quality beyond the 1 km impact zone (250m for mercury). Sediment quality may be slightly impacted at locations immediately around the platform over a longer timeframe (e.g. tens of years), but such impacts are considered unlikely over the duration of this EP. Slight, localised impacts in the immediate vicinity of the platform are considered acceptable.
	Sediment quality	No significant impacts to sediment quality. Impact not expected to result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity[26], social amenity or human health may be adversely affected.	Yes	
Natural features, values and sensitivities	Marine bioregions	No significant impacts to benthic habitats and communities. Impacts to non-sensitive benthic communities limited to a maximum of 5% of the Project Area (as defined in the OPP). No significant adverse effect on pelagic communities, populations, habitats or spatial distribution of a species. No substantial adverse effect on a population of a marine species or cetacean including its lifecycle and spatial distribution.	Yes	No direct impacts to benthic communities expected due to water depths at platform location and buoyancy of the PW plume. The benthic habitats and communities within the area of potential indirect effects from PW discharge are broadly distributed and not considered unique or particularly sensitive. Impact predicted to be highly localised to platform location and to represent <5% of the Project Area (as defined in the OPP). Modelling studies indicate that potential impacts of PW discharge will be localised around the platform which is characterised as open offshore waters, typical of the bioregion. Given the dispersion and dilution predicted following discharge, mobile species are unlikely to be exposed to sufficient concentrations of PW for sufficient durations to have significant impacts on mobile species. Localised scale (<1 km) of mixing zone represents negligible proportion of regional planktonic assemblage distributions which are expected to rapidly recover from any adverse effects. Given the absence of important habitat and ecological assemblages of pelagic species, potential effects to pelagic communities within a 1 km mixing zone boundary will not have any significant adverse impact on pelagic communities, populations, habitats or spatial distribution of a species.
	Threatened, migratory, marine and cetacean species	Management of aspects of the activity must align with Conservation Advice, recovery plans and threat abatement plans. No significant impacts to EPBC Act listed threatened, migratory, marine or cetacean species.	Yes	Most EPBC Act listed species within the area predicted to be influenced by the PW discharge are air breathing vertebrates, which are unlikely to be directly affected as their skin is relatively impermeable and they breathe air. Hence, direct impacts are not considered credible. Non-air breathing species are not anticipated to be present in significant numbers nor be exposed to levels that may adversely impact on individuals and therefore there will be no significant impacts.
Socioeconomic features, values and sensitivities	Fishing industry	No negative impacts to targeted fisheries resource stocks that result in demonstrated loss of income for commercial fisheries. Temporary displacement of fishing activities within the Activity Area (excluding PSZs) is acceptable. Permanent exclusion of fishing activities from PSZs is acceptable.	Yes	No impacts to fisheries are predicted whilst fisheries are excluded from the PSZ. Uncertainty around potential fisheries impacts related to bioaccumulation of mercury in benthic fauna and/or fish are managed to acceptable levels through EPO 7.3 and associated control measures and EPSs which ensure impacts and risks are managed within acceptable levels. EPO 7.3 ensures that produced water discharge do not result in contaminant levels in water and sediment that could reasonably lead to bioaccumulation at levels compromising ecosystem integrity or the safe consumption of aquatic resources.

The assessment of impacts from PW discharge determined a Slight residual worst-case impact (Table 9-49). The acceptability of the potential impacts from PW discharge associated with the activity has been considered in the following context.

Principles of ESD

The potential impacts from PW emissions are consistent with the principles of ESD because:

- The aspect does not degrade the biological diversity or ecological integrity of the Commonwealth Marine Area and significant impacts to MNES are not anticipated to occur.
- The precautionary principle has been applied, and studies/reviews were undertaken where knowledge gaps were identified. This knowledge was applied when evaluating environmental impacts.

Relevant Requirements

Managing the potential impacts from PW discharge is consistent with relevant legislative requirements (Table 9-53) and other relevant requirements, including:

- ANZG water quality guidelines.
- policies, strategies, guidelines, Conservation Advice, and recovery plans for threatened species.
- implementation of recognised industry standard practice, such as:
  - treatment of PW to ≤30 mg/L residual OIW.
  - chemical selection process for process chemicals discharged to the environment.
  - AMF for PW discharges.

Matters of National Environmental Significance

Threatened and Migratory Species

The evaluation of PW discharge impacts indicates that significant impacts to threatened and migratory species will not credibly result from PW discharge during the activity. Table 9-53 demonstrates alignment between the activity and relevant management plans, recovery plans and Conservation Advice.

Commonwealth Marine Area

The PW discharge impacts from the activity are predicted to not exceed any of the significant impact criteria for the Commonwealth Marine Area listed in Table 8-1; as such, it is considered that the aspect does not pose a credible risk of significant impact to the Commonwealth marine environment.

Table 9-53: Summary of Alignment with Relevant MNES Considerations

MNES	MNES Acceptability Considerations	Demonstration of Alignment
Threatened and Migratory Species	Significant impact guidelines for critically endangered, endangered, vulnerable and migratory species (Table 8-1)	The application of the Shell Chemical Change Process and proposed management controls for PW discharges reduces the potential for impacts from toxic pollutants introduced into, and/or persisting in, the marine environment.
	Conservation Advice on *Balaenoptera borealis* (sei whale) (DoE 2015c)	
	Conservation Advice fin whale (*Balaenoptera physalus*) (TSSC 2015b)	
	Recovery plan for Marine Turtles in Australia 2017– 2027 (CoA 2017b)	
	Conservation Advice on *Rhincodon typus* (whale shark) (DoE 2015e)	

MNES	MNES Acceptability Considerations	Demonstration of Alignment
Commonwealth Marine Area	Significant impact guidelines for Commonwealth marine environment (Table 8-1)	As detailed in Table 9-52, water and sediment quality impacts from PW discharges are expected to be highly localised. Impacts are not considered to be significant in the context of the significant impact criteria for the Commonwealth Marine Area given the nature and scale of the impacts and the characteristics of the local receiving environment (open offshore waters with regionally well represented soft and bare sandy sediments). The impact assessment indicates that any impacts associated with PW discharges are predicted to not have the potential to result in significant adverse impacts on marine ecosystem functioning/integrity, social amenity or human health. Shell has sought to reduce potential impacts by selecting and implementing the controls and EPSs listed in Section 9.9.4.

External Context

To date, no objections or claims about PW discharges have been raised by relevant persons. Shell's ongoing consultation program will consider feedback and claims or objections made by relevant persons throughout the life of this EP (see Section 5.13). Where new impacts or risks are established, these will be subject to the MOC process described in Section 10.3.5.

Internal Context

Shell also considered the internal context, including Shell's environmental policy and ESHIA requirements. The EPOs and the controls that will be implemented for the activity are consistent with the outcomes from consultation for the petroleum activity and Shell's internal requirements.

Acceptability Summary

The assessment of impacts and risks from PW discharges determined the residual impact ratings were Slight or lower (Table 9-49). The acceptability of the impacts from PW discharge associated with the activity has been considered in the context of:

- the established acceptability criteria.
- ESD.
- relevant requirements.
- MNES.
- external context (i.e. stakeholder claims).
- internal context (i.e. Shell requirements).

The EPOs defined in section 9.9.6 ensure the acceptable levels detailed in section 8.2 will not be exceeded for key environmental receptors, particularly physical values and sensitivities, natural features, natural values and sensitivities (including water quality, sediment quality, fisheries and marine ecological integrity).

Together, these EPOs and associated EPSs are implemented through a rigorous AMF that includes monitoring, modelling, and trigger-based responses. This ensures that any deviation from expected outcomes is detected early and managed proactively, maintaining compliance with Shell's commitments to environmental protection.

Shell considers impacts and risks from PW discharge associated with the activity to be ALARP and acceptable levels.

9.9.6 Environmental Performance Outcome

EPO #	EPO	Measurement Criteria
2.2	Refer to EPO 2.2.	Refer to EPO 2.2.
7.1	No impact to the water quality outside of the Mixing Zone Boundary from discharge of produced water.	Monitoring and other supporting records of implementation of the AMF.
7.2	Potential precipitation of toxicants from the PW discharge will not exceed toxicant default guideline values for sediment quality (ANZG) outside the impact zone for sediment, except where pre-operations baseline monitoring potentially shows exceedance already (ANZG).	Sediment quality monitoring results within and outside the impact zone. Monitoring and other supporting records of implementation of the AMF.
7.3	Ensure that produced water discharge does not result in contaminant levels in water and sediment leading to bioaccumulation at levels compromising ecosystem integrity or the safe consumption of aquatic resources.	Water quality monitoring results as per AMF step 2. Sediment quality monitoring results as per AMF step 2. Benthic fauna monitoring results adjacent to the platform, where triggered by the AMF (Trigger #4). Fish monitoring results adjacent to the platform, where triggered by the AMF (Trigger #5). Monitoring and other supporting records of implementation of the AMF.

9.10 Activity Discharges

9.10.1 Aspect Context

When manned (Section 6), the platform topsides will discharge liquids to the marine environment in the form of greywater (from sinks, basins, and showers), sewage (from the ablution module and temporary refuge) and through an open drains system when washdown events occur or during rainfall. There will be no food waste discharged from the platform. Additional activity discharges will also occur temporarily for short periods during well completions.

When the topsides are unmanned, there will be no activity discharges to the marine environment other than collection and discharge of stormwater during rain events through the open drains system and a minor influent to the open drain separator from the produced water oil-in-water analysers (Sections 6.7.8 and 6.7.12) which discharges reject sample water.

During manned periods, vessel operations and maintenance campaigns, there will be standard marine vessel activity discharges within the Activity Area.

This section excludes activity discharges related to produced water (see Section 9.9).

9.10.1.1 Crux Platform Discharges

9.10.1.1.1 Greywater

The following systems will discharge greywater from basins/showers to the marine environment through a separate header to the sewage caisson, which discharges ~15 m below the sea surface:

- Ablution module for up to ~80 POB.
- Temporary refuge with two basins and integrated shower with capacity up to ~40 POB when accounting for emergency sleeping space (see Section 6.7.21.1).
- Laboratory basins (contaminated water is self-contained for onshore disposal).

Greywater would typically be comprised of service/potable water reticulated to sinks, basins and showers combined with surfactant/detergents and any associated constituents washed through the system.

9.10.1.1.2 Sewage

The following systems will discharge macerated sewage to the marine environment through the sewage caisson which discharges ~15 m below the sea surface:

- Ablution module for up to ~80 POB.
- Temporary refuge with up to two toilets with capacity of up to ~40 POB when accounting for emergency sleeping space (see Section 6.7.21.1).

Each toilet has its own integrated macerator to convert solids and fluids into fine slurry before being expelled into the sewage line. Sodium hypochlorite will be injected into the disposal caisson on a regular basis. Temporary, self-contained toilet/ablution modules that are not discharged to the sewage or greywater header may also be used during hot commissioning, start-up and any subsequent planned or unplanned campaign depending on scope requirements. Sewage or greywater from these temporary units will be discharged through temporary piping/hoses for short durations or shipped onshore for disposal as required.

9.10.1.1.3 Drains Discharges

The topsides platform stormwater and washdown drainage system is segregated into the following categories based on area/source and will be in operation through all activities:

- Oily water open drains.
- Chemical open drains.
- Overboard open drains.

Oily Water Open Drains

The oily water open drain system is open to the atmosphere and is designed to safely collect, contain and remove oily water in an open drains separator, and therefore dispose of deck run-off and liquids from potentially oil/hydrocarbon contaminated surfaces (which may be in hazardous or non-hazardous area classifications) as a consequence of storm events, accidental spillage or washdown. The open drains separator is a horizontal three-phase separator with a single weir arrangement (for liquid-liquid separation), and a plate pack for oil droplet removal and bucket for oil collection. The only continuous influent to the open drain separator is the small stream from the produced water oil-in-water analysers (Sections 6.7.8 and 6.7.12) which discharges reject sample water. All other influents to the open drain separator occur during rainfall events, washdown/jetting operations when manned, or following accidental spills and any subsequent responses such as suppression mists.

The first flush of stormwater from potentially oil contaminated areas will be captured for treatment; drainage water above the first flush will be considered clean and discharged directly overboard via overflow piping in the system. The well bay area is classified as potentially oil contaminated when well activities are being undertaken and provided with containment for that period, but otherwise in normal operations classified as not contaminated (overboard drains).

Chemical Open Drains

The chemical open drain system is designed to safely collect and contain chemical contaminated spills because of maintenance activity to prevent these liquids from being discharged overboard. When required, deck drains, bunds, and tundishes from all areas with inventories of water soluble or high specific gravity chemicals are routed through the chemical drain system to the oil bucket of the open drains separator, and the collected fluids disposed to the waste oil storage tank for disposal onshore. Outside maintenance periods, the system will discharge rainfall/runoff overboard via either the open drain separator or drain boxes.

Overboard Open Drains

The overboard open drain system is open to the atmosphere and is designed to safely collect, contain, and dispose of deck runoff water from first flush rainfall overflow from areas which are not classified as having the potential for oil contamination. During periodic testing or actual emergency use, suppression water or the deck integrated firefighting system will be normally discharged overboard through the open drains system.

9.10.1.1.4 Well Completions

The well completions activities require short-term activity discharges to be released to the marine environment through temporary equipment associated with the first stage well clean-up. These discharges include pressure test/flush water and water curtains.

Pressure test and flush water is sourced from service water or imported water and likely to be dosed with oxygen scavenger, biocide, and corrosion inhibitor (at a concentration such as ~1000 ppm. Chemicals are selected in accordance with the Shell chemical selection and approval guidelines (see Section 10). The intention is that some, or all, of this water will be incinerated using the temporary flare boom during first stage clean-up. Any water that cannot be disposed of in this manner will be filtered and discharged to the marine environment through temporary piping/flexible hose with a release point above the sea surface (potentially commingled with other produced water discharges from this activity, see Section 9.9). If required, discharge will be of short duration until testing and flushing is complete and therefore does not involve a significant volume (estimated to be less than 200 m^3). Any pressure test or flush water used in the second stage clean-up will also be disposed overboard either via the permanent produced water handling system or temporary piping.

Water curtains (deluge) sourced from seawater (without any chemical treatment) will also be used for safety reasons during first stage clean-up flaring to help provide cooling to protect people and equipment from heat radiation. Depending on wind direction, deluge water may accumulate on deck and discharge through the open drain system or grated decking; however, it is not chemically dosed and will return to the marine environment.

9.10.1.2 Subsea Discharges

Subsea maintenance activities, system maintenance, equipment replacements, refurbishments and change-out may be undertaken during all activity periods to prevent deterioration and/or failure of infrastructure; maintain infrastructure reliability and performance, and ensure infrastructure is adequately maintained to enable the option of future removal.

Valve function testing and cycling of valves may be performed from the platform with observations by the ROV or control system, or manually performed by ROV, and routine testing is likely to result in small quantities of fluids being discharged.

Marine growth and calcareous deposit removal may also be undertaken by water jetting from an ROV or by divers, generally with untreated potable water or seawater, although items exhibiting calcareous deposit accumulation may require acid washing or soaking (typically using water-soluble sulphamic acid or similar). This task may precede other maintenance activities, where operation of or access to the equipment is hindered by marine growth or calcareous deposits.

IMR activities may involve the occasional subsea discharge of small quantities of fluids typically MEG, hydraulic fluids, acid and/or well fluids.

Estimated activity discharge compositions and volumes for typical IMR activities are subject to change and specific task assessment but indicative estimations include:

- chemical dye releases (~10 to 20 litres) during pressure and leak testing.
- control fluid releases (~5 to 10 litres) during hotstab/coldstab interventions and valve function testing.
- hydrocarbon (~1 to 10 litres), MEG (~100 litres) and scale inhibitor (~50 litres) during intervention isolations and subsea equipment replacements.
- acid-water mix (~20 to 200 litres typically citric or sulphamic acid) during calcium deposit and marine growth removal, also associated with water jetting, brush systems, and sand/abrasive blasting.
- hydraulic fluid (~20 to 100 litres) from operation of ROVs.
- staurolite products used for abrasive/sand blasting to clean and remove marine growth, the main component is staurolite, which is a naturally forming mineral.
- dilute preservation fluids such as corrosion inhibitor, oxygen scavenger, biocide (~5 to 10 litres).
- grout bag filling/hose flush (~20 to 200 litres), typically concrete based.

Subsea IMR activities such as ROV operations, pressure leak testing, flushing, hot stab operations, umbilical or hydraulic flying lead replacement, SSIV flushing (etc) all have potential for minor releases of residual

hydrocarbon liquids and gas, chemicals, nitrogen, control fluids, and hydraulic fluids with the volume involved depending on the geometry, pumping rates and task specific requirements.

Any major pipeline repairs may require hydrostatic pressure testing of the pipeline or section. If the leak testing fails, the repair will need to be rectified, and re-installed. The leak test may comprise flooding, gauging, and/or cleaning pigs or an alternative spread that uses chemical injection, filtration, and pumping equipment. Following a successful hydrostatic pressure test, the pipeline must be recommissioned via a dewatering and conditioning pig train. The conditioning pig train is expected to comprise slugs of compressed air, treated potable water, and MEG which will be discharged subsea or via temporary piping on the platform or Prelude FLNG.

9.10.1.3 Marine Vessel Discharges

Throughout all activity phases, marine vessels will transfer and receive goods and materials to/from the platform. Marine vessels will also be mobilised for the purposes of accommodation (ASV and W2W vessel), maintenance, fast rescue, IMR and other surveillance activities. Vessels routinely discharge a variety of wastewater streams to the marine environment including ballast, sewage, greywater, food waste, cooling water, brine, and bilge, as summarised in Table 9-54.

Table 9-54: Summary of Typical Marine Vessel Discharges

Type	Description
Discharges	
Ballast water	Ballast water will comply with the Australian Ballast Water Management Requirements (DAWE 2020), which implements the requirements of the *Biosecurity Act 2015* (Cth) and the International Convention for the Control and Management of Ships' Ballast Water and Sediments (of appropriate class).
Sewage and greywater	The volume of sewage and greywater is proportional to the POB number. Up to ~40 litres of sewage/greywater may be generated per person per day.
Deck drainage/run-off	Drainage water from vessels may comprise rainwater, sea water and washdown water, and which may contain trace residual quantities of oil, grease, detergents, grout, dyes, inhibitors, biocides, etc.
Cooling water	Excess or unused heat in cooling water will be carried away from vessel and equipment components using sea water and returned to the sea with residual sodium hypochlorite.
Bilge water	Oily bilge water will be treated via an oily water filter system to achieve 15 mg/L after treatment, then discharged.
Brine (if a reverse osmosis unit is used for water treatment)	Brine generated from the water supply systems on the vessels will be discharged to the ocean at a salinity ~10% higher than sea water.
Putrescible food waste	The volume of putrescible food waste effluent is proportional to the POB number. Putrescible waste discharge to sea will be ~1 litres of food waste per person per day and macerated in accordance with MARPOL as required.

9.10.2 Description and Evaluation of Impacts

Table 9-55 indicates the environmental features and values and sensitivities that have been identified to be potentially affected by the activity discharges that may occur during the activities covered by this EP, with further evaluation of the impacts and/or risks to each potentially affected receptor category (including cumulative impacts) provided in Sections 9.10.2.1 to 9.10.2.4. Features or values and sensitivities which could not be credibly affected by activity discharges are not discussed further.

Activity discharges to the marine environment may result in a localised decline in water quality, which may expose sensitive biological receptors in the area affected to physiochemical changes and/or contaminants at concentrations that may cause acute or chronic effects. The magnitude and sensitivity of any impacts on sensitive receptors will vary depending on multiple factors, including discharge composition, plume dilution/dispersion, bioavailability, duration of exposure and marine species physiology and behaviour.

Table 9-55:Activity Discharges Receptor Impact Screening Summary

| | Protected Areas | | | Features | | | | | | | | | | | | | | | Values and Sensitivities | | | | | | | | | | | | | | |

9.10.2.1 Natural Features

9.10.2.1.1 Timor Province Bioregion

Benthic Communities

The majority of activity discharges, including routine discharges from the Crux platform, involve relatively small volumes at or near the sea surface which are expected to be rapidly dispersed and diluted upon release into the open ocean environment. Given the water depths in the Activity Area, benthic communities are not anticipated to be adversely affected.

In the highly unlikely event that major repairs are required to subsea infrastructure, notably the export pipeline, that necessitate subsequent hydrotesting and dewatering, larger volumes of treated water may be released, potentially affecting benthic communities. Detailed evaluation, including dispersion modelling, of a worst-case scenario involving dewatering of the full pipeline inventory is provided in the Crux Installation and Cold Commissioning EP (Shell 2024a). The assessment indicates that potential impact consequences to benthic communities are Minor (Magnitude: –2; Sensitivity: L), with no long-term effects anticipated.

Pelagic communities

Pelagic communities potentially affected by activity discharges include plankton and pelagic marine fauna. EPBC Act listed species of marine fauna (including fish, sharks and rays) are discussed in Section 9.10.2.3.2.

The mobile nature of pelagic fauna combined with the intermittent nature of most activity discharges and the relatively localised extent of impacts on water quality (Section 9.10.2.2.1) restricts the likely duration and concentrations of exposure to contaminants that may have adverse effects. Impacts to pelagic fish are expected to be limited to avoidance of any localised area of decreased water quality. Discharge of sewage and putrescible wastes may create a localised and temporary increase in food sources for scavenging marine fauna, such as fish and seabirds. Given the absence of aggregation areas that may be exposed to activity discharges, and the localised extent of potential effects relative to the widespread distributions of the pelagic fauna present within the Activity Area, no or negligible impacts are expected.

Nutrients in sewage, greywater, and putrescible waste, such as phosphorus and nitrogen, can stimulate increased growth in phytoplankton. Conversely, the chemical and/or other potential contaminants in some discharges may have toxic effects on plankton. However, open marine waters are typically influenced by regional wind and large-scale ocean current patterns resulting in the rapid mixing of surface and near-surface waters where most discharges will occur. Because of this highly dispersive environment, potential effects are limited to the immediate vicinity of the discharge. Although the Timor Sea is characterised as a low nutrient environment (Brewer et al. 2007), natural seasonal upwelling can result in localised and sporadic high phytoplankton productivity along/offshore of the Sahul Shelf. Planktonic communities are regionally distributed and characterised by relatively rapid turnover rates of short-lived biota. Consequently, impacts from activity discharges are expected to be limited to short-term, localised changes in planktonic communities in the immediate vicinity of the discharge.

The impact consequence to pelagic communities associated with activity discharges is considered Slight (Magnitude: −1, Sensitivity: L).

9.10.2.2 Physical Values and Sensitivities

9.10.2.2.1 Water Quality

Deck Drainage, Bilge Water and Well Completions Discharges

Platform deck drainage and bilge water discharges from vessels are likely to be intermittent throughout all activity phases depending on the manning mode and frequency of rainfall and washdown events, and status of marine vessel campaigns. Activity discharges during well completions (pressure test/flush water and water curtains) are of short duration and limited to the first stage well clean-up. These discharges can affect water quality immediately surrounding the discharge points, with the spatial extent of effects depending on the volume and characteristics of the discharge(s).

Discharges of oily water from vessels will be treated to ≤15 mg/L in accordance with MARPOL requirements whilst platform discharges from the open drain system will be treated by the Open Drain Separator (6.7.12). Minor quantities of various metal and chemical constituents that are not captured by the oil treatment systems (Section 6.7.11) may be discharged into the ocean along with the residual hydrocarbons, potentially causing

localised and temporary reductions in water quality. Discharges are expected to disperse and dilute rapidly in the receiving waters, with contaminant concentrations dropping with distance from the discharge point. Given the water depths in the Activity Area, effects on water quality from these minor quantities of diluted toxicants are expected to be restricted to surface waters and unlikely to reach deep water/seabed receptors. Considering the minor quantities of contaminants involved and the high level of dilution/dispersion that will occur within the open water environment of the Activity Area, no significant impacts from the discharges are anticipated.

Overall, the residual impact consequence to water quality from deck drainage, bilge water and well completions discharges is considered Slight (Magnitude: −1, Sensitivity: L).

Putrescible Waste, Greywater and Sewage

Discharge of putrescible waste, greywater and sewage into the marine environment will occur when the platform is manned and/or vessels are operating in the Activity Area. These discharges can contain various substances (typically at very low concentrations), including oil/grease, some organic compounds, detergents, metals, suspended solids, chemicals (including treatments to keep inlet and outlet pipes associated with these waste systems free of biofouling), personal hygiene products and pathogens. Discharge will affect water quality, resulting in localised eutrophication, increased turbidity, increased microbe (eg bacteria) counts, and increased biological oxygen demand (BOD). Given the generally buoyant nature of the discharge and water depths in the Activity Area, effects on water quality are expected to be restricted to near surface waters and have no impact on deep water/seabed receptors.

In 2008, Woodside monitored water quality downstream of a 10 m^3 sewage discharge from an offshore platform. Monitoring was undertaken at distances of 50 m, 100 m and 200 m from the platform and at five different water depths over a period of 24 hours (Woodside 2008). This monitoring confirmed that discharges of macerated sewage were rapidly diluted and nutrients rapidly metabolised. The discharge was reduced to ~1% of its original concentration within 50 m and no elevations in monitored water quality parameters (e.g. total nitrogen, total phosphorous and selected metals) were recorded above background levels at any station. Similar rates of dilution are expected for the open waters of the Activity Area.

Given the volume and properties of the discharged effluent, which are typically highly biodegradable, low toxicity and low persistence, the rapid dilution in the open ocean environment, localised impact area, and the offshore location of the Activity Area, the residual impact consequence to water quality is assessed as Slight (Magnitude: −1, Sensitivity: L).

Subsea Discharges

There is potential for localised adverse effects on water quality because of subsea hydrocarbon and chemical discharges during operations and IMR activities. Routine discharges are minor and are minimised as far as practicable via pre-flushing of the lines during IMR activities. During operations, subsea control fluid discharges from SSIV actuation are eliminated by the closed loop system which returns fluids to the topsides. Fluids and chemicals released intermittently during IMR activities are typically of small volume and duration, expected to mix rapidly and dilute in the water column. Gas and condensate may be released during IMR activities that break containment of isolated subsea infrastructure. Hydrocarbons are likely to become dispersed as bubbles in the water column, which will rise to the surface. Methane (CH_4) is the principal component of the gas and is relatively insoluble in water. No measurable impacts to water quality are expected to occur because of these gas or fluids releases.

In the highly unlikely event that major repairs are required to subsea infrastructure, notably the export pipeline, that necessitate subsequent hydrotesting and dewatering, larger volumes of treated water may be released. Assessment of hydrotest dewatering for the pipeline installation (Shell 2024a) noted that the chemical additives were readily biodegradable with no potential for bioaccumulation, and that modelling indicated required dilutions of the constituents would be achieved within around 1 km of the release. Given the mixing potential at the oceanic location and the highly infrequent nature of this potential discharge, impacts to water quality would be limited in duration with rapid recovery expected once the discharge ceased.

Overall, the residual impact consequence to water quality from subsea activity discharges is considered Minor (Magnitude: −2, Sensitivity: L).

Cooling Water and Desalination Brine

The key physicochemical stressors associated with reject brine and cooling water discharges from vessels include salinity, temperature, and chemical toxicity. Generally, the chemical additives in desalination brine and cooling water are at low dosages which are largely consumed in the inhibition process, so there is little or no

residual chemical concentration remaining upon discharge. As such, any potential impacts to water quality are expected to be highly localised.

Depending on the vessel configuration, the temperature of cooling water discharge will cool rapidly as it falls to the sea surface and/or mixes with the receiving waters. Similarly, desalination brine, which is more saline and therefore denser than seawater, will sink and disperse rapidly in the deepwater and open oceanic conditions in the Activity Area. Studies of vessel brine discharges by the US EPA reported a 40 fold dilution within 4 m of surface discharge (Frick et al. 2001), indicating there would be no impacts beyond very close proximity of the discharge point.

The residual impact consequence for water quality as a result of vessel cooling water and desalination brine discharges is assessed as Slight (Magnitude: −1, Sensitivity: L).

9.10.2.3 Natural Values and Sensitivities

9.10.2.3.1 BIAs

The whale shark BIA associated with the migration of whale-sharks to/from Ningaloo overlaps the Activity Area and therefore is potentially affected by activity discharges. However, the temporary and/or highly localised nature of potential changes in water quality associated with activity discharges (Section 9.10.2.2.1) and the extensive area (~8,785 km^2) of this BIA in the immediate region means that the proportion of the BIA potentially affected is negligible. Since whale sharks could still migrate within the BIA even if entirely avoiding areas affected by activity discharges, no impact on the functional value of the whale shark BIA is expected.

9.10.2.3.2 Threatened, Migratory, Marine and Cetacean Species

Many of the EPBC Act listed species potentially exposed to activity discharges are air-breathing vertebrates, which are unlikely to be directly affected as their skin is relatively impermeable. Fish, including sharks and rays, are more susceptible to impacts from changes in water quality, particularly the potential toxicity of residual contaminants in discharges. However, there are no aggregation areas for any species of fish, sharks or rays within areas credibly affected by activity discharges and threatened or migratory species that may occur coincident with discharges, including whale sharks, are highly mobile and widely distributed.

The discharge of sewage and putrescible wastes will create a localised and temporary increase in particulates on or near the surface waters. This may act as a food source for scavenging marine fauna (e.g. fish and seabirds), whose numbers may temporarily increase locally as a result, and/or stimulate increased phytoplankton growth. This in turn could offer additional prey sources for predatory fish or cetacean species (e.g. dolphins) potentially altering feeding behaviours. However, given the nature and scale of discharges and the absence of important habitats for these species in areas potentially affected, the extent of any effects on EPBC Act listed species are expected to be negligible.

The discharge of cooling water will create a localised and temporary increase in water temperature on or near the surface waters. Sea snakes, including the dusky sea snake, are aquatic ectotherms that have little capacity to thermoregulate. However, marine sea snakes can generally avoid high water temperatures for short periods of time by moving to deeper and cooler layers of water (Heatwole et al. 2012). Additionally, no habitat where sea snakes may occur has been identified within the Activity Area.

Overall, the residual impact consequence of activity discharges on threatened, migratory, marine and cetacean species is considered Slight (Magnitude: −1, Sensitivity: L).

9.10.2.4 Cumulative Impacts

There is the potential for cumulative impacts from routine discharges from topsides and vessels adjacent the platform during the intermittent manned/campaign modes (and continuously during well completions, hot commissioning, and start-up), including with PW discharge. No cumulative impacts from liquid discharges from other production facilities (and their vessels) in the region (e.g. Prelude FLNG or Montara FPSO) are expected given the distance of these operations from discharges in the Activity Area.

Considering the volumes and types of discharges involved, the localised mixing zone and the rapid dilution/dispersion that will occur in the open water environment of the Activity Area, the potential for cumulative impacts to water quality are expected to be restricted to close proximity of the discharge locations. Consequently, no significant cumulative impacts from planned activity discharges are expected, and no change to the consequence levels identified for receptors is required.

9.10.3 Impact Assessment Summary

Table 9-56 lists the highest residual impact consequence rankings of the relevant environmental receptor groups.

Table 9-56: Activity Discharges Evaluation of Residual Impacts

Environmental Receptor	Magnitude	Sensitivity	Residual Impact Consequence
Evaluation – Planned Impacts			
Protected Areas	N/A	N/A	N/A
Physical Features	0	L	No Impact
Physical Values and Sensitivities	−2	L	Minor
Natural Features	−2	L	Minor
Natural Values and Sensitivities	−1	L	Slight
Socioeconomic Features	N/A	N/A	N/A
Socioeconomic Values and Sensitivities	N/A	N/A	N/A
Heritage and Cultural Features	N/A	N/A	N/A
Heritage and Cultural Values and Sensitivities	N/A	N/A	N/A

9.10.4 ALARP Assessment and Environmental Performance Standards

Table 9-57: Activity Discharges ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
ALARP Assessment						
Elimination	Eliminate discharges from vessels by storing all open drainage and bilge effluent, then transport and treat/dispose of it onshore.	No	There are significant costs and HSSE risks associated with storing all open drainage and bilge effluent on the vessels and transporting it onshore. These costs are grossly disproportionate to the potential environmental impacts of onboard treatment before discharge overboard.	N/A	N/A	N/A
Elimination	Store sewage, greywater, and food wastes on board for transport to and disposal at an onshore facility.	No	Store sewage, greywater, and food wastes on board for transport to and disposal at an onshore facility offers limited environmental benefit, as any changes to water quality beyond a localised mixing zone are likely to have no environmental effect. This option will likely increase operational costs associated with additional transits to and from port and introduce additional safety and environmental risks related to increased transit time and operation of additional vessels, plant, and equipment; the benefits of this option would be grossly disproportionate to the risk of potential environmental impact.	N/A	N/A	N/A
Elimination	Eliminate use of chemicals for subsea IMR activities.	No	The use of chemicals for subsea maintenance campaigns cannot be eliminated owing to the criticality for the integrity of materials and protection of equipment.	N/A	N/A	N/A
Elimination	Design closed loop control fluids for SSIVs to eliminate subsea control fluids discharge.	Yes	Control fluids for actuating SSIVs, an equipment control measure, are returned to the topsides (Crux and Prelude FLNG) when SSIVs are closed (closed loop) instead of discharging to the marine environment during normal operations.	8.1	Closed loop control fluids systems are used to return control fluids to the topsides.	As built engineering drawings.
Substitution	Source all freshwater from onshore.	No	Using a sea water desalination system and discharging reject brine is a common and accepted practice for vessels and offshore oil and gas facilities. Offshore activities cannot operate without fresh water, hence this option is not considered feasible.	N/A	N/A	N/A
Substitution	Use alternative sewerage treatment technologies.	No	Alternative sewerage treatment technology requires additional cost due to the space requirement for installation on vessels; this would be grossly disproportionate to the risk of potential environmental impact. This option increases operational costs for maintenance and staffing due to performance challenges associated with these technologies (e.g. clogging of membranes/screens). This option also increases potential exposure of the workforce to pathogens associated with these sewerage waste streams.	N/A	N/A	N/A
Substitution	Use an alternative technology to OIW separator system.	No	The OIW separator systems on the vessels are standard MARPOL-compliant systems for managing accidentally oil-contaminated drainage and bilge in offshore installations and vessels. Hence, this activity and the associated potential impacts are well regulated. Implementing this control across the vessel fleet is considered grossly disproportionate to any environmental benefit, if any.	N/A	N/A	N/A
Substitution	Vessels shall not operate within 1 km of named Shoals adjacent to the Activity Area.	Yes	The Conservation Advice for *Aipysurus fuscus* (dusky sea snake) (DCCEEW 2024h) lists the risk of other pollutants affecting the dusky sea snake known or likely habitat as a threat to the dusky sea snake. Although there are no dusky sea snake known or likely habitats within the Activity Area, Shoals do occur adjacent to the Activity Area. Therefore, Shell has adopted a control consistent with a management control outlined in the Crux OPP, to exclude vessels operating within 1 km of named Shoals adjacent to the Activity Area to eliminate vessels discharges where the dusky sea snake habitat may occur.	2.3	Refer to EPS 2.3.	Refer to EPS 2.3.
Engineering	Store waste desalination brine on board and transport for onshore treatment and/or disposal.	No	Storing brine on board and then transferring it to shore results in increased personnel and environmental costs associated with more vessel movements and is not possible because the required storage space would not be available on vessels.	N/A	N/A	N/A
Engineering	Use equipment to capture or collect subsea discharges.	No	No practicable engineering controls are available that are proven to be able to capture or contain subsea discharges. Designing and installing a temporary capture system would result in significant financial costs, with technical uncertainty, grossly disproportionate to any slight increase in environmental benefit of preventing small and infrequent discharges.	N/A	N/A	N/A

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
Engineering	For vessels, treat oily bilge water with an OIW separator before discharge, in accordance with MARPOL Annex I (and Marine Order 91: Marine pollution prevention – oil).	Yes	Treatment with an OIW separator, an equipment control measure, ensures oily water on vessels is treated and discharged in accordance with MARPOL Annex I (and Marine Order 91: Marine pollution prevention – oil). Discharges at this level are not expected to cause any measurable impact to the marine environment given low flow rates and high dilutions close to the source. The benefits outweigh the costs associated with implementing this control.	8.2	Vessel bilge and slops effluent will be discharged via an OIW separator compliant with MARPOL Annex I (and Marine Order 91: Marine pollution prevention – oil) requirements (≤15 mg/L).	Supplement to the International Oil Pollution Prevention (IOPP) Certificate that indicates that the vessel has approved oil-water separator calibrated to discharge at ≤15 ppm (as appropriate to class, size, and type). Vessel computerised maintenance management system records demonstrate vessel oil-water separator is maintained and operating effectively to meet discharge specification of ≤15 ppm.
Engineering	For the topsides, treat water collected in the open drain system with an OIW separator before discharge.	Yes	The open drain system, an equipment control measure, captures any oil that might be present on the topsides decks before it is discharged to the ocean. The system is an inherently low risk system that will mostly receive rainwater. The oil water separator system is designed to be able to capture the contents of the greatest hydrocarbon inventory tank on the topsides. The topsides design has bunding for the diesel tote tank and waste oil tank, which minimises the potential for significant hydrocarbons to end up in the open drains system.	8.3	Topsides deck drainage will be discharged via an oil-water separator (V-26501), except by design, where drain boxes discharge clean water directly overboard in the event of heavy rains or further wash water which is considered clean.	DCS indicates that the open drains system is discharged to sea via an oil-water separator (V-26501) where designed to do so.
Engineering	Containment around liquid hydrocarbon storage tanks will be installed on the Crux platform to reduce the potential for minor accidental releases of chemicals/hydrocarbons to the environment.	Yes	Containment around liquid hydrocarbon storage tanks, an equipment control measure, captures any oil that might be present around the liquid hydrocarbon storage tanks during filling or maintenance activity.	8.4	Containment installed around liquid hydrocarbon storage tanks.	Platform As Built drawings show containment around liquid hydrocarbon storage tanks.
Engineering	Vessels comply with Marine Order 94 and 95 (Macerate food waste to ≤25 mm particle size before discharge to sea.)	Yes	The marine assurance system, a system control measure, is administered by Shell's marine team and, amongst other relevant requirements, ensures compliance of contract vessels with MARPOL Annex V, *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth). In addition, vessels will be required to reduce food waste to ≤25 mm derived from Marine Order 95: Marine pollution prevention – garbage, a system and equipment control measure.	8.5	Vessels to comply with Marine Orders 94 and 95 (Marine pollution prevention – packaged harmful substances/garbage), specifically: • no planned disposal of domestic waste, solid wastes or maintenance wastes overboard from vessels (other than planned discharges permitted by this EP). • food wastes discharges macerated to < 25 mm particle size.	Records of marine assurance of vessels carried out consistent with the process outlined in section 10.8.5.1 including garbage record book maintained as per Marine Order 95.
Engineering	Vessels to comply with Marine Order 91 (IOPP certificates).	Yes	The marine assurance system is administered by Shell's marine team and, amongst other relevant requirements, ensures contract vessels comply with MARPOL, *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) and Marine Orders 91 and 96. The benefits outweigh the costs associated with implementing this control.	8.6	Marine assurance will be undertaken for vessels, including a check for valid and in date IOPP certificates (as required by vessel class requirements and type) and ISPP Certificate (or equivalent voluntary statement of compliance audits where relevant) (as required by vessel class, size and type).	Records of marine assurance of vessels carried out consistent with the process outlined in section 10.8.5.1 including valid IOPP and ISPP certificates, as required by vessel class and type.
Administrative and Procedural	Vessels routine discharges of treated sewage and grey water will comply with *Navigation Act 2012* (Cth), *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) and Marine Order 96 (International Sewage Pollution Prevention [ISPP] certificates) as relevant to vessel class, size and type.	Yes				
Administrative and Procedural	Shell Australia Chemical Change Process.	Yes	Shell has adopted a chemical selection and approval process in accordance with its chemical selection and approval guidelines (as indicated in Shell Australia Chemical Change Process and Shell Global Product Stewardship guidelines) to assess chemicals that may pose a risk of environmental impact via planned discharges. Following the chemical change process (as detailed in Section 10.3.6) will minimise to ALARP levels the impact of those chemicals that are used and discharged.	7.20	Refer to EPS 7.20.	Refer to EPS 7.20.

ALARP Demonstration Statement

Based on the impact assessment outcomes and control measures adopted, Shell considers implementing the control measures appropriate to manage the potential impacts associated with deck drainage, bilge water, putrescible waste, greywater, sewage, cooling water, desalination brine and subsea discharges. No additional, alternative, or improved controls were identified that could further reduce the impacts—beyond negligible environmental benefits if any—without disproportionate effort and cost. Therefore, the impacts are considered to be reduced to ALARP.

9.10.5 Acceptability of Impacts

Table 9-58: Acceptability of Impacts – Activity Discharges

Receptor		Acceptable Level of Impact	Acceptable?	Acceptability Assessment
Category	**Subcategory**			
Physical features, values and sensitivities	Water quality	No significant impacts to water quality. Impact not expected to result in a substantial change in water quality, which may adversely impact biodiversity, ecological integrity[26], social amenity or human health.	Yes	Liquid discharges have the potential to result in localised reduced water quality at the discharge location; however, discharges will rapidly dilute in the open ocean environment. Shell will implement measures to reduce the potential for impacts to water quality from routine discharges. Given the offshore location and absence of particularly sensitive marine ecosystems at the activity location and immediate surrounds, the potential magnitude of impacts to the marine environment is considered minor.
Natural features, values and sensitivities	Marine bioregions	No significant impacts to benthic habitats and communities. Impacts to non-sensitive benthic communities limited to a maximum of 5% of the Project Area (as defined in the OPP). No significant adverse impact on demersal or pelagic communities, populations, habitats or spatial distribution of a species. No substantial adverse effect on a population of a marine species or cetacean including its lifecycle and spatial distribution.	Yes	The benthic habitats and communities within the area of potential indirect affects from activity discharges are broadly distributed and not considered unique or particularly sensitive. The impact is predicted to be highly localised to discharge location and represent <5% of the Project Area (as defined in the OPP). Given the dispersion and dilution predicted following discharge, mobile species are unlikely to have significant impacts. Localised scale (within hundreds of metres) of mixing zone represents a negligible proportion of regional planktonic assemblage distributions which are expected to rapidly recover from any adverse effects. Given the absence of important habitat and ecological assemblages of pelagic species, potential effects to pelagic communities within the mixing zone will not have any significant adverse impact on pelagic communities, populations, habitats or spatial distribution of a species.
	Threatened, migratory, marine and cetacean species	Management of aspects of the activity must align with Conservation Advice, recovery plans and threat abatement plans. No significant impacts to EPBC Act listed threatened, migratory, marine or cetacean species.	Yes	Most EPBC Act listed species within the area predicted to be influenced by activity discharges are air-breathing vertebrates, which are unlikely to be directly affected as their skin is relatively impermeable and they breathe air. Hence, direct impacts are not considered credible. Non-air breathing species are not anticipated to be present in significant numbers nor be exposed to discharge concentrations that may adversely impact on individuals. Giving regard to the Conservation Advice for the dusky sea snake and the risk of pollutants affecting the dusky sea snake, the vessel discharges including liquid effluent and cooling water, will cause highly localised affects. By adopting the precautionary principle and restricting access of vessels to adjacent shoals, where the dusky sea snake habitat may occur, these impact pathways are reduced to ALARP and acceptable levels (refer to EPS 2.3). Therefore, it is considered there will be no potential for significant impacts upon threatened, migratory, marine or cetacean species.

The assessment of impacts from activity discharges determined the residual impact consequence to be Minor or lower (Table 9-56). The acceptability of the potential impacts from activity discharges associated with the petroleum activity have been considered in the following context.

Principles of ESD

The potential impacts from activity discharges are consistent with the principles of ESD because:

- The environmental receptors within the Activity Area are not expected to be significantly impacted.
- The precautionary principle has been applied, and reviews were undertaken where knowledge gaps were identified. This knowledge was applied when evaluating environmental impacts.

Relevant Requirements

Managing the potential impacts from activity discharges are consistent with relevant legislative requirements, including:

- Compliance with international maritime conventions, including:
  - MARPOL:
    - Annex I: regulations for the prevention of pollution by oil.
    - Annex II: regulations for the control of pollution by noxious liquid substances in bulk.
    - Annex III: regulations for the prevention of pollution by harmful substances carried by sea in packaged form.
    - Annex IV: regulations for the prevention of pollution by sewage from ships.
    - Annex V: regulation for the prevention of pollution by garbage from ships.
- Compliance with Australian legislation and requirements, including:
  - *Navigation Act 2012* (Cth) and *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth):
    - Marine Order 91 (Marine pollution prevention – oil).
    - Marine Order 93 (Marine pollution prevention – noxious liquid substances).
    - Marine Order 94 (Marine pollution prevention – packages harmful substances).
    - Marine Order 95 (Marine pollution prevention – garbage).
    - Marine Order 96 (Marine pollution prevention – sewage).
- Policies, strategies, guidelines, Conservation Advice, and recovery plans for threatened species (Table 9-59).
- Implementation of recognised industry standard practice, such as:
  - Treatment of collected drainage bilge water to less than 15 mg/L residual oil for vessels.

Matters of National Environmental Significance

Threatened and Migratory Species

The evaluation of liquid discharges predicts that there will be no credible risk of significant impacts to threatened and migratory species as a result of activity discharges during the activity. Table 9-59 summarises the alignment of the petroleum activities with management plans, recovery plans and Conservation Advice for threatened and migratory fauna.

Commonwealth Marine Area

The potential impacts and risks from the activity discharges aspect on the Commonwealth marine environment are predicted to not to exceed any of the significant impact criteria, as listed in Table 8-1. Hence, it is considered that the activity does not pose a credible risk to the Commonwealth Marine environment.

Table 9-59: Summary of Alignment with Relevant MNES Considerations

MNES	MNES Acceptability Considerations	Demonstration of Alignment
Threatened and Migratory Species	Significant impact guidelines for critically endangered, endangered, vulnerable and migratory species (Table 8-1)	The application of the Shell Chemical Change Process and proposed management controls for activity discharges reduces the potential for impacts from toxic pollutants introduced into and/or persisting in, the marine environment. Shell has adopted a management control outlined in the Crux OPP, to exclude vessels operating within 1 km of any named Shoals adjacent to the Activity Area to limit vessel discharges where the dusky sea snake habitat may occur.
	Conservation Advice on *Balaenoptera borealis* (sei whale) (DoE 2015c)	
	Conservation Advice fin whale (*Balaenoptera physalus*) (TSSC 2015b)	
	Recovery plan for Marine Turtles in Australia 2017–2027 (CoA 2017b)	
	Conservation Advice on *Rhincodon typus* (whale shark) (DoE 2015e)	
	Conservation Advice for *Aipysurus fuscus* (dusky sea snake) (DCCEEW 2024h)	
Commonwealth Marine Area	Significant impact guidelines for Commonwealth marine environment (Table 8-1)	Water quality impacts by planned activity discharges are expected to be highly localised. Impacts are not considered to be significant in the context of the significant impact criteria for the Commonwealth Marine Area given the nature and scale of the impacts and the characteristics of the local receiving environment (open offshore waters with regionally well represented soft and bare sandy sediments). The impact assessment indicates that any impacts associated with activity discharges are predicted to not have the potential to result in significant adverse impacts on marine ecosystem functioning/integrity, social amenity or human health. Shell has sought to reduce potential impacts by selecting and implementing the controls and EPSs listed in Section 9.10.4.

External Context

To date, no objections or claims about activity discharges have been raised by relevant persons. Shell's ongoing consultation program will consider statements and claims made by Relevant Persons when further assessing impacts (see Section 5.13).

Internal Context

Shell also considered the internal context, including Shell's environmental policy and ESHIA requirements. The EPOs and the controls that will be implemented for the activity are consistent with the outcomes from consultation for the petroleum activity and Shell's internal requirements.

Acceptability Summary

The assessment of potential impacts and risks from activity discharges determined the residual impacts rankings were Slight (Table 9-58). The acceptability of the impacts has been considered in the context of:

- the established acceptability criteria.
- ESD.
- relevant requirements.

- MNES.
- external context (i.e. stakeholder claims).
- internal context (i.e. Shell requirements).

Shell considers residual impacts of Minor or lower to be acceptable if they meet legislative and Shell requirements. The discussion above demonstrates that these requirements have been met in relation to the activity discharges aspect.

Shell considers the potential for impacts from activity discharges associated with the activity to be ALARP and acceptable.

9.10.6 Environmental Performance Outcome

EPO #	EPO	Measurement Criteria
2.2	Refer to EPO 2.2.	Refer to EPO 2.2.
4.3	Refer to EPO 4.3.	Refer to EPO 4.3.

9.11 Atmospheric Emissions

9.11.1 Aspect Context

Atmospheric emissions are the gases and particulates released into the atmosphere from an activity that may have an adverse effect on the environment. Atmospheric emissions that have the potential to impact local and regional air quality include pollutants such as nitrogen oxides (NO_x)[40], sulphur oxides (SO_x)[41], carbon monoxide (CO), particulate matter less than 10 microns (PM_{10})[42]; and air toxics such as volatile organic compounds (VOCs) which includes BTEX and hydrogen sulphide which may be released to the atmosphere as a result of combustion processes on the platform topsides or vessels, emission alongside combustion byproducts, or leakage through vents, emission points or other equipment. Fuel gas sourced from the Crux wells is expected to be low in sulphur and may contain impurities from the reservoirs, such as mercury (further detailed in Section 9.11.1.1) and carbon dioxide (CO_2), that may also be carried forward into the fuel gas system and, therefore, gas turbines and flare systems.

Atmospheric emissions associated with the activity will be generated by a variety of sources, with most of these occurring at the Crux platform from operating the Crux facility, including:

- Combustion of fuels that will release atmospheric emissions in exhaust gases. Sources will include temporary and permanent power generators, machinery and engines on the platform topsides and marine vessels using diesel or other fuels. Sources will also include propulsion engines and machinery on marine vessels and helicopters; incinerators on supply vessels, power generation on vessels, and gas turbine generators which consume fuel gas to provide permanent power to the Crux topsides.
- Combustion of hydrocarbons through flare systems that will release atmospheric emissions. Sources will include temporary flare systems used in completions and workover activities to safely dispose of waste gases from well clean-ups and associated activities. Sources will also include permanent high-pressure and low-pressure flare systems required to safely dispose of gases generated from hydrocarbon and utility processing systems, well clean-ups, start-ups, pressure relief, depressurisation, blowdown, and emergency shutdowns (etc). The flare systems will be maintained with continuous safety purge and pilot gas.
- Fugitive releases to the atmosphere from platform equipment and vessels. Sources include vents on process vessels and tanks, breathers, valves, piping components, piping connections, analysers, instruments, well test and workover equipment, HVAC systems, and switchgear and may occur during maintenance or whist in operation.

During operations activities, most atmospheric emissions are forecast to be emitted from the permanent flare and power generation systems (Table 9-60 and Figure 9-5) in the form of NOx, CO, and VOCs calculated

[40] Nitrogen oxides (NO_X) emissions consist predominantly of nitrogen dioxide (NO_2) and nitrogen oxide (NO).

[41] Sulphur oxides refers to many types of sulphur and oxygen containing compounds such as SO, SO_2, SO_3, S_7O_2, S_6O_2, S_2O_2 (etc).

[42] PM_{10} refers to particulate matter emissions, particularly those with an aerodynamic diameter of less than 10 microns.

using methodologies from the NPI Oil & Gas Emissions Estimation Handbook (2013). NOx and CO are combustion by-products for the fuel gas that is used in these systems, and annual VOC loadings are a result of the factor applied and combustion efficiency and will be proportionally higher because of the higher flaring rates expected during well completions, hot commissioning, and start-up. Mercury (and other trace impurities) may partition into the fuel gas system and therefore emitted through GTG exhausts and flare system with annual loadings expected to be less than ~6.6 kilograms per year average over the first five years of activity after start-up (refer Section 9.11.1.1, Table 9-61 rows E, F and G which assumes the design reference case heat and mass balance for fuel gas distributed to flare and flare system, excluding intermittent releases from the HP flare, refer Section 9.11.1.1.3).

Table 9-60: Atmospheric Emissions to 2030 including first stage clean-up (tonnes)[43]

Equipment	NO_x	CO	PM_{10}	VOC[44]	SO_x
Power Generation (GTGs)	299	78	1.8	2	0.48
Flare Systems	166	966	8.6	1666	0.72
Diesel Users	35	9	1	1	1.12E-05
Fugitive Emissions	0	0	0	701	0
Total	500	1053	11	2370	0.20
Average (tonnes/year)	100	211	2	474	0.24

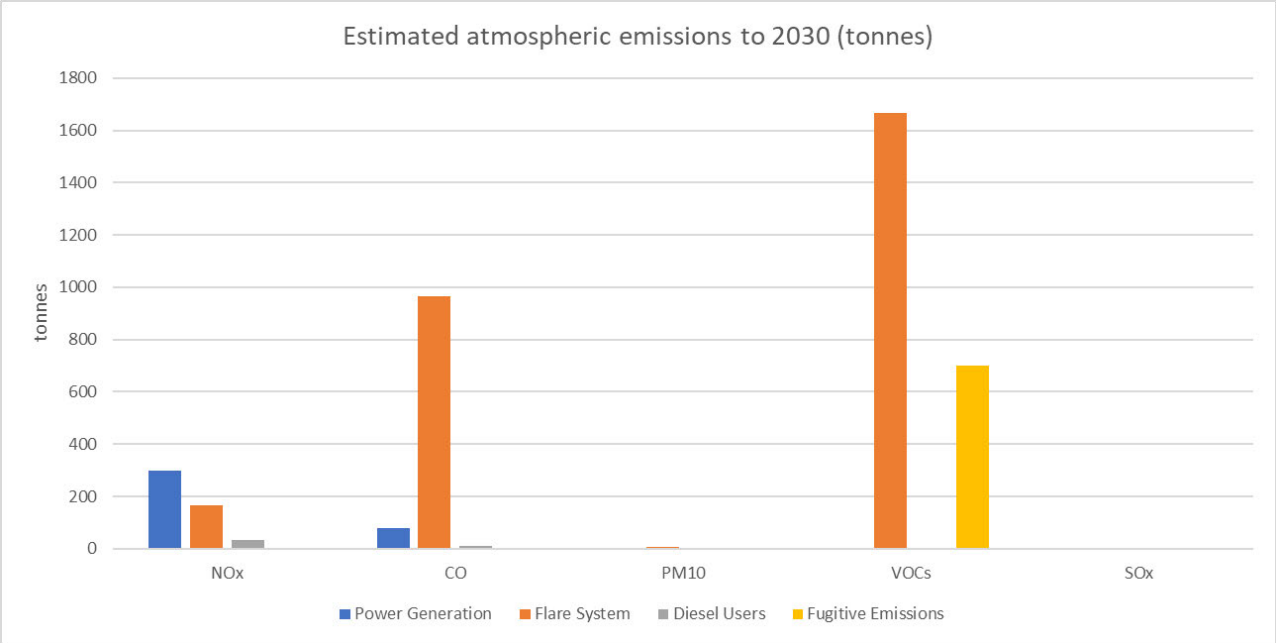


Figure 9-5: Forecast Atmospheric Emissions to 2030 by Emission Source

The flare system consists of purged safety-critical low-pressure and high-pressure piping systems which combust purge and pilot gases (sourced primarily from the fuel gas system) to ensure the flare is available when required. Apart from the purge and pilot gas, the high-pressure system does not flare unless required for safety reasons or for the safe start-up or shutdown of the facility. Along with the purges and pilot gas, the low-pressure system also flares off gas from the TEG regeneration system (which includes flash and surplus stripping gas containing a high proportion of water vapour which does not contribute to atmospheric emissions) and off gas from the produced water treatment degasser vessel (which includes surplus purge gas from DGF system). Flaring of gases will also occur during well cleanups and workovers. The flare system is designed to minimise potential for uncombusted hydrocarbons, however, there remains a possibility that equipment

[43] Calculated using emissions factors published in National Pollutant Inventory Oil & Gas Emissions Estimation Handbook v2.0 (2013).
[44] VOC forecast for flare system is likely to overestimated as the NPI emission factor assumes gas composition of 70% CH4, 30% VOC by weight and destruction efficiency of 95%; however, the expected composition is expected to have a high-water vapour content.

malfunction could lead to some additional venting of hydrocarbons (either HP or LP) in the event of flame-out condition, in which case the releases into the atmosphere will be vented as volatile organic carbons.

The power generation system on the topsides consists of three GTGs which are fuelled by cleaned and conditioned fuel gas generated from Crux wells process, supplying permanent power to electrical users on the platform. Other emissions are associated with other sources, such as intermittent testing and use of diesel engines (BSDG), temporary diesel generators and other diesel or fuel fired equipment, as required; and emissions associated with vessels, helicopters, and fugitive emissions. There is expected to be additional flaring in the completions, hot commissioning and start-up phases as required to clean the wells, provide for a safe initial start-up, testing emergency systems in initial start-up and developing a safe, reliable platform in start-up and ramp-up phases.

Vessels and diesel engines will use diesel fuels such as MDO, MGO, LSMGO, and potentially during the activity period future some vessels may also be fuelled by liquified natural gas. Project helicopters will use aviation kerosene.

SO_x and PM_{10} emissions from Activities are expected to be negligible given the low expected hydrogen sulphide/sulphur content (4–9 ppm expected) of the Crux reservoir gas (which is used for fuel gas) and intermittent (not continuous) combustion of low sulphur diesel (from vessels, BSDG and temporary power generators only). Most of the fuel consumption is scrubbed fuel gas, which is relatively cleaner fuel than diesel such that, when combusted, emits negligible particulate matter. All combustion processes (particularly diesel-fuelled combustion and flares) have potential to occasionally emit dark or visible smoke in the nearfield proximity of the Activities. Ozone is not emitted typically directly from gas consumption or processing however is formed through anthropogenic sources via chemical reactions between oxides of nitrogen and other emissions such as VOCs and CO in the presence of UV light.

Atmospheric emissions associated with well completions and hot commissioning are of short duration. During well completions, an estimated two temporary diesel power generators of ~1200 kW each (primary and backup) may be in operation by third party contractors to supply temporary electrical loads, in addition to standalone temporary generators used by the completions spread contractor. In the completions phase (well perforation and clean-up) the combustion of diesel fuel could be ~15 kL per day for the duration (i.e. ~60 days assumed). The well completions first stage well clean-up by third party contractors may require hydrocarbons (gas and liquids) to be produced through the five wells at rates of up to 90 MMscfd for 24 hours or until safe, estimated to emit up to 2,340 t of hydrocarbon per well resulting with potential for fugitive emissions through flame-out venting, pressure relief and vents in the well test equipment.

During the lifecycle, temporary power generation is likely to be required during maintenance periods and marine vessels and helicopters will be combusting diesel and aviation fuels in the activity area. The temporary diesel generators (various rating from small units up to ~1200 kW) may also be used on the platform topsides throughout all activity phases to provide additional power demand as required for minor and major maintenance and repairs, refurbishment, turnarounds, well interventions and workovers.

9.11.1.1 Mercury emissions

9.11.1.1.1 Mercury Design Basis

Whilst only trace amounts of mercury were observed in Crux reservoir fluids during the exploration campaign (0.2 to 0.8 ug/Sm^3) based on Drill Stem Test (DST) samples, mercury assessments have utilised a conservative basis of 150 to 240 ug/Sm^3, based on regional mercury data. Whilst this provides a useful datapoint, it is difficult to accurately ascertain the concentration of mercury until the Crux wells commence production[45]. The primary reason for the conservatism in the design basis is to ensure equipment and materials specifications that are issued in FEED and detailed engineering phases have appropriate safety and integrity margins and tolerances for potential / worst case scenarios. Crux is designed so that temperature control measures that ensure ~99% of produced mercury (~95% in late life) remains in the gas and condensate export

[45] Mercury is a highly volatile element that has a strong affinity for organic matter. It is soluble in natural gas and condensates and present in hydrocarbon basins globally, exhibiting a wide range of concentrations. The physical, chemical and geochemical properties of mercury create complex distributions in hydrocarbon systems. Through the process of thermal evolution, mercury concentration in hydrocarbons can be influenced by source rock origin, migration pathway and fluid chemistry (Lawer *et al* 2023). Even when in production, mercury may be limited to pockets or zones in the reservoir and therefore not uniformly produced to the platform, or results may be highly variable or spurious. Mercury monitoring therefore is often unpredictable with a high degree of uncertainty.

streams to the existing Mercury Removal Unit (MRU) on Prelude FLNG (that has been in operation on Prelude since 2018).

9.11.1.1.2 Mercury Partitioning

Partitioning studies have been performed for the design cases covering the different operating phases over the lifecycle using best available engineering judgement. Table 9-61 shows the mercury partitioning study results utilising the worst-case (assumed) reservoir mercury concentration for three design cases, representing potential operating conditions through the Crux lifecycle (which will be verified after startup):

- Reference Case – maximum platform hydrocarbon production at initial reservoir pressure;
- End of Plateau – maximum hydrocarbon production at end of production plateau during mid-life. Platform operation will be in low pressure mode. This design case assumes formation water production from wells, resulting in elevated produced water discharge flowrates of ~11,000 b/d;
- Late Life – late life production case with formation water production at the design limit of the produced water system (~19,020 b/d or 3,029 m^3/d water production assumed for the late life design case, which is conservative) (also refer Section 6.7.8 and 9.9.1).

Table 9-61: Predicted mercury partitioning concentrations

Process Area	Design Case	Overall Mass flow (kg/h)	Hg Concentration (Note 1)	Hg Partitioning (% of Inlet Hg)	Hg Mass Rates (kg/yr)
Overall full well stream (A)	Ref Case	665,855	240	100%	1,403.4
	End of Plateau	731,723	240	100%	1,450.8
	Late Life	242,115	240	100%	275.3
Gas export (B)	Ref Case	569,828	183	71.37%	1,001.5
	End of Plateau	568,978	202	76.68%	1,112.2
	Late Life	104,796	226	85.69%	235.9
Condensate export (C)	Ref Case	82,424	346	28.15%	395.0
	End of Plateau	71,682	491	22.35%	324.2
	Late Life	8,500	348	9.94%	27.4
Produced water (D)	Ref Case	9,791	1.3	0.01%	0.1
	End of Plateau	86,711	1.8	0.10%	1.4
	Late Life	126,384	2.3	0.93%	2.6
Fuel Gas to Gas Turbines (E)	Ref Case	1,480	183	0.18%	2.6
	End of Plateau	1,478	202	0.20%	2.9
	Late Life	758	226	0.60%	1.7
Low Pressure (LP) Flare Gas (F) Note 2	Ref Case	2,231	187	0.27%	3.8
	End of Plateau	2,772	374	0.66%	9.5
	Late Life	1,576	566	2.76%	7.6
High Pressure (HP) Flare Gas (G) Note 3	Ref Case	101	183	0.01%	0.2
	End of Plateau	102	202	0.01%	0.2
	Late Life	101	226	0.08%	0.2

Note 1: Gas (µg/Sm3). Condensate (ppbw). Produced water (µg/L or ppbw).

Note 2: The LP Flare Gas is contributed from tanks blanketing gas, purge, pilot and flash and off-gases from the triethylene glycol (TEG) regeneration system during normal operations.

Note 3: The HP Flare Gas is contributed from purge and pilot gas during normal operations. For intermittent HP Flare Gas contributed by emergency platform blowdown, refer Section 9.11.1.1.3.

The partitioning study predicts that the trace quantities of mercury present in the fuel gas have a concentration of ~183-226 µg/Sm^3 (Table 9-61, row E). Fuel gas supplied to the Gas Turbine Generators (GTG) will be combusted with air to produce electrical power for the Crux facility. The resultant combustion products will be sent to atmosphere via the GTG exhaust stacks. Based on complete combustion and stoichiometric rate of air, with the presence of N_2, CO_2 and H_2O in the flue gas, the mercury concentration in the exhaust gas is calculated to be ~11-29 µg/Sm^3. This concentration is significantly lower than the most stringent Group 6-point source concentration target for exhaust flue gases (200 ug/Sm^3) under the *Protection of the Environment Operations (Clean Air) Regulation 2022 (NSW)*.

The emissions associated to other fuel gas users will be to the LP and HP flare systems (Table 9-61, row F and G). Along with fuel gas, the LP Flare Gas waste stream will also consist of flash gas from the TEG Flash Drum and the off gasses from the TEG Reboiler and Produced Water Degasser. Based on the partitioning study, the LP Flare Gas is expected to have a mercury concentration of ~187-566 µg/Sm^3 prior to combustion (Table 9-61, row F). The flare combustion process will result in rapid dispersion of this point source concentration.

It is estimated from the partitioning basis that a mass rate of ~2.6-2.9 kg of mercury per year will be emitted through the GTG exhaust; ~3.8-9.5 kg of mercury per year emitted through the LP flare system; and approximately ~0.2 kg of mercury per year emitted through HP flare system.

At the End of Plateau Case production, the worst-case mercury emissions summarised in Table 9-61 are predicted to comprise the sources subdivided in Table 9-62. For the LP Flare Gas, the main contribution is the Produced Water Degasser off-gas, when it is letdown from high operating pressure of 100-123 barg to near atmospheric pressure, liberating dissolved gasses which contains trace mercury. The Produced Water Degasser off-gas, TEG off-gas generated at the Reboiler, and the TEG flash gas generated at the Flash Drum, are low pressure waste gas streams amounting to 8.1 kg/yr of mercury which cannot be treated unless it gets compressed to higher pressure.

Table 9-62: Fuel Gas to Gas Turbines and Flare Gas Sources Emission Rates for End of Plateau Case

Options	Fuel Gas source kg/h	Flash Gas source kg/h	Total Gas Rates kg/h	Hg Mass Rates from Fuel Gas kg/yr	Hg Rates from Flash Gas kg/yr	Total Hg Mass Rates kg/yr
Gas Turbines Exhaust	1478	-	1478	2.9	-	2.9
TEG Flash Gas from Flash Drum	-	362	362	-	1.8	1.8
TEG Off Gas from Reboiler	638	1239	1877	1.2	0.57	1.8
Produced Water Degasser Off Gas	16.9	408	425	-	5.7	5.7
LP Flare Header Purge Gas	12.4	-	12.4	0.02	-	0.02
LP Flare Pilot Gas	3.5	-	3.5	0.01	-	0.007
MEG Storage Vessel Blanketing	92	-	92	0.2	-	0.2
HP Flare Gas Sources	101	-	101	0.2	-	0.2
Totals	**2342**	**2009**	**4351**	**4.5**	**8.1**	**12.6**

9.11.1.1.3 Intermittent Mercury Releases from HP Flare

During normal operation, the HP flare system will only have minimal purge and pilot fuel gas consumption (Section 9.11.1). The high pressure (HP) flare system is designed to enable pressure relief from high pressure hydrocarbon system and emergency depressurisation of the facilities in a sufficient time that reduces the risk of vessel failure and loss of facility integrity in the event of confirmed fire or gas, and for safely depressurising the facility during shutdowns. Given the HP flare system is designed to depressurise the production facility,

consisting of gas with mercury, it is expected that each HP flare event has the potential to emit mercury to the atmosphere. Based on blowdown calculation and modelling work, it is predicted that these intermittent events will emit ~75 grams of mercury per year on average (Table 9-63). The blowdown calculation assumes three unplanned emergency shutdowns with blowdown each year and one controlled planned shutdown with depressurisation every four years for major maintenance campaigns. The mass of production gas per blowdown was calculated by taking a constant two-thirds of peak blowdown rate over 15 minutes depressurisation. This is a conservative assumption given that the blowdown curve is a decaying curve; with 7 barg reached within 15 minutes; and to account for the final depressurisation to atmospheric pressure. The mercury mass rate is then calculated by multiplying mercury concentration in the gas stream (200ug/Sm^3 was taken) by the blowdown volumetric rates.

Table 9-63: Intermittent HP Flare Releases

Process Area	Design Case	Mass flow (kg/h)	Concentration Gas (µg/Sm3)	Hg Mass Rates (kg/yr)
HP Flare Gas (normal production)	Ref Case	101	183	0.2
	End of Plateau	102	202	0.2
	Late Life	101	226	0.2
HP Flare Gas (intermittent)	Blowdown	36.9	200	0.069 (69 grams)
	Controlled shutdown	3.1	200	0.006 (6 grams) HP Flare Total = 75 grams

9.11.2 Description and Evaluation of Impacts

Table 9-64 identifies the environmental features and values and sensitivities potentially affected by atmospheric emissions that may result from the activities covered by this EP, with further evaluation of the impacts and/or risks to physical values and sensitives (including cumulative impacts) provided in this Sections 9.11.2.1 and 9.11.2.2. Features, protected areas or values and sensitivities which could not be credibly affected by atmospheric emissions are not discussed further.

Table 9-64: Atmospheric Emissions Receptor Impact Screening Summary

	Protected Areas			Features															Values and Sensitivities																							
				Physical		Natural				Socioeconomic								Heritage and Cultural			Physical				Natural								Socioeconomic								Heritage and Cultural		
Aspect	Receptor	Marine Conservation Reserves	Wetlands of International and National Importance	Commonwealth and National Heritage Places	Marine Regions	Australian Environment	Northwest Shelf Province Bioregion	Northwest Shelf Transition Bioregion	Northwest Transition Bioregion	Timor Province Bioregion	People and Communities	Fishing Industry	Tourism and Recreation	Defence	Shipping	Scientific Research/Restoration	Oil and Gas Industry	Indonesian and Timor-Leste Coastlines	Underwater Cultural Heritage	Traditional Indonesian Fishing	Indigenous Cultural Connections	Air Quality	Water Quality	Sediment Quality	Underwater Noise	BIAs	Critical Habitat	Shoals and Banks	Offshore Reefs and Islands	Coastal Reefs and Islands	KEFs	Threatened, Migratory, Marine and Cetacean Species	Fishing Industry	Tourism and Recreation	Defence	Shipping	Scientific Research/Restoration	Oil and Gas Industry	Indonesian and Timor-Leste Coastlines	Underwater Cultural Heritage	Traditional Indonesian Fishing	Indigenous Cultural Heritage

9.11.2.1 Physical Values and Sensitivities: Air Quality

Other operational offshore facilities exist within the region of the Activity Area, including the Prelude FLNG (~165 km), the Ichthys Offshore Facilities (~164 km) and the Montara FPSO (~36 km). Based on public reporting under the NPI scheme published on the DCCEEW, these regional facilities produce similar or higher annual emission loadings into the atmosphere (Table 9-65). The assumed activity as a percentage of the regional loading is less than 12% across all parameters (e.g. 3% for NOx and 7% for CO) (Table 9-65). Crux contribution of VOCs represents ~10% of the airshed, however this is attributable to the temporary and once-off flaring events that occur during the first stage well clean-ups and start-ups periods and is expected to be a lower proportion in operations.

Table 9-65: Regional Facility Annual NPI Emissions

Equipment	NOx	CO	PM_{10}	VOC	SOx
NPI Tonnes Reported 2022/2023					
Prelude FLNG[46]	1,800	1,400	78	2,500	3.1
Montara FPSO[47]	380	270	17	240	0.35
Ichthys Offshore Facility[48]	1,300	940	20	1,300	2.3
Regional Loading (Total)	3,480	2,610	115	4,040	6
Estimated Activity NPI Contribution					
Topsides Equipment (Table 9-60)	100	211	2	474	0.24
Regional Loading (with Crux)	3,602	2,770	117	4,329	7
Crux Airshed Contribution (%)	3	7	2	10	4

NEPM Standards

The NEPM Ambient Air Quality Guidelines specify 0.015 ppm as an annual average and 0.08 ppm on an hourly average for NO_2 emissions (there are no limits for NOx or NO, only for NO_2). A screening level assessment was undertaken for NOx assuming a stack concentration of 170 ppm at the highest emission rates across the expected range of operations using the Atmospheric Dispersion Modelling System Gaussian plume air dispersion model (developed by Cambridge University). Using NOx as a proxy for all pollutants, the study showed that dispersion was high, and both the NEPM hourly (Figure 9-6) and annual (Figure 9-7) NEPM limits were achieved well within the nearfield region of the platform and therefore negligible or no probability of exceedance of NEPM standards at the nearest sensitive receptor (Montara FPSO at ~36 km distance).

Mercury is not a regulated substance under the National Environment Protection (Ambient Air Quality) Measure or National Environment Protection (Air Toxics) Measure. These guidelines aim to minimise the impact of air emissions from industrial activities on the environment. Safe Work Australia sets Workplace Exposure Standards (WES) for airborne contaminants for occupational exposure, including mercury. These standards aim to minimise the impact of mercury emissions from industrial activities. These have been developed to protect against acute and chronic human exposure.

[46] Prelude FLNG Individual report emissions (npi.gov.au)
[47] Montara FPSO Individual report emissions (npi.gov.au)
[48] Ichthys Offshore Facility Individual report emissions (npi.gov.au)

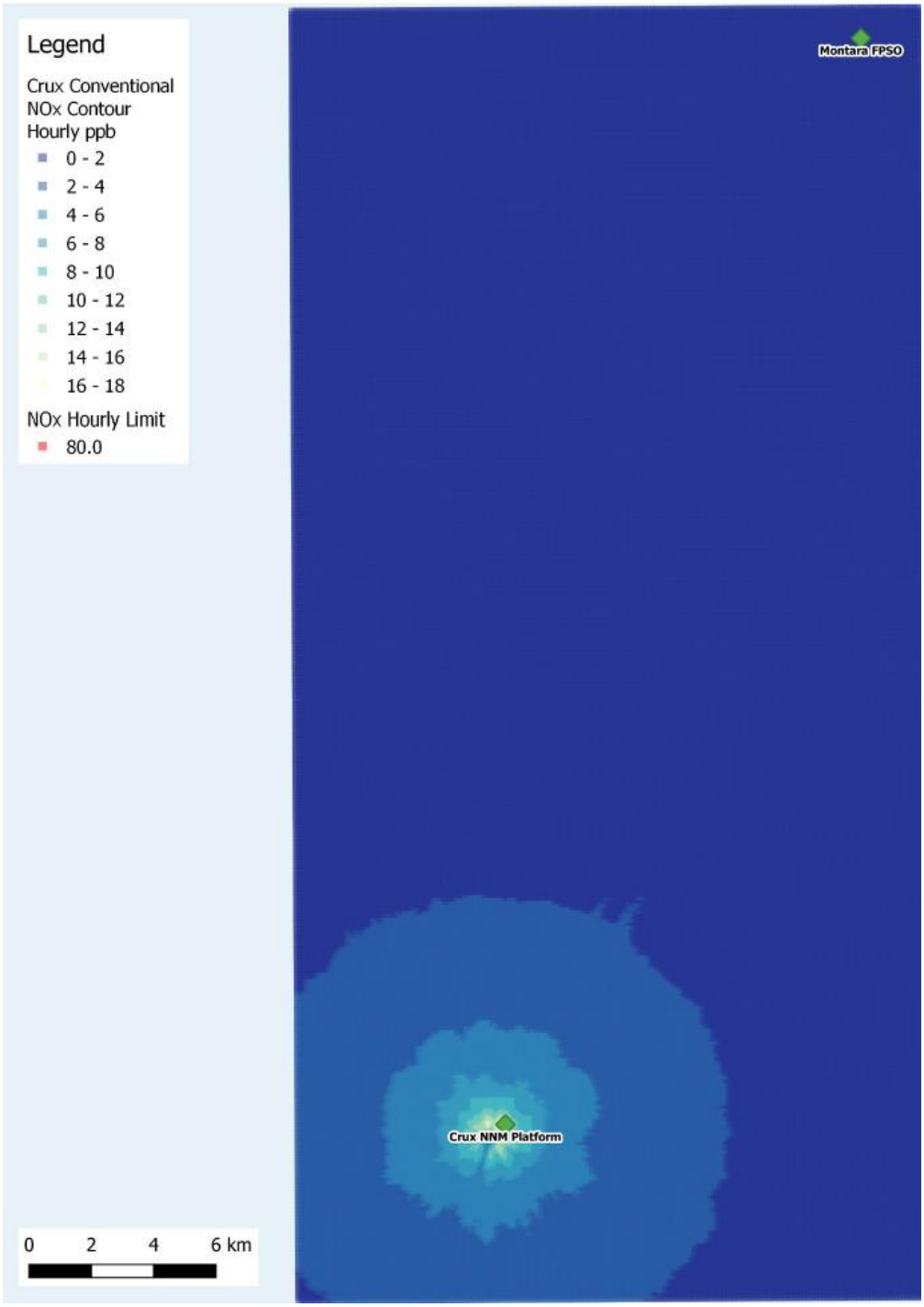


Figure 9-6: NO_X Emissions Contour – Hourly Average

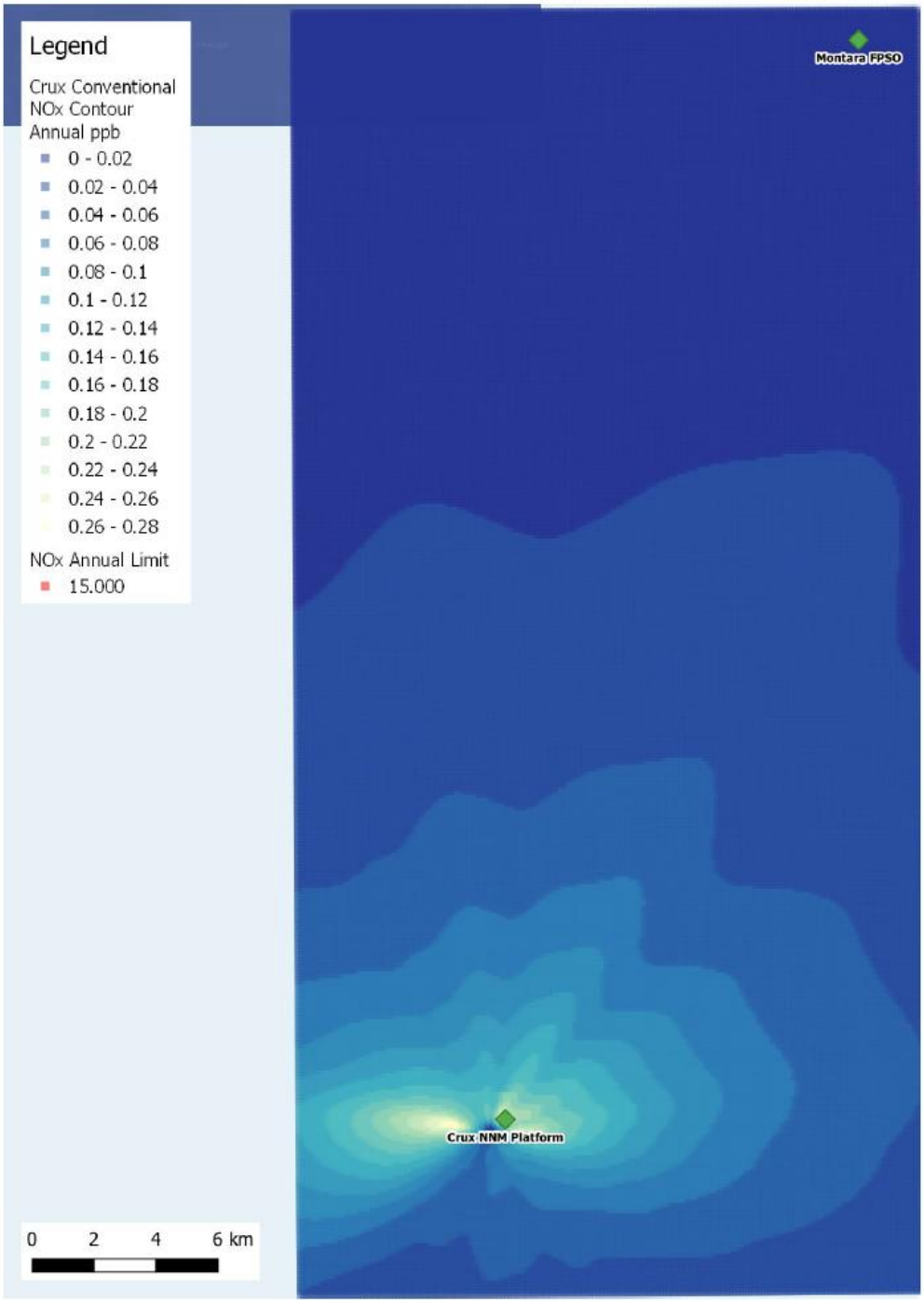


Figure 9-7: NO_X Emissions Contour – Annual Average

Point Source Concentrations

Not all Australian jurisdictions have standards for emissions from point sources such as those from the flare and power generation exhaust. However, the *Protection of the Environment Operations (Clean Air) Regulation 2022* (NSW) is generally the most comprehensive state-based legislation and often applied to projects throughout all Australian jurisdictions. For the most stringent Group 6 criteria, this legislation includes a maximum point source concentration target of 0.2 mg/m^3 (200 µg/Sm^3). For the GTGs, based on complete combustion and stoichiometric rate of air, with the presence of N_2, CO_2 and H_2O in the flue gas, the mercury concentration in the exhaust gas is calculated to be ~11-29 µg/Sm^3 depending on design case. This concentration (prior to dispersion in the atmosphere) is already significantly lower than the Group 6-point source concentration target for exhaust flue gases (200 µg/Sm3), prior to further dilution in the atmosphere by the hot plume (i.e., example exhaust flow rate of 17 kilograms per second and temperature 374 degrees

Celsius; which would typically be at least 10 to 100-fold within 10 to 20 metres of the exhaust stack). Similarly, the LP flare system forecast mercury concentrations range from 187 µg/Sm^3 to 566 µg/Sm^3 (reference case, Table 9-61, row F) which are either already under this stringent point source standard or will be after rapid dispersion with the flare plume.

9.11.2.2 Cumulative Impacts of Crux Processing on Prelude FLNG

In 2020, Shell conducted cumulative air modelling impact assessment based on the atmospheric emissions from Prelude FLNG and Ichthys FPSO facilities. The cumulative modelling results predicted that the maximum concentrations at the closest receptor—Browse Island—are well below the associated ambient air quality standards for normal and exceptional case scenarios examined (Shell 2020). Refer to the Prelude FLNG EP [Shell document number: 2000-010-G000-GE00-G00000-HE-5880-00002] for a full summary of the modelling inputs, methodology and results. The indirect processing of Crux molecules by Prelude FLNG (not part of activity) is not expected to significantly change the trajectory emissions profile on Prelude FLNG as Crux production is progressively replacing ullage in Prelude production (not adding to Prelude production) and therefore demand for power by utilities is not being increased.

9.11.2.3 Summary

The quantities of gaseous emissions associated with the Activities are relatively small and will, under normal circumstances, be quickly dissipated into the surrounding atmosphere through natural dispersion and dilution (e.g. wind, mixing). In general terms, the sensitivity of local air quality in the Activity Area is considered low due to the absence of existing pollution sources and the absence of sensitive receptors. Considering the location of the Activity Area in the open ocean, which is well-removed from nearest residential or sensitive populations of the WA coast (~200 km offshore), and the localised nature of the emissions, it is considered highly unlikely that atmospheric emissions will result in significant impacts to ambient air quality at a local and regional scale.

Furthermore, no impacts to the local airshed at the nearest shorelines of Cartier Island (~105 km from the Crux platform) and Ashmore Reef (~155 km from the Crux platform), which support foraging and breeding populations of turtles and birds, are expected given the localised nature of the emissions. Atmospheric emissions will result in only minor deterioration in local air quality for transient bird species passing through the Activity Area. Sixteen threatened and/or migratory seabirds were identified as potentially occurring within, or having habitat potentially transiting through the Activity Area, these species may be impacted by temporary and short-term deterioration in air quality if they are transiting the immediate area of the platform topsides and vessel exhaust release points. The potential impacts to these receptors from emissions are considered negligible due to the low magnitude of emissions and remote location. The potential for black smoke resulting from emissions may impact visual amenity, however, no impacts to visual amenity for residential communities and tourism activities are expected.

Given the offshore remote context, and the low volumes of atmospheric emissions that will be generated, environmental sensitivities that may be impacted by atmospheric emissions include only physical features (air quality). No impacts to protected areas, natural features, socioeconomic features, heritage and cultural features, physical values and sensitivities, natural values and sensitivities, socioeconomic values and sensitivities, or heritage and cultural sensitivities are predicted or reasonably foreseeable. NEPM standards at the nearest populated areas are unlikely to be exceeded.

9.11.3 Impact Assessment Summary

Table 9-66 lists the highest residual impact consequence ranking of the relevant environmental receptor groups.

Table 9-66: Atmospheric Emissions Evaluation of Residual Impacts

Environmental Receptor	Magnitude	Sensitivity	Residual Impact Consequence
Evaluation – Planned Impacts			
Protected Areas	N/A	N/A	N/A
Physical Features	N/A	N/A	N/A
Physical Values and Sensitivities	-1	L	Slight

Environmental Receptor	Magnitude	Sensitivity	Residual Impact Consequence
Natural Features	N/A	N/A	N/A
Natural Values and Sensitivities	N/A	N/A	N/A
Socioeconomic Features	N/A	N/A	N/A
Socioeconomic Values and Sensitivities	N/A	N/A	N/A
Heritage and Cultural Features	N/A	N/A	N/A
Heritage and Cultural Values and Sensitivities	N/A	N/A	N/A

9.11.4 ALARP Assessment and Environmental Performance Standards

Table 9-67: ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
ALARP Assessment						
Elimination	Use of renewable energy (e.g. solar, wind and wave) in lieu of fossil fuels for power generation and marine vessel propulsion.	No	Use of solar, wind or wave energy for a continuously running operation does not have the required reliability and will also require additional space and capital investment which are not currently justified.	N/A	N/A	N/A
Elimination	Use of fired heaters to increase the efficiency of generating heat duty for TEG reboilers and therefore reduce emissions load.	No	Standalone gas fired boilers were assessed to provide heating duty for the TEG reboilers which represents ~50% of the electrical load. Whilst the gas fired boilers can be more efficient than electric heaters, the additional maintenance demand was considered a significant disadvantage that would reduce facility availability and would therefore be detrimental to the minimal manning philosophy and personnel safety exposure offshore. Therefore, electric heaters were selected to provide heating duty to the TEG reboilers given the lower maintenance requirement and offshore personnel safety exposure relative to fired heaters.	N/A	N/A	N/A
Elimination	Waste heat recovery units on turbine exhausts to increase the efficiency of generating heat duty for TEG reboilers and reduce emissions load.	No	Assessment of waste heat recovery units (WHRU) from the GTG exhaust was assessed to be the most efficient option to provide heating duty to the TEG reboilers (which represents ~50% of the electrical load), however, the additional space, weight, complexity, and maintenance demands associated with WHRU system was determined to be detrimental to the availability, minimal manning philosophy, and personnel safety exposure offshore. Therefore, electric heaters were selected to provide heating duty to the TEG reboilers given the lower maintenance requirement and offshore personnel exposure relative to WHRU.	N/A	N/A	N/A
Elimination	Selection of off gas recovery system to eliminate flaring of low-pressure waste gas stream.	No	Crux requires various off gas streams to be safely routed to flare from process and utility systems such as the TEG regeneration and produced water system. The opportunity to recover, compress and reinject these off gasses for export was assessed, however, the requirement for multi-stage compression to capture and safely reinject the off gasses was determined to introduce additional complexity, is not suited to remote operation and would adversely impact platform reliability, manning philosophy, and incremental personnel safety exposure offshore. The interaction with the safety critical flare system and continued operation of gas compression would also increase Crux safety risks, and the environmental benefit gained would be limited to a portion of flare system flows due to process safety constraints, and so this would not be complete elimination of an emission source. Operation of compression equipment will also increase energy demand on the platform and therefore increase fuel gas consumption and associated emissions. In addition, required compression facilities increases the potential for trips which would consequently have a detrimental impact by increasing flaring of large inventories of high-pressure gas. The flare stream downstream of the degasser vessel and TEG system also contains a very high proportion of water vapour which does not contribute to emissions. Instead, the Crux design chose to minimise the gas passed through these systems to manage process safety without detrimentally impacting the functional performance or integrity of the export pipeline, TEG regeneration and produced water systems.	N/A	N/A	N/A
Substitute	Battery energy storage system (BESS) to store energy and	No	A battery energy storage system (BESS) was considered in conjunction with the main power generation system to better stabilise power loads	N/A	N/A	N/A

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
	partially substitute fuel combustion.		and potentially increase efficiency of the system. Given the relatively lower power demand and simplified equipment layout for Crux, studies concluded limited benefits of using a battery system and was not selected given the trade-offs with increased equipment complexity and space allocation required to install and weakness associated with remote operation of the BESS with limited energy efficiency improvements. Shell is developing battery energy storage systems in Australia and globally, however these are generally developed at the infrastructure level.			
Engineering	Power generation and management systems; • Gas turbine generator configuration optimised and monitored for emissions and performance. • High-Efficiency Particulate Air (HEPA) inlet air filtration system. • Solar Insight Platform equipment health monitoring. • Facility Operating Procedures require GTG's to be started using backflow pipeline gas rather than well gas, to minimise flaring and emissions.	Yes	The power system, an equipment control measure, was optimised by selecting three Solar gas turbine generators (GTGs) to be run on fuel gas only (not dual fuelled with diesel), with one in cold standby. This setup is energy-efficient and reduces GHG emissions compared to having three GTGs in operation or hot standby. The Solar Turbines GTGs are efficient, quick to react to load changes, and reliable, minimising shutdowns and associated GHG emissions. They can be remotely monitored and controlled by a Power Management System (PMS) for efficient load shedding and energy management. Normally, two GTGs operate with a spinning reserve, while the third is on cold standby, running in a 2 x 50% configuration. The GTG packages have been fitted with a High-Efficiency Particulate Air (HEPA) inlet air filtration system to minimise any performance/ efficiency degradation due to turbine compressor fouling. The system includes a differential pressure alarm that alerts operators to conditions that may impact efficiency and performance of the system, enabling the investigation and planning of filter maintenance activities (e.g., higher differential pressure alarm may indicate blockages and an indicator of performance and efficiency decline requiring action). This helps ensure that the turbine continues to run at best possible performance between maintenance interventions (compressor washes) managed by CMMS. The Solar InSight System is a proprietary system for equipment health monitoring and management. It combines data acquisition, machine learning and remote diagnostics to monitor the efficiency and condition of gas turbines and related equipment to continuously assess turbine performance, in conjunction with PTM monitoring for long-term (months – years) trend analysis and preventative maintenance, such as water washing, to minimise efficiency degradation over time. Factory testing indicates that the thermal efficiency of the GTGs at full load is about 26.7% to 28.3% (depending on ambient conditions). The thermal efficiency changes at different loads and is lower when operating at reduced loads. The GTGs do not have operational controls to optimise GHG performance beyond load management (EPS 9.1) and systems maintenance. Turbine efficiency will naturally decline over time. Key factors influencing degradation include environmental exposure (e.g., salt air), fuel type and quality, maintenance intervals and practices, load cycling and thermal stresses. Initial degradation of GTGs tends to be more rapid in the first few thousand operating hours, often due to compressor fouling, tip clearance increases, and airfoil surface deterioration. Recoverable degradation (e.g., from fouling) can be mitigated through water washing and maintenance. Non-recoverable degradation (e.g., erosion, corrosion, and material fatigue) typically results in a ~2–5% drop in thermal efficiency over several years of operation. Solar InSight Platform monitoring of efficiency trends over the longer term will inform maintenance actions, such as de-fouling, to restore its recoverable degradation/performance.	9.1	Power generation GTG configuration optimised so that two GTGs will operate with a spinning reserve for each, while the third remains on cold standby. This configuration will continue unless it is later found not to manage impact and risk to ALARP.	DCS records for operation of the power generation system show two GTGs operating with a spinning reserve for each, while the third remains on cold standby. This configuration will continue unless it is later found not to manage impact and risk to ALARP.
				9.2	Operate GTGs using fuel gas.	DCS shows GTGs operated using fuel gas.
				9.3	During normal operations, the GTGs will operate with a High-Efficiency Particulate Air (HEPA) inlet air filtration system with differential pressure alarm.	HEPA filtration system as built drawings. Filter pressure differential tracked on DCS. Master Alarm Database shows alarm configuration. CMMS maintenance records.
				9.4	The InSight System will monitor efficiency of the Crux GTGs as a predictive maintenance indicator. Data will be used to establish and implement condition-based maintenance trigger within two years of start-up to inform scheduling and execution of planned maintenance such as water washing in accordance with the CMMS.	InSight turbine health monitoring records. CMMS maintenance records. InSight records demonstrate GTG efficiency monitoring. InSight records demonstrate a threshold for acceptable efficiency decline and/or expected gains post-maintenance.

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
Engineering			The Crux design includes the capability to receive clean gas backflow from Prelude as an alternative fuel gas required for hot commissioning, start-up and restart activities (i.e. from a black start after an emergency shutdown or after a planned shutdown). This design feature minimises the duration of flaring required to meet fuel gas specifications, thereby reducing atmospheric emissions. As a contingency, Crux well gas may be used where Prelude backflow gas is unavailable or if, due to unforeseen circumstances, the measure is no longer considered to be ALARP in reducing environmental impacts and risks in accordance with operating procedure.	2.1	Refer to EPS 2.1.	Refer to EPS 2.1.
Engineering	Flare tip ignition system managed in accordance with Operation Environmental Critical Elements and Performance Standards Manual and CMMS detailed in sections 10.4.1.1, 10.4.7 and 10.4.8 to maximise efficiency of combustion, minimise flame-out events.	Yes	Flare tip integrity and ignition system functionality minimises potential for venting, incomplete combustion waste products and smoke emissions. This includes the following elements: • To maintain, monitor and record the flare flame to avoid venting scenarios a High Energy Ignition (HEI) system has been designed as the flare ignition system with automatic restart on flame-out. Ignition system control measure shall attempt to relight pilots after flame-out; if this fails the package shall initiate an alarm signal. • A Flame Front Generator (FFG) flare ignition system has been designed and shall act as remotely operated manual system. • A Flare Pilot Monitoring System has been designed and shall include thermocouple flame detection which will indicate pilot status (on/off for each pilot); and transmit signal to the DCS. The Flare Monitoring System has been designed to include CCTV dedicated to the flare flame (to the maximum practical extent) with a software analytics package to help operators detect simultaneous flame-out. • LP and HP flare tips were specified in design to achieve a combustion efficiency of not less than 98% over the anticipated flow ranges, which is planned to be tested for the LP flare when operational (given the HP flare is used primarily in emergency high pressure relief scenarios which cannot be safely tested). The LP flare testing will require the mobilisation and operation of specialist survey drones with specialist contractors. Shell views the appropriate timeframe to complete LP flare testing as within 12 months of start up to allow the focus to be on safe start up and reaching steady state operations which are higher priorities. Once an appropriate activity window is scheduled after start-up, it may take an additional 12-24 weeks to mobilise the required specialist contractor(s) and equipment onto the platform and then finalise the survey report. Therefore, to complete the first survey within 12 months of operation is viewed by Shell as an appropriate and reasonable timeframe to complete this testing activity. Combustion efficiency of the HP flare will not be validated during normal service conditions, such as blowdowns, as doing so would require planned releases that generate significant emissions. This approach is not considered ALARP, given the environmental impact of conducting validation tests solely for measurement purposes. The goal of the flare tip ignition system ECE is ‘to prevent and mitigate flame-out occurrences to avoid venting scenarios’. Maintaining the system in accordance with CMMS will help ensure the goal of the ECE is met. Environmental critical equipment is maintained accordance with CMMS, as outlined in section 10.4.1.1, 10.4.7 and 10.4.8 to ensure they are within reliability, availability, and accuracy requirements for the equipment.	9.5	Environment critical equipment for Flare Tip Ignition System (ECE-IC9), will be managed in accordance with the Operation Environmental Critical Elements and Performance Standards Manual, which provide the functional performance criteria and required tasks to validate that the ECE’s perform their required functions e.g., maintain flare tip integrity and ignition system functionality to minimise potential for venting, incomplete combustion of waste products and smoke emissions. Monitoring is in place to ensure flare/pilots are lit and ignition system is available to light the flare in a timely manner.	Environmental critical equipment is maintained accordance with CMMS.
				9.6	LP flare combustion efficiency will be validated to be 98% or greater during normal operating conditions within 12 months of start-up.	Flare survey combustion efficiency results. Methane monitoring vendor report.
				10.2	Refer to EPS 10.2.	Refer to EPS 10.2.

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
			The design therefore ensures the safe disposal of hydrocarbons by combustion rather than cold venting, thereby minimising the potential for intentional VOC emissions to the atmosphere. Any flame-out events will be recorded in the DCS and reported in Sphera.			
Engineering	Flare flow meters and CMMS as detailed in section 10.4.7 and 10.4.8.	Yes	Flare flow meters, an equipment control measure, are maintained according to the maintenance schedule and maintenance system to ensure they are within reliability, availability, and accuracy requirements for this equipment.	9.7	Flare flow meters will be maintained in accordance with the CMMS.	Flare flow meter CMMS maintenance records.
Engineering	Crux platform process system includes the following to assist in managing mercury; • Temperature regulation to maximise partitioning of mercury to gas and condensate export streams. • Differential Temperature Alarm • Maintenance of temperature controllers and differential alarms.	Yes	Crux platform process system includes the following measures to manage mercury; • Temperature regulation to maximise partitioning of mercury to gas and condensate export streams. • Differential Temperature Alarm • Maintenance of temperature controllers and differential alarms. • no continuous injection of hydrate inhibitor chemicals into Crux field wells. Temperature management is a critical component in the Crux design. Temperature control is primarily used to ensure gas and condensate dehydration. However higher temperatures also reduce mercury content in the water stream. <u>Inlet Cooler temperature control</u> The multiphase wellstream is initially cooled from 120°C to ~50°C in the Inlet Cooler with an expected operating window of between 45°C-55°C. At these temperatures, ~ 40% of the mercury in the inlet stream will remain in the gas phase. A temperature controller is installed upstream of the inlet separator, providing operators with surveillance of process temperatures prior to the bulk separation stage. <u>Liquids cooler differential temperature</u> The liquids (condensate and produced water) are separated and further cooled at the Liquid Cooler to ~40°C. To maintain production limits, a differential temperature alarm is set at ~8°C to maintain a minimum temperature differential between the outlet of the inlet cooler and outlet of the liquid cooler. The temperature management components will be maintained to ensure ongoing adherence to temperature control and differential temperature functionality. At these design and operational temperatures, the mercury has a much higher solubility in gas and condensate. Use of this system control in the Crux process system is expected to result in 99% of the mercury partitioning to the hydrocarbon phase and routed to the Prelude FLNG Mercury Removal Unit (MRU) (~95% in late life if there is formation water breakthrough). These temperature limits therefore maximise the partitioning of mercury to the gas and condensate streams and minimised mercury partitioning in water. It should be noted that in non-routine/unstable operations, ambient weather conditions (e.g., high ambient heat conditions) can impact the operation and efficiency of the temperature controller systems on these coolers (e.g., efficiency of the cooling fans) and therefore some variation	7.15	Refer to EPS 7.15.	Refer to EPS 7.15.
				7.16	Refer to EPS 7.16.	Refer to EPS 7.16.
				7.17	Refer to EPS 7.17.	Refer to EPS 7.17.

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
			from these temperature setpoints is allowed for in the operating envelope. An assessment of best available techniques and best environmental practices was undertaken during concept engineering. The existing mercury removal units on Prelude FLNG were assessed for capability to process Crux production alongside concept phase studies on other technologies detailed below. The Prelude MRU has the capability to treat mercury within gas from the acid gas removal unit and gas recovered from the condensate stabilisation system. This strategy optimises the use of existing equipment, avoiding the need for additional MRUs on the Crux platform and thus preventing resource inefficiency. The design, operations, and maintenance of the Prelude MRU are detailed in the current Prelude FLNG EP, and the processing of Crux gas and condensate will only commence once a revised EP is accepted by NOPSEMA.	7.19	Refer to EPS 7.19.	Refer to EPS 7.19.
Administrative and Procedural	Report emissions where required by the NPI.	Yes	National Pollutant Inventory (NPI) Measure 1998 (established under the *National Environment Protection Council Act 1994* Cth), a system control measure, provides the framework for the development and establishment of the NPI, which provides publicly available information on the types and amounts of substances being emitted into the Australian environment. These substances have been identified as important due to their possible effect on human health and the environment.	9.8	Report types and amounts of relevant NPI substances as required by the National Pollutant Inventory (NPI) Measure 1998.	Public NPI reporting records.
Administrative and Procedural	GHGEMS includes LDAR surveys as detailed in section 10.6.6.	Yes	Leak Detection and Repair (LDAR) surveys form part of the GHGEMS as detailed in Section 10.6.6. During operations, LDAR surveys will be conducted to identify fugitive emissions from valves, emission points, flanges, or equipment from any hydrocarbon processing areas of the plant. All identified fugitive emissions will be registered and corrected to reduce emissions.	9.9	Perform LDAR survey annually and correct fugitive emissions through implementing the corrective maintenance process.	Records of LDAR survey occurring annually, associated register and corrective maintenance records.
				10.11	Refer to EPS 10.11.	Refer to EPS 10.11.
Administrative and Procedural	Vessel engines to use low-sulphur content fuel or an IMO approved alternative measure (e.g. EGCS fitted) to reduce sulfur oxide emissions in accordance with marine order 97.	Yes	The MARPOL Annex VI requirement, the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) and Marine Order 97, a system control measure, requires that all fuel used by a vessel for propulsion or operation and carried on the vessel must have a low sulphur content.	9.10	Use only low-sulfur fuel (≤0.5 m/m S) or an IMO approved alternative measure (e.g. EGCS fitted) to reduce sulfur oxide emissions.	Sulfur content of fuel oil/ diesel, % w/w as verified in bunker receipts. A copy of a maintained EGCS record book (if relevant).
Administrative and Procedural	Vessels (as appropriate to vessel class) will comply with MARPOL Annex VI (Prevention of Air Pollution from Ships), the *Navigation Act 2012* (Cth), the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) and subsequent Marine Orders.	Yes	Marine Order 97, a system control measure, requires specified marine vessels to possess the applicable pollution prevention and energy efficiency certificates. These certificates include Engine International Air Pollution Prevention Certificate (EIAPP), IAPP and an International Energy Efficiency (IEE) Certificate. In addition, all vessels >400 t (gross) are required to carry a Ship Energy Efficiency Management Plan (SEEMP). These requirements are also recognised and enforced in the Shell Marine Assurance Process and procedures.	9.11	Vessels are required to have this valid documentation, as required by vessel class, size and type: • EIAPP certificate. • IAPP certificate. • IEE certificate. • SEEMP.	Marine Assurance Record confirming valid SEEMP and IAPP, EIAPP, IEE certificates are in place for vessels (where required by vessel class, size and type).
				9.12	Waste from incineration managed in accordance with MARPOL Annex VI.	A copy of the completed garbage record book or official recording system that captures incinerated waste records. Records of an IMO type approval certificate for each incinerator in use, demonstrating the incinerator is designed for operation within the limits of Regulation 16 of MARPOL Annex VI.
				9.13	ODS managed in accordance with MARPOL Annex VI to reduce the risk of an accidental release of ODS to air, as required by vessel class, size and type.	A copy of the current and maintained ODS Record Book or recording system.
Administrative and Procedural	GHGEMP for execute phase requires a TEG Gas Stripping Optimisation Study	Yes	A TEG gas stripping optimisation study, a system control measure, is a planned mitigation to further reduce flaring and associated mercury emissions from the Crux platform. This study will be conducted and implemented not more than one year following commencement of	9.14	Shell will carry out a TEG fuel gas stripping optimisation study and commence implementing its outcomes within one year following the startup of Crux.	GHGEMP execute phase Technical Note and Instruction to Operations to change operational parameters for revised Operating Mode and

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
			operations. Early estimate indicates this may reduce mercury emissions by up to 1 kg/year. Early work indicates it is feasible, however further study work can only occur once Crux is in stable operations, to ensure technical integrity of the pipeline is maintained throughout operations and ALARP. Determining a safe operating envelope for the water content in the export pipeline is critical to technical integrity, as moisture may impact rates of corrosion in the pipeline (for example), therefore, the optimisation study must consider the trade-offs of optimising stripping gas rates versus increasing pipeline moisture content and potential impacts on pipeline technical integrity. The outcomes of the optimisation study will be implemented where a reduction of flaring rates and associated mercury emissions from the Crux platform may be realised and ALARP.			optimise stripping gas usage whilst maintaining dehydration performance criteria.
Administrative and Procedural	MRU for Fuel Gas Study	Yes	The current assessment for an MRU on the fuel gas stream concluded that the cost (~USD$22 million) is considered to be grossly disproportionate to the incremental decrease in mercury emission to air. Given there are currently limited precedents on MRUs installed specifically to treat fuel gas stream prior to GTG combustion for analogous offshore facilities, maturation of a formal study, a system control measure, to further establish cost, technical feasibility and expected environmental outcome is required. Progression of this engineering study for this treatment option is seen as a best practice approach. This enables the refinement in costs and further establishment of technical feasibility. The use of operational data also enables the verification of mercury rates in the fuel gas stream, which will further quantify the actual benefit gained from implementing this technology. This approach provides risk mitigation for higher-than-expected mercury rates and/or realisation of costs-based efficiencies, which may change the current assessment outcome for a fuel gas MRU. The timeframe required for completion of engineering processes and reaching a FID decision are aligned to industry standards. Typically, FEED for this scale of modification would be completed within 1 year. By progressing the engineering design study prior to start-up, and validating it using operational data, FEED and FID can be accelerated if required.	9.15	Conduct engineering design study for MRU on the fuel gas stream prior to the commencement of operations. This study will consider: • Technical feasibility of installing the available technology. • Engineering Risk Assessment. • Verified mercury rates within Crux product stream and/or emission sources. • Economic viability. • Assessment of related aspects (e.g., health, safety, operability & maintenance). • Weighting of cost compared to environmental benefit gained for adopting an MRU on the fuel gas stream. The engineering design study will be validated using mercury sampling and analysis data during the start-up phase. FEED, FID and implementation will be aligned to EPS 7.32.	Engineering design study report which includes a decision (post-validation) for entering FEED or rejecting an MRU on the Crux fuel gas stream.
Administrative and Procedural	Prelude FLNG EP covers the processing of Crux gas and condensate activities at Prelude FLNG facilities.	Yes	The Prelude FLNG EP, as revised will detail further information related to the design/operation and effectiveness of the Prelude MRU. The Prelude MRU is the key mercury removal technology used by the Crux project and enables the most efficient use of resources.	7.19	Refer to EPS 7.19.	Refer to EPS 7.19.

ALARP Demonstration Statement

Based on the outcomes of the impact assessment and the control measures adopted, Shell considers that the implemented controls are appropriate to manage the potential impacts associated with atmospheric emissions from the activity. These emissions are consistent with MARPOL and other applicable regulatory requirements, and the facility design incorporates measures to minimise emissions, including flare system improvements and fuel efficiency strategies. No additional or alternative controls were identified that would further reduce the impacts without disproportionate effort or cost. Therefore, the impacts are considered to be reduced to ALARP and acceptable levels.

9.11.5 Acceptability of Impacts

Table 9-68: Acceptability of Impacts – Atmospheric Emissions

Receptor		Acceptable Level of Impact	Acceptable?	Acceptability Assessment
Category	**Subcategory**			
Physical Values and Sensitivities	Air Quality	No significant impacts to air quality defined as no substantial change in air quality which may adversely impact on biodiversity, ecological integrity[26], social amenity, or human health.	Yes	Impacts to air quality from atmospheric emissions during the activity will be localised. Given the remoteness of the Activity Area, there is no potential for significant environmental impacts to occur.

The assessment of impacts from atmospheric emissions determined the residual impact consequence to be Slight (Table 9-66). Given that the air quality in the area is generally expected to be very high and the lack of sensitive human receptor populations and therefore considered acceptable (Table 9-68). The acceptability of impacts on air quality have also been considered in the following context.

Principles of ESD

The potential impacts from atmospheric emissions are considered acceptable and consistent with the principles of ESD because:

- The physical values/sensitivities within the Activity Area are not expected to be significantly impacted.
- The precautionary principle has been applied to the impact assessment.

Relevant Requirements

Managing the potential impacts from atmospheric emissions is consistent with relevant legislative requirements, including:

- Air quality in the Crux regional airshed complies with the current NEPM Ambient Air Quality Standards (National Environment Protection Council 1998) and the key changes to the ambient air quality measure (National Environment Protection Council 2021).
- National Environment Protection (NPI) Measure (NPI NEPM).
- Marine fuel oil used by vessels supporting operations complies with 1 January 2020 MARPOL Annex VI (Prevention of Air Pollution from Ships), the *Navigation Act 2012* (Cth), the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) and subsequent Marine Orders, which require vessels ≥400 t to have a valid IAPP certificate and use low-sulphur fuel.

Matters of National Environmental Significance

Commonwealth Marine Area

The potential impacts and risks from atmospheric emissions from the Activities on the Commonwealth Marine environment are predicted to not exceed any of the significant impact criteria, as listed in Table 8-1. Hence, it is considered that the aspect does not pose a credible risk to the Commonwealth marine environment.

Table 9-69: Summary of Alignment with MNES Considerations

MNES	MNES Acceptability Considerations	Demonstration of Alignment
Commonwealth Marine Area	No significant impacts on air quality	Criteria for significant impacts and risks to air quality over the Commonwealth Marine Area where the activity will operate are not considered likely to be exceeded by atmospheric emissions from the activity.

External Context

To date, no objections or claims about atmospheric emissions have been raised by relevant persons. Shell's ongoing consultation program will consider statements and claims made by Relevant Persons when further assessing impacts (see Section 5.13).

Internal Context

Shell also considered the internal context, including Shell's environmental policy and ESHIA requirements. The EPOs and the controls that will be implemented for the activity are consistent with the outcomes from consultation for the petroleum activity and Shell's internal requirements.

Acceptability Summary

The assessment of the potential impacts from atmospheric emissions determined the residual impact rankings to be Slight (Table 9-66). As outlined above, the acceptability of the potential impacts and risks from this aspect have been considered in the context of:

- the established acceptability criteria.
- ESD.
- relevant legislative requirements.
- MNES.
- external context (i.e. stakeholder claims).
- internal context (i.e. Shell requirements).

The potential residual impacts are deemed to be Slight, which Shell considers to be inherently acceptable if they meet legislative and Shell requirements. The discussion above demonstrates that these requirements have been met in relation to the atmospheric emissions aspect.

Shell considers the potential impacts from atmospheric emissions associated with the activity to be ALARP and acceptable.

9.11.6 Environmental Performance Outcome

EPO #	EPO	Measurement Criteria
9.1	Atmospheric emissions associated with the Activity will meet all regulatory source emission standards.	Demonstrated implementation of EPSs for activity atmospheric emissions.

9.12 Greenhouse Gas Emissions

9.12.1 Aspect Context

Greenhouse Gas (GHG) emissions trap heat in the atmosphere contributing to global temperature increases and are defined in the NGER Act to include CO_2, CH_4 and nitrous oxide (N_2O). Under the NGER Act, other greenhouse gases include perfluorocarbons, hydrofluorocarbons, and sulphur hexafluoride. GHG emissions are measured in CO_2-e to standardise their impact.

The GHG Protocol[49] classes GHG emissions as:

- Scope 1: direct GHG emissions produced from sources that are owned or controlled by the company;
- Scope 2: indirect GHG emissions when importing steam, heating, cooling, or electricity for use; and
- Scope 3: indirect GHG emissions, are a consequence of the activities of the company, but occur from sources not owned or controlled by the company.

In accordance with guidance from the Clean Energy Regulator on reporting under the NGER Act, in this assessment Scope 1 emissions are 'direct' emissions from activities under the Crux joint venture partners

[49] ghg-protocol-revised.pdf (ghgprotocol.org)

operational control and Scope 2 and 3 emissions are 'indirect' emissions outside of the Crux joint venture partners' operational control[50].

9.12.2 Methodology and Assumptions

While there are observed and predicted impacts of global climate change, it is not feasible to meaningfully link GHG emissions associated with the activity to climate change impacts globally and its impacts on potential Australian receptors. This is not to understate the potential environmental impact on the climate, rather it is to clarify that the source of any impact is from global emissions quantities rather than emissions from a single project. Nonetheless, this impact assessment is framed by reference to the incremental contribution that this activity will make to Australian and global GHG emissions.

Carbon dioxide equivalents (CO_2-e) are calculated using global warming potentials and emission factors from the National Greenhouse and Energy Reporting (Measurement) Determination 2008 or National Greenhouse Account Factors, GHG Protocol Corporate Value Chain Scope 3 Accounting and Reporting Standard (WRI/WBCSD 2011) and ISO 14040:2006 Life Cycle Assessment Principles and Framework (ISO 2006) based on the current Operating Plan production estimate.

This assessment adopts a conservative approach and considers:

- GHG emissions from the processing of production from the Crux wells at the Crux platform.
- GHG emissions from the processing of production from the Crux wells at the Prelude FLNG facility (during the period of the Crux activity) (Crux Energy[51]).
- GHG emissions from the processing of production from Prelude wells at the Prelude FLNG facility (Prelude Energy).
- The combined emissions of Prelude Energy and Crux Energy at the Prelude FLNG facility.

Two calculation methodologies are used to estimate Scope 3 GHG emissions associated with the activity (see Figure 9-8):

- '**End Use**' Scope 3 GHG emissions are the emissions related to the combustion of all products processed at the Prelude FLNG facility (during the period of the Crux activity) by consumers, such as power plants.
- '**Life Cycle**' GHG emissions take the Crux value chain into account, where emissions occurring during fabrication and transport, processing and third-party end use are included.

Consistent with how the facilities are set up for reporting under the NGER Act, in this assessment GHG emissions generated from:

- hot commissioning, start-up and operation activities under the Crux joint venture partners operational control are treated as Scope 1 and 'direct' emissions; and
- emissions produced from activities outside the operational control of the Crux joint venture partners (such as first stage well cleanup, fabrication, transport[52], processing at the Prelude FLNG facility[53] and third-party end use GHG emissions) are treated as Scope 3 and 'indirect' emissions.

Scope 2 GHG emissions are not expected from the activity.

Scope 3 and total GHG emissions are shown as an incremental increase to global GHG inventory and carbon budgets for this assessment, because third party end user GHG emissions will not count toward Australian inventories and carbon budgets and will instead be accounted for in the end-use countries under their respective domestic and international GHG emissions control frameworks.

While assumptions made have been robustly considered, actual GHG emissions may vary based on operational factors. Operating Plan and forecasts are reviewed regularly and may change. Detailed assumptions included in Appendix H. GHG emissions estimates will be reviewed after the first NGER reporting

[50] Emissions and energy types | Clean Energy Regulator (cer.gov.au)

[51] The use of terms Crux Energy and Prelude Energy is to enable differentiation at the Prelude FLNG facility.

[52] Including some shipping from the Prelude FLNG facility operated by Shell Group Companies.

[53] The same emissions will be addressed as Scope 1 emissions separately in the Prelude FLNG EP.

period. Completions and Year 1 GHG emissions forecasts may extend into Years 1 or 2, affecting estimates for subsequent years.

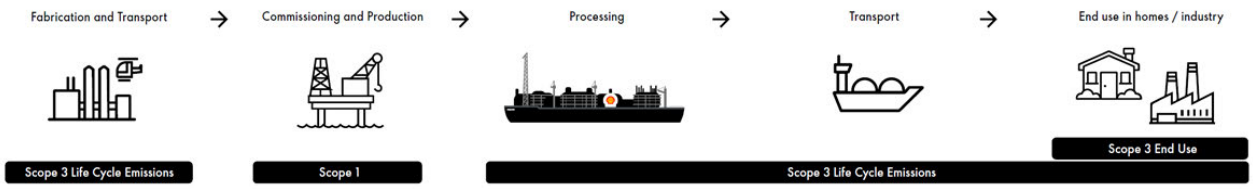


Figure 9-8: Lifecycle GHG Emissions

9.12.3 GHG Emissions Summary

Table 9-70 below sets out the total estimated GHG emissions associated with the activity.

Table 9-70: GHG Emissions Summary

GHG Emissions Estimate[54]	Completions Phase[55] Forecast (~MtCO2-e)	Year 1 Forecast[56] (~$MtCO_2$-e)	5 Year Total Forecast[57] (~$MtCO_2$-e)	Lifecycle Total (~$MtCO_2$-e)
Direct Emissions (Scope 1)				
Flare systems, power generation and fugitive emissions	-	0.24	0.55	1.3
Indirect Emissions (Scope 3) – Crux Energy				
Completions (1st stage cleanup flaring)	0.05	0	0.05	0.05
Marine Vessels, Aviation and Temporary Diesel Generation	0.03	0.03	0.13	0.2
Prelude FLNG Processing (Crux Only)	-	0.43	7.48	24.8
Supply Chain, Transport, and Third-Party End Use (Crux Only)	-	2.62	35.6	100.8
Total Indirect Crux Energy	0.08	3.1	43.2	125.8
Total Crux GHG Emissions (Direct and Indirect)	**0.08**	**3.3**	**43.8**	**127.1**
Indirect Emissions (Scope 3) – Crux and Prelude Energy				
Total Prelude FLNG Processing (Prelude & Crux)	-	2.3	13.73	33.1
Total Supply Chain, Transport, and Third-Party End Use (Prelude & Crux)	-	13	74	150
Total Indirect Crux & Prelude	0.08	15.8	88.1	183.5
Total Crux and Prelude (Direct and Indirect) GHG Emissions	**0.08**	**16**	**89**	**185**

[54] Year 1 and 5–Year Forecasts are considered conservative, given an entire year of production is assumed which is unlikely.

[55] Includes first stage well clean-up (across 5 wells) and associated indirect emissions during that phase.

[56] Includes hot commissioning activity, second stage well clean-up, start-up and first year operations (export to Prelude FLNG) in accordance with the Operating Plan. Annual average unless specified otherwise by table or section references.

[57] Fabrication and transport scope 3 emissions are excluded, as these GHG emissions are primarily embedded/entrained in infrastructure. Consequently, completed or discontinued GHG emissions are not included in further evaluation.

Note 1: Refer to Appendix H.1 for detailed assumptions and Appendix H (various) for breakdown by GHG type (CH_4, CO_2 and N_2O); Appendix H.8 provides a summary of GHG emissions versus activity durations.

Note 2: MtCO2-e = Million tonne of carbon dioxide equivalent

For the activity, the estimated incremental contribution of GHG emissions will be negligible in the context of Australian and global GHG emissions, given (see Table 9-76):

- Scope 1 emissions:
  - are equivalent to less than 0.02% and 0.0002% to Australian and global GHG emission inventories respectively.
  - on a forward-looking basis are equivalent to less than 0.03% of the Australian carbon budget for 2020–2030.
- Scope 2 emissions are not expected from the activity.
- Scope 3 emissions are equivalent to less than 0.03% of global GHG emission inventories.
- Total GHG emissions, on a forward-looking basis, are equivalent to less than 0.056% of the global GHG emissions in the IEA's 'Announced Pledges' scenario and the highly stretching 'Net Zero by 2050' scenario.

While Shell has assessed no impact to the overall consequence level, and therefore to an acceptable level, it will nevertheless manage GHG emissions associated with the activity and any impacts to ALARP.

9.12.4 Direct GHG Emissions (Scope 1)

Direct GHG emissions are produced from hot commissioning, startup and operation of the Crux facility (Table 9-71 and Figure 9-10), including from the following sources:

- Flare Systems: GHG emissions from the combustion of hydrocarbons in the permanent high-pressure and low-pressure flare systems required for safe disposal of gases.
- Fuel use for Power Generation: GHG emissions from the combustion of fuel gas by the GTGs for power generation to provide permanent power to the Crux topsides.
- Fugitive emissions: GHG emissions from leakage or relief and maintenance including the produced water system.
- Diesel System that supplies the BSDG which provides intermittent power when the GTGs are not available.

The overall direct GHG emissions are estimated to be 1.3 $MtCO_2$-e over the lifecycle, averaging 0.09 $MtCO_2$-e per year (see Table 9-71).

For the first 5 years, the estimate is 0.55 $MtCO_2$-e, with an annual average of 0.11 $MtCO_2$-e due to high-pressure flaring during hot commissioning and start-up (see Table 9-71).

Table 9-71: Direct GHG Emissions Forecast Estimates (5 Year and Lifecycle)

GHG Estimate[58] ($MtCO_2$-e)	Year 1	Year 2	Year 3	Year 4	Year 5	5 Year Total / (%)	5 Year Average	Lifecyle Total / (%)	Lifecycle Average
Power Generation	0.01	0.02	0.03	0.02	0.03	0.10 (18.4%)	0.02	0.34 (25%)	0.022
Flare system	0.23	0.06	0.05	0.04	0.05	0.44 (79.9%)	0.09	0.97 (72.3%)	0.065
Diesel System	0.0001	0.0001	0.0001	0.0001	0.0001	0.001 (0.1%)	0.0001	0.002 (0.12%)	0.0001
Fugitive Emissions	0.002	0.0017	0.0017	0.0017	0.0017	0.01 (1.6%)	0.002	0.03 (2.4%)	0.0022
Total Direct Emissions	**0.24**	**0.08**	**0.08**	**0.07**	**0.08**	**0.55 (100%)**	**0.11**	**1.3 (100%)**	**0.09**

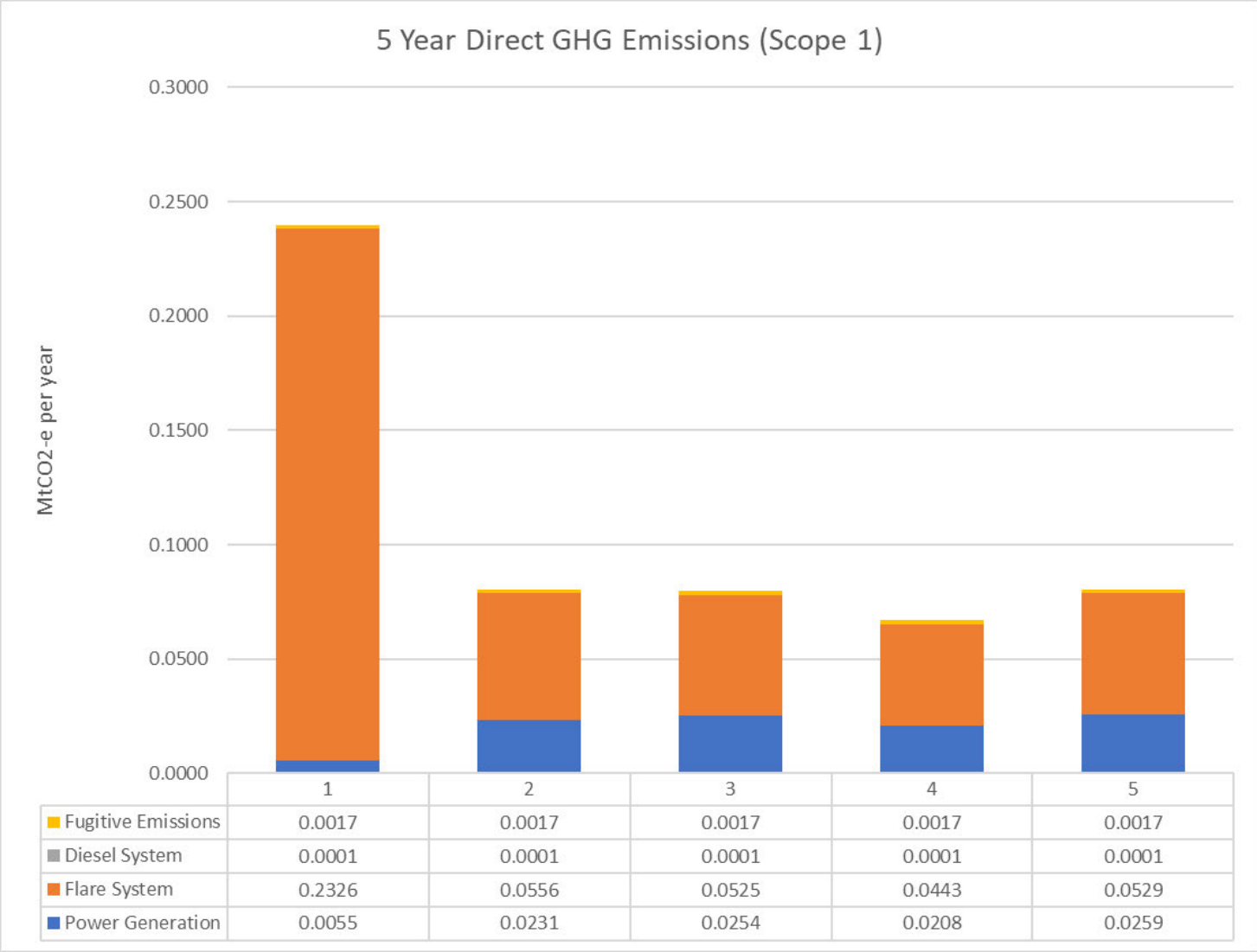
Note 1: Refer to Appendix H, H.1 and Appendix H.4 for detailed assumptions and breakdown by GHG type (CH_4, CO_2 and N_2O).

Note 2: MtCO2-e = Million tonne of carbon dioxide equivalent.

Note 3: Year 1 includes hot commissioning, start-up, and operations with assumptions defined in Appendix H (H.3 High Pressure Flaring, H.4 Operations).

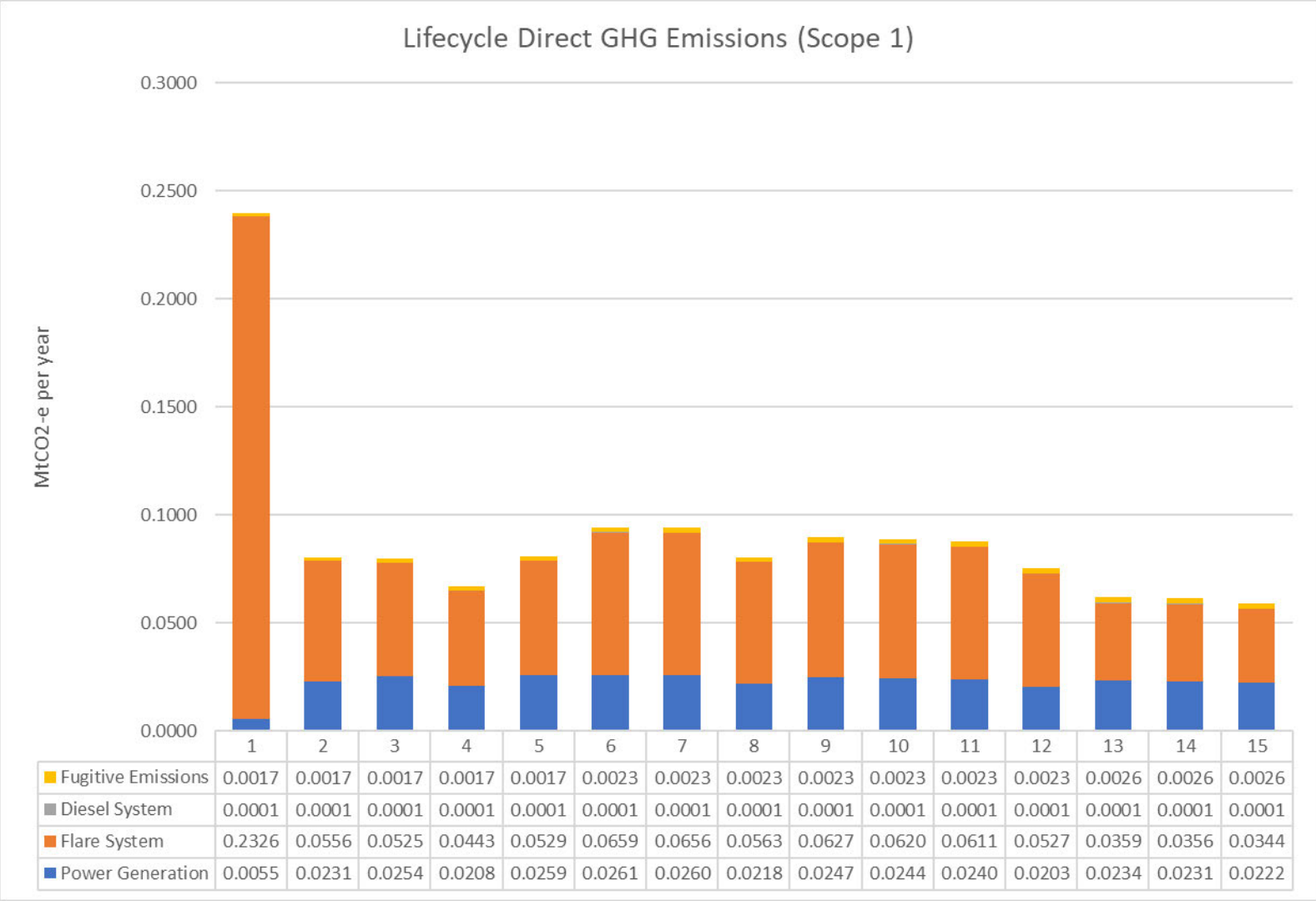
Note 4: For fugitive emissions assumptions, refer to Table 9-72.

[58] Further detail relating to the approximate breakdown of flare sources is provided in Appendix H.



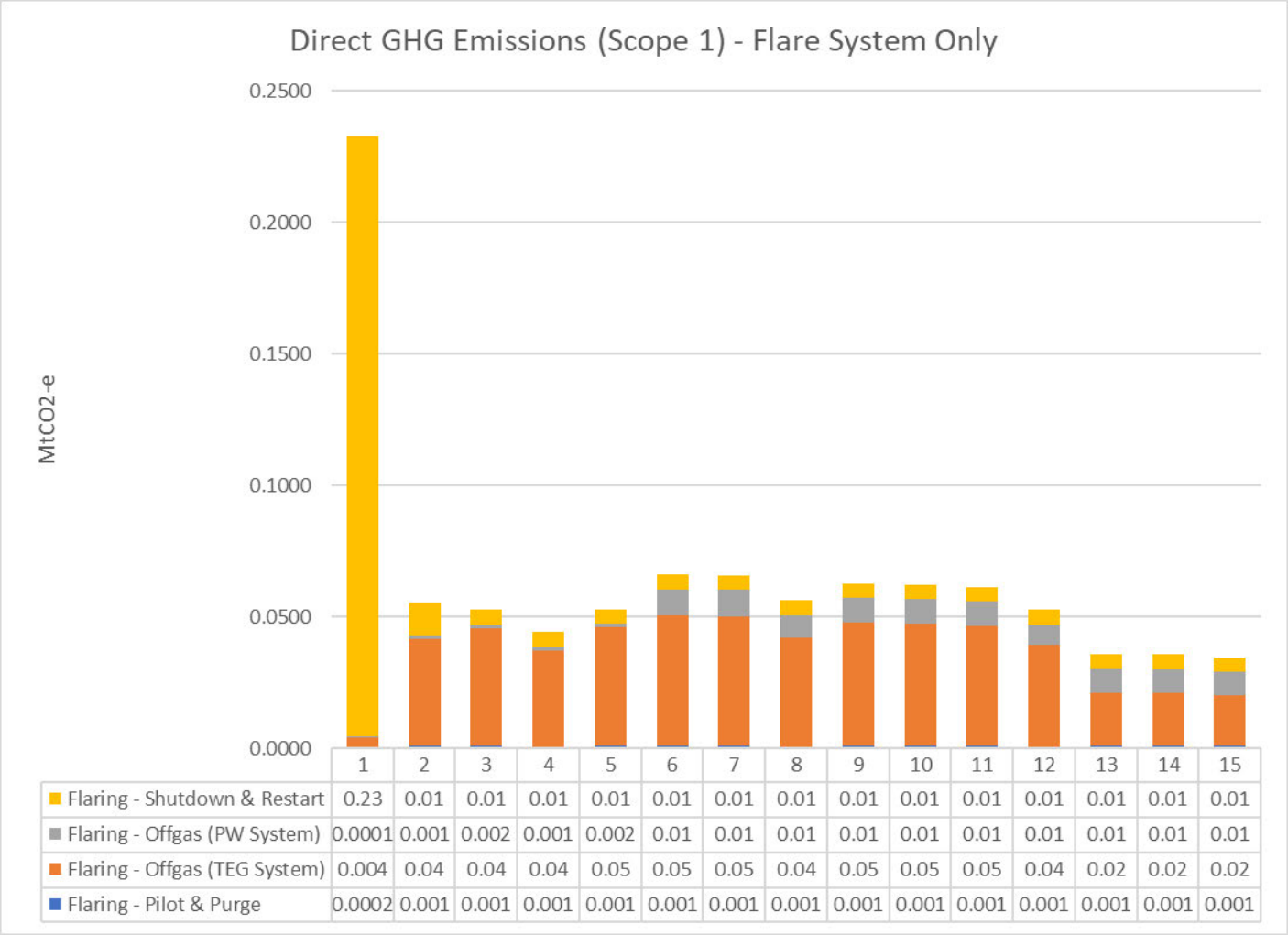
	1	2	3	4	5
Fugitive Emissions	0.0017	0.0017	0.0017	0.0017	0.0017
Diesel System	0.0001	0.0001	0.0001	0.0001	0.0001
Flare System	0.2326	0.0556	0.0525	0.0443	0.0529
Power Generation	0.0055	0.0231	0.0254	0.0208	0.0259

Figure 9-9: Direct GHG Emissions (Scope 1) - 5 Year Forecast



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Fugitive Emissions	0.0017	0.0017	0.0017	0.0017	0.0017	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0026	0.0026	0.0026
Diesel System	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Flare System	0.2326	0.0556	0.0525	0.0443	0.0529	0.0659	0.0656	0.0563	0.0627	0.0620	0.0611	0.0527	0.0359	0.0356	0.0344
Power Generation	0.0055	0.0231	0.0254	0.0208	0.0259	0.0261	0.0260	0.0218	0.0247	0.0244	0.0240	0.0203	0.0234	0.0231	0.0222

Figure 9-10: Direct GHG Emissions (Scope 1) - Lifecyle Forecast



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Flaring - Shutdown & Restart	0.23	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Flaring - Offgas (PW System)	0.0001	0.001	0.002	0.001	0.002	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Flaring - Offgas (TEG System)	0.004	0.04	0.04	0.04	0.05	0.05	0.05	0.04	0.05	0.05	0.05	0.04	0.02	0.02	0.02
Flaring - Pilot & Purge	0.0002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Figure 9-11: Direct GHG Emissions (Flare System Lifecyle Forecast)

Over the 15-year lifecycle, direct emissions are primarily from the permanent flare (72.3%) and GTGs (25%), diesel system (0.12%) and fugitive emissions (2.4%) (see Table 9-71 and Table 9-72 for fugitive emissions assumptions).

The GHG emissions forecast of direct emissions has reduced significantly from the Crux OPP due to design changes and changed Operating Plan assumptions including:

- Exclusion of Compression Facilities: Shell decided not to include compression facilities in the current design, which were previously estimated to contribute 0.282 $MtCO_2$-e/year.
- Duration: The forecast life of the Crux reservoir was reduced from 20 years set out in the OPP to 15 years because of revised production estimates.
- Design Changes: Modifications in the project design have led to more efficient operations and lower GHG emissions.

These changes have resulted in a nearly four-fold expected reduction in annual GHG emissions, and a five-fold expected reduction in total lifecycle GHG emissions.

Flare Systems

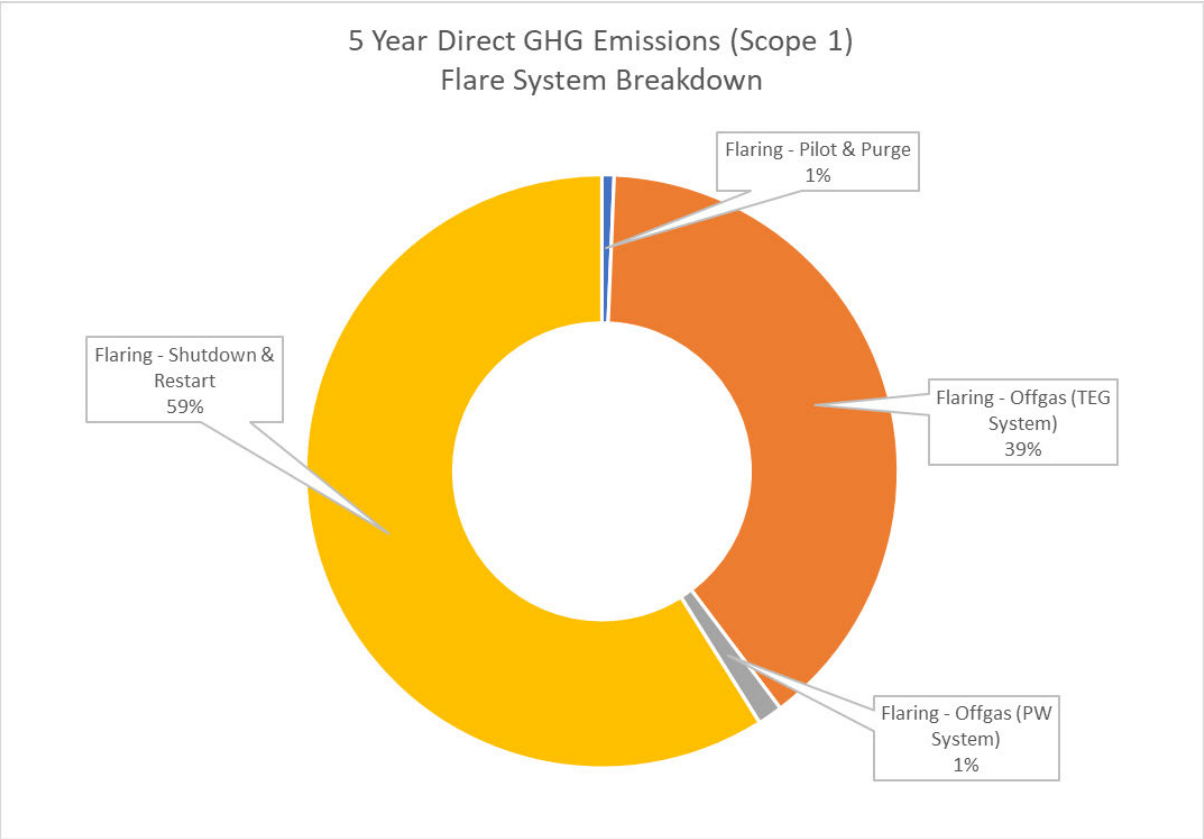
The flare system includes safety-critical low-pressure and high-pressure piping designed to combust purge and pilot gases ensuring availability for relief scenarios.

High pressure flaring primarily occurs during hot commissioning and start-up to safely import start-up fuel gas from Prelude FLNG, condition fuel gas for the GTGs, ensure a safe initial start-up, test emergency systems, and develop a reliable platform. Approximately 0.2283 $MtCO_2$-e or ~24% of direct GHG from flaring over the lifecycle is expected to be contributed during the hot commissioning and start-up period[59] (see detailed data and assumptions in Appendix H.4 and shown graphically in and Figure 9-11 and Figure 9-12). During operations, apart from the purge and pilot gas which contributes ~1% of direct GHG emissions from flaring over the lifecycle, the high-pressure flare system does not flare unless required for safety reasons or for the safe start-up or shutdown of the facility. Fugitive emissions associated with the flare system are addressed below.

The low-pressure system carries the following flaring loads (along with the continuous purge and pilot gas) (Figure 9-12):

- TEG system off-gas includes flash and surplus stripping gas with high water vapour content. The overall contribution from this low-pressure flaring is estimated to be ~57% of direct GHG emissions from flaring over the lifecycle (~39% over 5 years).
- Produced water treatment degasser vessel off-gas includes surplus purge gas. The overall contribution from this low-pressure flaring is estimated to be ~10% of direct GHG emissions from flaring over the lifecycle (~1% over 5 years).
- Minor stream: includes MEG storage vessel blanket gas, which is expected to be negligible.

[59] The assumptions for HP flaring durations are provided in Appendix H.3 (including restarts) and included in the Year 1 forecast and Appendix H.4 shown over the lifecycle. First year HP flaring is ~0.2283 $MtCO_2$-e whereas lifecycle flaring is ~0.97 $MtCO_2$-e (Appendix H.4).



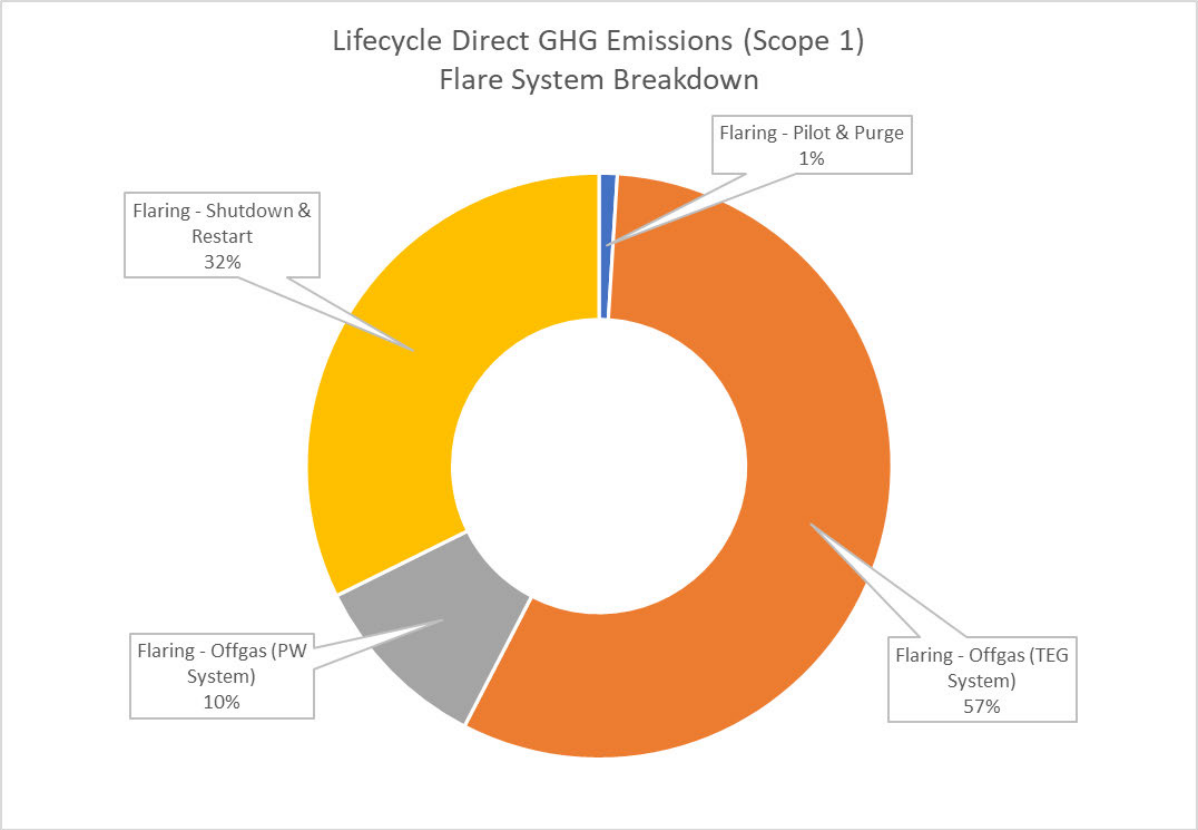


Figure 9-12: Direct GHG Emissions (Flare System 5 Year and Lifecyle Breakdown)

Fuel use for power generation (GTGs)

The main power generation system includes three GTGs, each rated at 2.8 MW, fuelled by scrubbed and conditioned fuel gas from Crux wells or imported backflow from Prelude FLNG during hot commissioning and start-ups. These GTGs provide the main platform power, backed by the 800 kW BSDG and a battery-powered UPS. GTGs contribute about 25% of direct GHG emissions over the lifecycle (18% over the first 5 years) (see Table 9-71) and consume 2,200–2,350 kg/hr of fuel gas when two GTGs are online, generating up to 3,183 kW.

Electrical power uses include the TEG reboiler, electric motors for pumps, air cooler fans, fuel gas heater, air compressors, HVAC, electric crane, lighting, small power, and UPS battery units. Temporary uses may include engines, pumps, compressors, lighting, and batteries. Normally, two GTGs operate with a spinning reserve, while the third is on cold standby. In case of a GTG failure, the fast load shedding system adjusts non-critical loads to match the remaining power until the standby unit is operational. Fuel gas consumption is metered for each GTG.

Fuel use for diesel engines

BSDGs provide power when no production gas is available, during shutdowns, and for temporary users during all activity phases, including completions, hot commissioning, start-ups, maintenance, repairs, turnarounds, well interventions, and workovers. BSDGs consume about 33 t of diesel per year over 200 operating hours, including periodic testing and unplanned usage (48 hours per unplanned shutdown, three times per year) (refer Appendix H.4). Approximately 0.12% of direct GHG emissions come from intermittent BSDG operation (Table 9-71).

Fugitive emissions

Fugitive emissions are either inherent in design or occur unexpectedly from equipment like valves, flanges, pump seals, relief valves, vents, sampling connections, process drains, open-ended lines, casing, tanks, and other pressurised equipment. Small volumes of non-ozone depleting refrigerant gases used in HVAC and refrigerant systems may also leak. The NGER specifies an approach to indirectly estimate the amount of fugitive emissions based on platform type. Fugitive emissions are calculated using NGER Determination factors:

- For shallow water offshore platforms (NGER Division 3.3.6B.1, 3.73F, Method 1): [Number of platforms x factor] * [share of gas type (by volume)/default share of gas type] for CO_2 and CH_4 (composition assumes CO_2 at 10.6%, CH_4 at 78.05%). This component makes up 1,639 tCO2-e (0.001639 MtCO2-e) per year average (methane) and 21 tCO2-e (0.000021 MtCO2-e) per year average (carbon dioxide).
- For produced formation water component (NGER Division 3.3.6D - 3.73NB, Method 2) over the range of lifecycle production profiles (24 to 1,106 megalitres per year): this component makes up 522 tCO_2-e (0.000052 $MtCO_2$-e) per year average (methane only).
- Approximately 2.4% of direct GHG emissions come from fugitive CH_4 emissions (Table 9-71) (NGER Methods).
- The 5-year total is forecast to be ~ 0.01 $MtCO_2$-e, and lifecycle total ~0.03 $MtCO_2$-e (Table 9-71).

Table 9-72: Fugitive Emissions (Lifecycle Average)

Component[60]	Estimated annual fugitive emissions (~tCO_2-e)	Estimated annual fugitive emissions (~$MtCO_2$-e)
CO_2	21	0.000021
CH_4	2,161 (1,639 + 522)	0.002161
N_2O	-	-
Average CO_2-e	2,182	0.002182

[60] Variance within the period for this EP may occur.

Unplanned Venting

In the unlikely event the flares are extinguished (flame-out), the hydrocarbon gas discharged via the flare system may initially not be combusted during the period required to purge the flare and re-establish flare ignition (flame-out). Three scenarios have been identified:

- The short term (hours) low-rate release of methane and carbon dioxide to atmosphere, at a rate of ~2,331 kg/h. In this unlikely event, the duration is conservatively assumed to be 1 hour to infer a delay in remote operator intervention (i.e., in a squall or cyclone) and could release ~1,333 kg/h of methane (~37 tCO_2-e per hour, or 0.000037 $MtCO_2$-e) and ~534 kg/h carbon dioxide (~1 tCO_2-e per hour, or 0.000001 $MtCO_2$-e). The flame-out will be rectified by either automatic or manual reignition (Section 6.7.10, which therefore equates to ~38 tCO_2-e. Such an event would represent ~ 0.04% of annual average GHG emissions (i.e., ~0.04% of 0.09 $MtCO_2$-e) (Table 9-71) and would be unlikely to exceed ~3 triggering events per year (i.e., ~114 tCO_2-e or 0.000114 $MtCO_2$-e per year).
- Peak blowdown through an unignited HP flare for a duration of 15 minutes releasing methane at 390,332 kg/h (~2,732 tCO_2-e over 15 minutes) and carbon dioxide at 52,195 kg/h (~13 tCO_2-e over 15 minutes, or 0.000013 $MtCO_2$-e) until the depressurisation has concluded. Such a low probability emergency event would represent ~3% of annual average GHG emissions (i.e., ~3% of 0.09 $MtCO_2$-e) (Table 9-71).
- The short term (minutes) low-rate release of methane and carbon dioxide to atmosphere during a startup, at a rate of ~117 kg/h (both LP and HP flares). In this unlikely event, the duration is conservatively assumed to be 1 hour to infer a delay in remote operator intervention and could release ~94 kg/h of methane (~3 tCO_2-e per hour, or 0.000003 $MtCO_2$-e) and ~12 kg/h carbon dioxide (~0.01 tCO_2-e per hour, or 0.00000001 $MtCO_2$-e). The flame-out will be rectified by either automatic or manual reignition (Section 6.7.10, which therefore equates to ~2.65 tCO_2-e. Such an event would represent ~ 0.003% of annual average GHG emissions (i.e., ~0.003% of 0.09 $MtCO_2$-e) (Table 9-71).

Noting that the design of the Crux flaring system has been designed with fundamental improvements to the Prelude FLNG facility flare system which has experienced several unplanned flare flame outs which were not immediately reignited, as described in section 6.7.10.1.

In the unlikely event of a flame-out, the duration will be limited by remote ignition functionality (refer Section 6.7.10). The measures described in Section 6.7.10 and below in Section 9.12.10 have been implemented to reduce the risk of such an occurrence to ALARP.

Another source of venting could be during some major maintenance or turnaround activities where it is not possible to route residual hydrocarbons to flare from depressurised vessels or equipment, and otherwise need to be vented. This may occur in some instances and therefore considered as an unplanned venting source. Frequency of this type of event may occur once every four years and volumes of GHG emissions is expected to not exceed 10 tCO_2-e (0.00001 $MtCO_2$-e) over that period.

Given the past occurrence of unplanned venting on Prelude amount to small amounts of GHG emissions being released and the predicted likelihood of occurrence on Crux is significantly lower than that of the Prelude FLNG, the unplanned venting GHG estimates are not included in the GHG emissions forecast.

9.12.5 Indirect GHG Emissions (Scope 3)

Indirect emissions associated with the activity include those outside the operational control of the Crux joint venture partners including from:

- Fuel use for power generation and transport during the completions, maintenance, and operations phases;
- Processing at the Prelude FLNG facility ('Processing GHG Emissions')[61]; and

[61] That is, the scope 1 emissions of the activities under the Prelude JVs operational control which will be included in the Prelude FLNG EP

- Fuel use for transport[62] and value-adding product end-use of Crux Energy by Shell Group's[63] customers once exported from the Prelude FLNG facility ('End User GHG Emissions').

9.12.5.1 Fuel Use for Power Generation, Completions and Transport

Indirect GHG emissions from fuel used for power generation and transport include:

- Construction and Installation Phase: Embedded GHG emissions from the fabrication, transport, and installation of the Crux and Prelude infrastructure which are estimated to be 0.5 and 3 $MtCO_2$-e, respectively[64]. This assessment includes GHG emissions from constructing and installing Prelude FLNG which is an operating as-built facility, and Crux facility which in its construction and installation phase to enable the assessment of relativity across all GHG emission sources. However, as these GHG emissions are already primarily embedded/entrained in infrastructure, they are therefore completed or discontinued GHG emissions excluded from further evaluation.
- Completions Phase: During completions, an estimated two temporary diesel power generators of ~1,200 kW each (primary and backup) may be in operation by third party contractors to supply temporary electrical loads. GHG emissions are also expected from first stage well clean-up and temporary power generation using diesel generators. These indirect GHG emissions include:
  - Temporary diesel generators for power generation during the phase (~1,200 kW each) contributing ~0.0134,000 $MtCO_2$-e (Table 9-73 with detailed assumptions Appendix H.6);
  - Well clean-up may require hydrocarbons to be produced and flared through the five wells at rates of up to 90 MMscfd for 24 hours or until safe and contribute ~0.05 $MtCO_2$-e across five wells (Table 9-73 with detailed assumptions Appendix H.6); and
  - Fugitive emissions are likely during well clean-up through well test equipment, although this contribution is expected to be negligible at ~641 tCO_2-e methane and ~8.63 tCO_2-e carbon dioxide (~657 tCO_2-e or ~0.00065 $MtCO_2$-e) calculated using Subdivision 3.3.2.3.1, 3.46AB Method 1.
- Maintenance Phase: Temporary power generation may also be required during maintenance periods. These indirect GHG emissions include:
  - Temporary diesel engines are calculated to contribute ~2,601 tCO_2-e/year average (~0.0026 $MtCO_2$-e/year average) (Table 9-73 with detailed assumptions Appendix H.6).
- Operations Phase: Marine vessels will transfer goods and materials to the platform and may be required for rescue, maintenance, module delivery, IMR and other surveillance activities. Personnel are mobilised to the facility by helicopter, with a four-hour return flight. Aviation operations include offshore helicopter access to platforms, vessels, ASV, and W2W vessel in the Activity Area. Helicopters are also used for shipping freight to and from the platform and vessels. These indirect GHG emissions include:
  - Marine vessels transfer goods and personnel, are estimated to contribute ~1,301 tCO_2-e/year average (0.0013 $MtCO_2$-e/year average) from ASV engines and ~4,179 tCO_2-e/year average (~0.0042 $MtCO_2$-e/year average) from W2W vessel engines (Table 9-73 with detailed assumptions Appendix H.6);
  - Support/IMR Vessels contributing ~4,695 tCO_2-e/year average (~0.0047 $MtCO_2$-e/year average) (Table 9-73 with detailed assumptions Appendix H.6); and
  - Helicopters contributing ~2,109 tCO_2-e/year average (~0.0021 $MtCO_2$-e/year average) (Table 9-73 with detailed assumptions Appendix H.6).

Refer Table 9-73 for a summary of indirect GHG emissions including average and phase or lifecycle totals.

[62] Including some shipping from the Prelude FLNG facility operated by Shell Group Companies

[63] The Shell Group consists of Shell plc and all companies in which Shell plc either directly or indirectly has a controlling interest (Shell companies). Each Shell company remains responsible for the adaptation and maintenance of its legal entity policies and corporate governance processes. Services provided or consumed vis-à-vis other companies (from within the Shell Group or third parties) are to be conducted in compliance with legal and regulatory (including tax) requirements.

[64] Based on assumptions as to the materials, weights, fabrication yard locations, and pipeline distances using National Greenhouse Account Factors emission factors.

Table 9-73: Indirect GHG Emissions (Scope 3): Fuel Use for Power Generation, Completions and Transport

GHG Emission Estimate[65]	Average ~tCO2-e ($MtCO_2$-e)	Total ~tCO2-e ($MtCO_2$-e)
Fuel Use Power Generation and Transport during Completions (Total is for Phase)		
Diesel combustion for power generation	–	13,413 (0.0134)
Flaring during first stage well clean-up	–	50,412 (0.0504)
ASV	–	11,869 (0.0119)
Vessels	–	5,203 (0.0052)
Helicopters	–	1,886 (0.0019)
TOTAL	–	**82,782 (0.083)**
Fuel Use for Power Generation and Transport during Hot Commissioning, Startup and Operations (Total is for Lifecycle)		
Diesel combustion for power generation	2,601 (0.0026)	39,020 (0.039)
ASV	1,301 (0.0013)	19,510 (0.020)
W2W	4,179 (0.0042)	62,681 (0.063)
Vessels (Support/IMR)	4,695 (0.0047)	70,420 (0.070)
Helicopters	2,109 (0.0021)	31,640 (0.032)
TOTAL	**14,885 (0.015)**	**223,272 (0.223)**

9.12.5.2 Prelude FLNG Processing

Crux Energy will be exported to the Prelude FLNG facility and processed using the equipment currently used to process production from the Prelude wells ('Prelude Energy').

Processing GHG emissions include emissions from power generation, flaring, fugitive emissions, and venting of reservoir carbon dioxide. Crux reservoir carbon dioxide will be vented on Prelude FLNG using the existing acid gas removal unit, and the Crux Energy will be processed using existing facilities, with associated fugitive emissions from valve or component leakage. Flaring may be required during vaporisation before backflow during Crux start-ups, and potentially for Crux shutdowns or other activities affecting export flowrates to Prelude FLNG.

Processing GHG emissions from Crux Energy are estimated to average 1.7 $MtCO_2$-e per year and 24.8 $MtCO_2$-e over the facility lifecycle (Table 9-74) based on Shell's Operating Plan which utilises emission factors to estimate GHG emissions (detailed assumptions are provided in Appendix H.5). Therefore, combined processing GHG emissions from both sources are considered for the purpose of this assessment, from the time Crux Energy is first expected to be processed at Prelude FLNG. The combined processing GHG emissions are estimated to be about 33.1 $MtCO_2$-e over a 15-year lifecycle, averaging 2.2 $MtCO_2$-e per year (Table 9-74). Crux Energy's contribution is expected to be ~54% of the total GHG emissions over the 5 years of this EP, however this increases to ~75% as the Prelude Energy production declines, with a progressive transition expected.

[65] For detailed assumptions and 5 Year Forecast, refer Appendix H.6. Excludes support and IMR vessels, and helicopters supporting Prelude FLNG operations and maintenance.

Table 9-74: Indirect GHG Emissions (Scope 3): Prelude FLNG Processing

GHG Emissions Estimate[66]	Average (~$MtCO_2$-e/year)	Total 5 Years) (~$MtCO_2$-e)	Total (Lifeycle) (~$MtCO_2$-e)
Indirect Emissions (Prelude FLNG)			
Crux Energy	1.7	7.48	24.8
Crux Energy & Prelude Energy Total (Crux %)	2.2 (75%)	13.73 (54%)	33.1 (75%)

Note 1: Refer to Appendix H.5 for detailed assumptions.

Note 2: MtCO2-e = Million tonne of carbon dioxide equivalent.

9.12.5.3 Third-Party End Use

End User GHG emissions from the transport and value-adding end-use of Crux Energy by Shell Group's customers once exported from the Prelude FLNG facility are estimated using the GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard, as described in the detailed breakdown of Shell Group's 2023 Scope 3 GHG emissions[67].

Assessing End User GHG emissions requires consideration of the likely customer markets and energy mixes. While arrangements are not yet in place for the sale of Crux Energy, based on the historical sale of Prelude Energy it is anticipated that Crux Energy will be delivered primarily to end users in Asia. End User GHG emissions will result from the conversion of Crux Energy to thermal, mechanical, and electrical energy, mainly through combustion in power stations. End User GHG emissions are primarily from customers, outside of Australia, using LNG for power and condensate for refining (also refer Appendix H.7).

End User GHG emissions from Crux Energy are estimated to be 100 $MtCO_2$-e over the lifecycle, averaging 6.7 $MtCO_2$-e/year. As processing of Crux Energy will eventually replace the processing of Prelude Energy at Prelude FLNG, combined End User GHG emissions are considered for the purpose of this assessment from the time that Crux Energy is first expected to be processed at Prelude FLNG. The combined End User GHG emissions are expected to be 150 $MtCO_2$-e over the lifecycle, averaging 10 $MtCO_2$-e/year (Table 9-75).

Table 9-75: Indirect GHG Emissions (Scope 3): Third-Party End Use

GHG Emissions Estimate[68]	Average (~$MtCO_2$-e/year)	Total (15 years) (~$MtCO_2$-e)
Third-party End Use[69]		
Crux supply chain, transport	6.7	100
Crux & Prelude supply chain, transport, and third-party end use	10	150

9.12.6 Context – Expected Third Party End Users

As Crux Energy is expected to be delivered to end users primarily in Asia, these End User GHG emissions will be accounted for in the end-use countries under their respective domestic and international GHG emissions control frameworks. It is anticipated that the primary end users are likely to include consumers in Japan, South Korea, Taiwan, China and potentially India. Each of these countries, except for Taiwan (which is not presently a member of the United Nations), has ratified the Paris Agreement and is therefore responsible for accounting, reporting and reducing GHG emissions that occur within its jurisdiction. The Paris Agreement requires

[66] Refer Appendix H.5 for detailed subdivision of Prelude FLNG emissions (Crux and Prelude Energy) and 5 Year / Lifecycle data.

[67] https://www.shell.com/sustainability/transparency-and-sustainability-reporting/performance-data/greenhouse-gas-emissions/_jcr_content/root/main/section_1654294871/text_625214062_copy.multi.stream/1724059220539/5ac74b121026aa654e5bff7a0be354d21385d5a3/scope-ghgemissions-summary-final.pdf

[68] Refer Appendix H.7 for detailed breakdown and assumptions that underpin this table, including expanded data showing the forecast subdivision of Crux and Prelude Energy, 5 Year and Lifecycle forecasts.

[69] Calculated using Shell Product Value Chain Intensity Metrics (in alignment with GHG Protocol Corporate Value Chain Scope 3 Accounting and Reporting Standard (WRI/WBCSD 2011); associated Technical Guidance for Calculating Scope 3 Emissions (WRI/WBCSD 2013) and ISO 14040:2006 Life Cycle Assessment Principles and Framework (ISO 2006).

countries to publish Nationally Determined Contributions to meet their goals. End User GHG emissions will therefore be considered under domestic and international GHG emissions control frameworks, including:

- South Korea: aims to reduce its GHG emissions by 40% from 2018 levels by 2030 and has a long-term goal of achieving carbon neutrality by 2050. South Korea published its Update of its First National Determined Contribution in December 2021. South Korea's National Climate Change Adaption Plan acknowledged the role of LNG as a transition fuel. The plan includes measures to shift from coal to LNG to reduce GHG emissions in the short to medium term. However, the long-term strategy emphasises a gradual transition towards renewable energy sources like solar and wind[70].
- Japan: aims to reduce its GHG emissions by 46% from 2013 levels by 2030 and has set an ambitious target which is aligned with the long-term goal of achieving net zero by 2050. Japan published an Outline of Strategic Energy Plan in 2021 which assumes that LNG will account for 20% of Japan's electricity generation mix in 2030[7172].
- China: China aims to peak CO_2 emissions before 2030 and achieve carbon neutrality before 2060. While China is prioritising renewable energy sources and domestic security, LNG will continue to play a role in China's energy mix. In 2024 China's National Development and Reform Commission pledged to reduce GHG emissions from its national industrial system which contributes roughly half of China's carbon GHG emissions. China is due to publish a new climate action plan by February 2025, with a focus on targets for 2035.
- India: India's Updated First Nationally Determined Contribution was public in August 2022 and aims to reduce carbon intensity below 45% by 2030 compared to 2005 levels and achieving net zero GHG emissions by 2070[73]. India has a target of increasing natural gas share in total energy mix to 15% by 2030.
- Taiwan: Taiwan aims to achieve net-zero carbon GHG emissions by 2050. This goal was officially announced by President Tsai Ing-wen on Earth Day, 22 April 2021[74]. Taiwan also aims to reduce is emissions by 20% by 2030 and 50% by 2050, compared to 2005 levels.

The use of Crux Energy by third party end users is therefore anticipated to play a role towards customer commitment and plans to decarbonise through the energy transition.

9.12.7 Context – The role of LNG in the Asian energy transition

Today, fossil fuels meet more than 80% of global energy demand, with an even greater reliance in many developing countries. As the world's population grows by an estimated two billion people by 2050, and the benefits of energy are extended to the hundreds of millions who do not have it today, demand for energy will only grow. The world needs a balanced and orderly transition away from fossil fuels to maintain secure energy supplies, while accelerating the transition to affordable low-carbon solutions. Countries, sectors and energy sources will move at different speeds to decarbonise.

Coal accounts for more than 60% of the energy used across Asia to power heavy industries such as steel. Shell believes LNG can help displace the use of coal in industry and power generation. LNG currently makes up around 13% of the global gas market, but is expected[75] to exceed 20% by 2040, mostly driven by China's industrial decarbonisation and strengthening demand in other Asian countries. Figure 9-13 shows Shell's view of China's expected gas demand by sector, supply by source and Russian, US term supply to China from 2020–2040.

[70] 211223_The Republic of Korea's Enhanced Update of its First Nationally Determined Contribution_211227_editorial change.pdf (unfccc.int)

[71] Strategic_energy_plan.pdf (meti.go.jp)

[72] STATEMENT: China Releases New Climate Commitment Ahead of COP26 | World Resources Institute (wri.org)

[73] National Development Council-Taiwan's Pathway to Net-Zero Emissions in 2050 (ndc.gov.tw)

[74] National Development Council-Taiwan's Pathway to Net-Zero Emissions in 2050 (ndc.gov.tw)

[75] Based on Shell's interpretation of Wood Mackenzie data

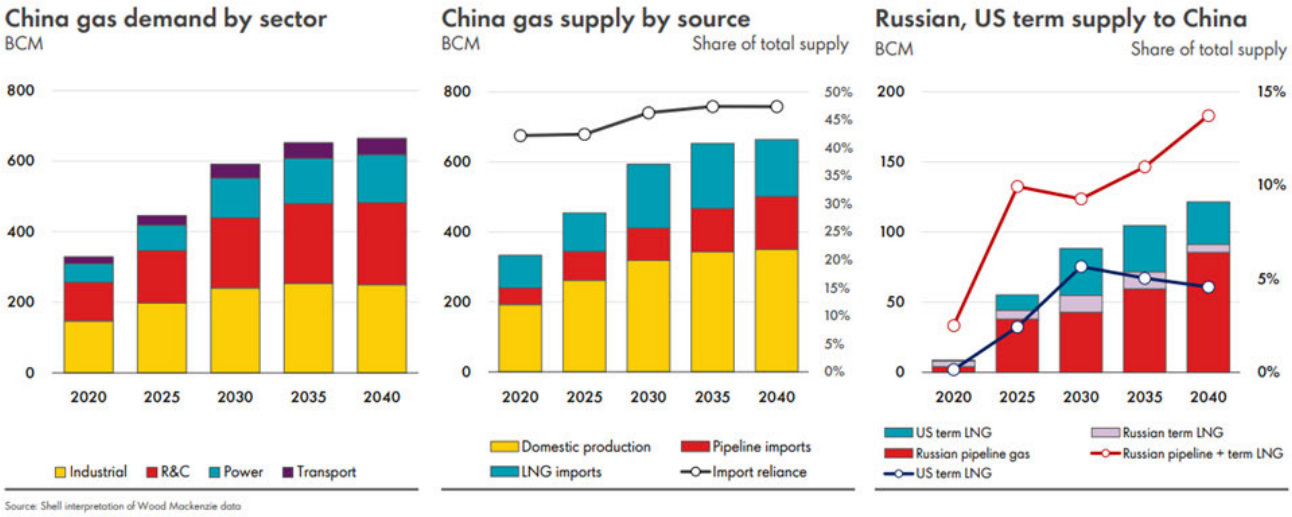


Figure 9-13: Extract from Shell's LNG Outlook

Shell believes that LNG, the lowest-carbon marine fuel available at scale, can offer significant GHG emissions reductions and a long-term decarbonisation pathway through bio-LNG. It will play a crucial role in the energy transition, as recognised by the Global Stocktake Agreement[76]. The final text adopted by delegates at COP28 reinforces the role of natural gas and LNG in the global energy transition, and in particular, the recognition that 'transitional fuels can play a role in facilitating the energy transition while ensuring energy security'.

Gas-fired power generation will play an increasingly important role while renewables scale up. Gas will provide the flexibility that the electricity grids will need, to manage the intermittency of renewable energy sources. Intermittency of renewable energy is the variation in power output, due to factors like weather conditions. Gas will help balance the grid, during times when renewable sources like wind or solar are not producing enough electricity. This is crucial to maintain a stable and reliable power supply. Figure 9-14 shows how Shell expects renewable supported by gas are expected to reduce the role of coal in South Asia.

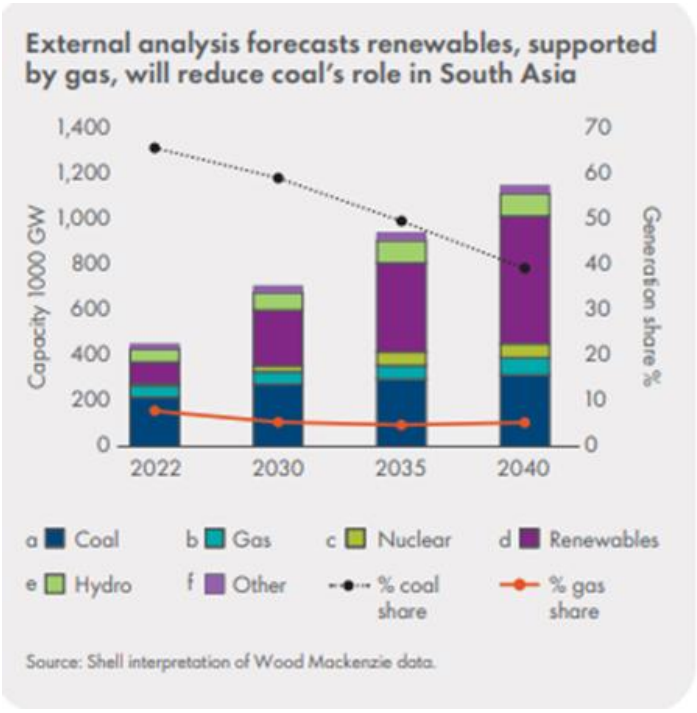


Figure 9-14: Extract from Shell's Energy Transition Strategy 24

[76] Global Stocktake | UNFCCC

Rising global demand for LNG is expected[77] to keep pace with new supply until 2035. In the medium term, latent demand for LNG, especially in Asia, is set to consume new supply that is expected to come into the market in the second half of the 2020s. Figure 9-15 shows Shell's view of expected global LNG supply verses demand.

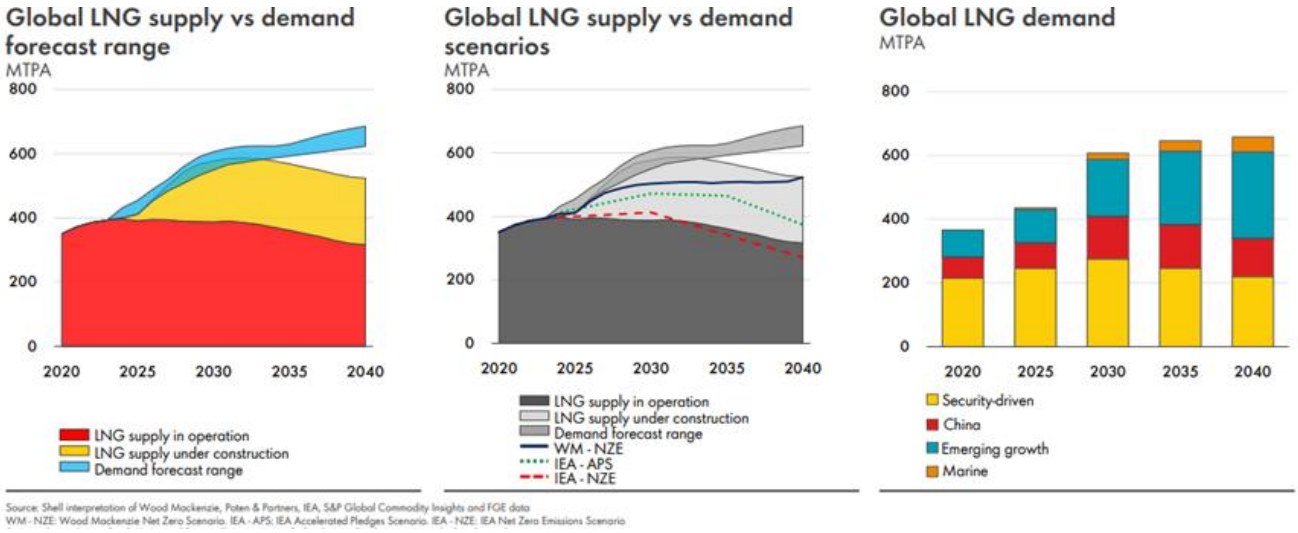


Figure 9-15: Extract from Shell's LNG Outlook

The use of Crux Energy by third party end users is therefore anticipated to play a role towards customer commitment and plans to decarbonise through the energy transition.

9.12.8 Description and Evaluation of Impacts

This impact assessment considers the potential impacts of climate change on sensitive receptors, including MNES within Australian jurisdictions.

The international scientific community views GHG emissions as contributors to climate change, primarily through global temperature increases. Shell recognises the existence of climate change and that GHG emissions, which include CO_2, are contributing to climate change. Shell also acknowledges that urgent action is required to address climate change.

Projecting GHG emission impacts is complex due to variables like surface pressure, wind, temperature, humidity, and rainfall. Isolated climate events cannot be solely attributed to specific temperature increases. It is not feasible to meaningfully link the GHG emissions associated with the activity to climate change impacts globally and its impact on potential Australian receptors. Nonetheless, this impact assessment is framed by reference to the incremental contribution that this activity will make to Australian and global GHG emissions, as well as well as their impact on the Australian and Global carbon budgets.

Scope 3 and total GHG emissions are shown as an incremental increase to global GHG inventory and carbon budgets. This is because third party end user GHG emissions will not count toward Australian inventories and carbon budgets and will instead be accounted for in the end-use countries under their respective domestic and international GHG emissions control frameworks.

Total lifecycle GHG emissions associated with Crux are estimated to be ~185.4 $MtCO_2$-e, of which ~35.4 $MtCO_2$-e originate in Australia. For the purposes of comparison, assuming scope 1 emissions were split evenly across operational years the ~0.09 Mtpa CO_2-e are equivalent to ~0.02% of national Australian emissions and 12.33 Mtpa CO_2-e total lifecycle emissions, 0.03% of global GHG emissions (see Table 9-76). The incremental increase in GHG emissions from the activity will be negligible in the context of Australian and global GHG emissions.

Table 9-76 presents the estimated CO_2-e emissions for the activity and contributions compared to CO_2-e emissions estimates for Australia and globally in 2023.

[77] Shell interpretation of Wood Mackenzie, Poten & Partners, IEA, S&P Global Commodity Insights and FGE data PowerPoint Presentation (shell.com).

Table 9-76: GHG Emissions National and Global Inventories

GHG Emissions Data Source[78]	Total (~$MtCO_2$-e)	Estimated Scope 1 Emissions Average Crux Activity (~$MtCO_2$-e)	Estimated Scope 3 Emissions Processing on Prelude FLNG[79] (~$MtCO_2$-e)	Estimated Total Scope 3 Emissions (~$MtCO_2$-e)[80]	Estimated Total Emissions for the Lifecycle (15 years) (~$MtCO_2$-e)[81]
Per Year Basis					
DCCEEW Paris Agreement GHG Inventory[82]	432.9 p.a.	0.09 p.a. (0.02% of total)	2.2 p.a. (0.51% of total)	N/A	N/A
Total UNFCCC 2035 Baseline Scenario[83]	312 p.a.	0.09 p.a. (0.03% of total)	2.2 p.a. (0.71% of total)	N/A	N/A
UNFCCC Annex 1 Parties[84]	15,400 p.a.	0.09 p.a. (0.001% of total)	2.2 p.a. (0.014% of total)	12.24 p.a. (0.08%) of total	12.33 p.a. (0.08% of total)
IEA Global GHG Estimate[85]	37,400 p.a.	0.09 p.a. (0.0002% of total)	2.2 p.a. (0.006% of total)	12.24 p.a. (0.033% of total)	12.33 p.a. (0.03% of total)
Budget over					
IEA Net Zero by 2050 Budget	22,000 p.a.	0.09 p.a. (0.0004% of total)	2.2 p.a. (0.01% of total)	12.24 p.a. (0.056% of total)	12.33 p.a. (0.056% of total)
Australian NDC GHG Budget to 2030	4,381	1.3 (0.03% of total)	33.1 (0.76%)	N/A	N/A
IPCC Global GHG budget to meeting 2 Deg C scenario (67% likelihood)	1,150,000	1.3 (0.0001% of total)	33.1 (0.003% of total)	183.5 (0.016% of total)	184.9 (0.016% of total)
IPCC Global GHG budget to meeting 1.5 Deg C scenario (50% likelihood)	500,000	1.3 (0.0003% of total)	33.1 (0.007% of total)	183.5 (0.037% of total)	184.9 (0.037% of total)

Table 9-77 indicates the environmental features and values and sensitivities potentially affected by the GHG emissions that may result from the activities covered by this EP. Features, protected areas or values and sensitivities which could not be credibly affected by GHG emissions are not discussed further.

[78] For detailed assumptions that underpin Crux and Prelude data, refer to Appendix H.1.
[79] Management of Prelude FLNG Facility GHG emissions are address separately in the Prelude FLNG Operations EP.
[80] Refer to Appendix H.1 row 'Total Crux and Prelude Energy Indirect Emissions (Scope 3)'.
[81] Refer to Appendix H.1 row 'Total Crux and Prelude Energy Direct and Indirect Emissions (Scope 1 and 3)'.
[82] Source: DCCEEW 2024
[83] Source: Total UNFCCC 2035 Baseline Scenario. Australia's National Greenhouse Accounts (DCCEEW).
[84] Source: UNFCCC Annex 1 Parties 2021. Without land use, land-use change, and forestry
[85] Source: Climate Change Authority 2024

Table 9-77: GHG Emissions: Receptor Impact Screening Summary

	Protected Areas			Features																Values and Sensitivities																															
				Physical		Natural				Socioeconomic								Heritage and Cultural			Physical				Natural							Socioeconomic							Heritage and Cultural											
Receptor	Marine Conservation Reserves	Wetlands of International and National Importance	Commonwealth and National Heritage Places	Marine Regions	Australian Environment	Northwest Shelf Province Bioregion	Northwest Shelf Transition Bioregion	Northwest Transition Bioregion	Timor Province Bioregion	People and Communities	Fishing Industry	Tourism and Recreation	Defence	Shipping	Scientific Research/Restoration	Oil and Gas Industry	Indonesian and Timor-Leste Coastlines	Underwater Cultural Heritage	Traditional Indonesian Fishing	Indigenous Cultural Connections	Air Quality	Water Quality	Sediment Quality	Underwater Noise	BIAs	Habitat Critical	Shoals and Banks	Offshore Reefs and Islands	Coastal Reefs and Islands	KEFs	Threatened, Migratory, Marine and Cetacean Species	Fishing Industry	Tourism and Recreation	Defence	Shipping	Scientific Research/Restoration	Oil and Gas Industry	Indonesian and Timor-Leste Coastlines	Underwater Cultural Heritage	Traditional Indonesian Fishing	Indigenous Cultural Heritage
Aspect																																															

Legend:		
		Potentially affected
	×	Predicted impact

9.12.8.1 Physical Features, Natural Values and Sensitivities and Protected Areas

The Intergovernmental Panel on Climate Change (IPCC) is the United Nations body for assessing the science related to climate change and finalised the Sixth Assessment Report (AR6) in 2023 (IPCC 2023)[86]. A summary of outcomes of the AR6 Working Group's contributions comprises a range of matters, which amongst others include:

- The AR6 Working Group I (AR6-WG1) report stated that it is unequivocal that there is human-induced warming. It also stated that increased atmospheric CO_2 levels, generated by human activity, are the largest driver of warming over the longer term, and that there are a range of factors, including emissions of CH4, which increase warming in the short-term.
- The AR6 Working Group II (AR6-WG2) report noted that societal choices and actions implemented in the next decade will determine the extent to which medium and long-term pathways will deliver climate resilient development.
- The AR6 Working Group III (AR6-WG3) report provided an updated global assessment of climate change mitigation progress and pledges and examined the sources of global emissions. It explained developments in emissions reduction and mitigation efforts and assessed the impact of national climate pledges in relation to long-term emissions goals. More than 2000 quantitative emissions pathways were submitted to the IPCC, of which 1202 scenarios included sufficient information for assessing the associated warming.

The IPCC (2023) predicts that using the global Nationally Determined Contributions (NDCs) committed by 2030 may result in a temperature increase of 1.5 °C in the first half of the 2030s and a 2.8 °C [2.1–3.4 °C] median temperature rise by the end of the century (medium confidence).

The IPCC AR6-WG2 report identified climate risks for natural values in the Australasian region. Similar risks have also been identified by DCCEEW (2021), including:

- loss and degradation of coral reefs and associated biodiversity and ecosystem service values in Australia due to ocean warming and marine heatwaves;
- loss of alpine biodiversity in Australia due to less snow;
- transition or collapse of alpine ash, snowgum woodland, pencil pine and northern jarrah forests in southern Australia due to hotter and drier conditions with more fires;
- loss of kelp forests in southern Australia due to ocean warming, marine heatwaves, and overgrazing by climate driven range extensions of herbivore fish and urchins;
- loss of natural and human systems in low-lying coastal areas due to sea level rise;
- disruption and decline in agricultural production and increased stress in rural communities in south-western, southern, and eastern mainland Australia due to hotter and drier conditions;
- increase in heat-related mortality and morbidity for people and wildlife in Australia due to heatwaves;
- cascading, compounding and aggregate impacts on cities, settlements, infrastructure, supply-chains, and services due to wildfires, floods, droughts, heatwaves, storms, and sea level rise; and
- inability of institutions and governance systems to manage climate risks (Lawrence et al. 2022).

The IPCC reports that the global mean sea level has increased by 0.20 m between 1901 and 2018 (IPCC 2023). The IPCC (2023) predicts that it could rise between 0.15 m and 0.29 m further by 2050[87] (medium confidence), leading to coastal inundation and habitat loss. This may affect mangroves, offshore islands, salt marshes, and coastlines (Ward et al. 2016). Increased CO_2 absorption by oceans and freshwater bodies, raises water acidity impacting aquatic organisms (Steffen et al. 2009).

Australia's average sea surface temperature has warmed by more than 1 °C since 1900 (IPCC 2023). Marine heatwaves are more frequent and intense (Ruthrof et al. 2021) threatening marine community structure and

[86] This consists of three Working Group contributions and a Synthesis Report.

[87] relative to 1995–2014

coral bleaching events (BOM and CSIRO 2024). Coral reefs could decline by a further 70–90% at 1.5 °C of global warming (high confidence) (IPCC 2023).

The IPCC (2023) predicts that near-term risks for biodiversity loss as a result of global climate change are moderate to high, especially in kelp, seagrass, and warm-water coral reefs (high to very high confidence). These changes undermine the coral reef's ability to support marine life. (Hoegh-Guldberg et al. 2018).

Table 9-78 lists species and associated EPBC publications that recognise climate change as a potential risk to the receptor and describes the potential impacts to key animal groups.

Table 9-78: Overview of Potential Climate Change to Taxa

Taxa	Potential Impacts
Marine Mammals	Marine mammals most sensitive to climate change generally show marked feeding and habitat specialisation (Albouy et al. 2020). The EPBC publications that recognise climate change as a potential threat relevant to marine mammals are associated with whales (blue, fin and sei). Whales may also be affected by climate change through changes in distribution and abundance of their prey (CoA 2015a; WWF n.d.a). Changes in ocean temperatures, upwellings, acidification, and melting Antarctic Sea ice may impact krill availability, the major food source for these whales (CoA 2015a; DoE 2015c; TSSC 2015b). Climate change may also affect their migratory timing, habitat occupancy, breeding schedules, reproductive success, and survival (van Weelden et al. 2021).
Marine Reptiles	The EPBC publications that recognise climate change as a potential threat to marine reptiles are associated with marine turtles and the dusky sea snake. Climate change may alter turtle dispersal patterns, food webs, species range, primary sex ratios, habitat availability, reproductive success, and survivorship (CoA 2017b). Possible impacts to marine turtles include increased air temperatures (altered embryo development) and increased sea levels rise (nesting beach stability and foraging ground distributions) (TSSC 2008a; Lockley and Eizaguirre 2021). Climate change and severe weather, including frequent and severe heatwaves; high average water temperatures; and severe cyclones and storms are identified as threats to the dusky sea snake. These threats can result in the reduction of dusky sea snake habitat, caused by marine heatwaves, ocean acidification, coral bleaching and increased wave action. Higher water temperatures can also periodically create lethal thermal conditions for the dusky sea snake (DCCEEW 2024h).
Sharks, rays, and other fish	The EPBC publications that recognise climate change as a potential threat to sharks, rays and other fish are those associated with sharks (namely whale sharks and white sharks). Most sharks and rays are ectothermic, with their biology and metabolism influenced by the ambient water temperature. Ocean temperature directly affects physiological and metabolic functions in sharks, including digestion, growth, and reproduction. Warmer water decreases oxygen solubility, increasing metabolic rates and thereby limiting oxygen availability (Pearce 2022). Climate change may also affect whale sharks through changes in prey distribution and abundance. As ocean water warms, juvenile whale sharks may shift their range and feeding aggregation locations to follow prey (WWF 2024; Grose et al. 2020).
Birds	Numerous EPBC publications recognise climate change as a potential threat to shorebirds and seabirds. Climate change may cause advanced spring migration, changes in habitat, higher disease transmission, earlier egg-laying time, reduced food availability, and population decline (Xiaohan et al. 2022).

The State of the Climate Report 2024 (BOM and CSIRO 2024) observed the following impacts of global climate change on the Australian physical environment, such as (but not limited to):

- Australia's climate has warmed by an average of 1.51 ± 0.23 °C since national records began in 1910.
- Sea surface temperatures have increased by an average of 1.08 °C since 1900.
- The warming has led to an increase in the frequency of extreme heat events over land and in the oceans.
- Heavy short-term rainfall events are becoming more intense.

- There has been an increase in extreme fire weather, and a longer fire season, across large parts of the country since the 1950s.
- Oceans around Australia are becoming more acidic, with changes happening faster in recent decades.
- Sea levels are rising around Australia, including more frequent extreme high levels that increase the risk of inundation and damage to coastal infrastructure and communities.

The State of the Climate Report 2024 (BOM and CSIRO 2024) forecasts that Australia may experience ongoing changes to its weather and climate, such as (but not limited to):

- Continued increase in air temperatures, with more heat extremes and fewer cold extremes.
- More intense short-duration heavy rainfall events even in regions where the average rainfall decreases or stays the same.
- Continued increase in the number of dangerous fire weather days and a longer fire season for much of southern and eastern Australia.
- Further sea level rise and continued warming and acidification of the oceans around Australia.
- Fewer tropical cyclones, but with higher intensity on average, and greater impacts when they occur through higher rain rates and higher sea level.

The North-West Marine Parks Network Management Plan 2018 (DNP 2018) identifies climate change as a pressure that may impact marine park values. The management plan states that impacts of climate change on the marine environment are complex and may include changes in sea temperature, sea level, ocean acidification, sea currents, increased storm frequency and intensity, species range extensions or local extinctions, all of which have the potential to impact on marine park values (DNP 2018). Within the Marine Bioregional Plan for the NWMR (DSEWPaC 2012), pressures related to climate change are assessed as 'of potential concern' for species of marine turtle, inshore dolphins, sawfish, sea snakes, whale shark, dugong, and seabird and shorebird, as well as the KEFs and shipwrecks known to occur in the NWMR.

Climate variability and change has been identified as a risk to some EPBC Act protected species, including marine turtles, whales, seabirds, and migratory shorebirds (CoA 2017, CoA 2015a, CoA 2022 and CoA 2015). The Australian Marine Parks – North-west Marine Parks Network Management Plan 2018 (DNP 2018b) considers the effects of climate change and the potential impact on marine park values such as habitats, KEFs and marine fauna species. The management plan acknowledges that the potential impacts of climate change on the marine environment are complex and may include changes in sea temperature, sea level, ocean acidification, sea currents, increased storm frequency and intensity, species range extensions, or local extinctions. These changes have the potential to impact marine park values (DNP 2018b).

In the Marine Bioregional Plan for the NWMR (DSEWPaC 2012), climate change-related pressures are assessed as 'of potential concern' for various species and features, including marine turtles, inshore dolphins, sawfish, sea snakes, whale sharks, dugongs, seabirds, and shorebirds, KEFs and shipwrecks that may occur in the NWMR.

9.12.9 Impact Assessment Summary

While there are observed and predicted impacts of global climate change (and associated global GHG emissions) to physical and biological receptors, it is not feasible to meaningfully link GHG emissions from an individual project or activities to specific impacts of climate change to these receptors. The incremental increase in GHG emissions from the activity is considered to be negligible in the context of Australian and global GHG emissions and therefore Shell has assessed no impact to the overall consequence level reasonably expected. While this is considered to be an acceptable level, it will nevertheless manage its GHG emissions and any potential impacts to ALARP.

Table 9-79 lists the highest residual impact consequence ranking of the relevant environmental receptor groups.

Table 9-79: GHG Emissions Evaluation of Residual Impacts

Environmental Receptor	Magnitude	Sensitivity	Residual Impact Consequence
Evaluation – Planned Impacts			
Protected Areas	0	L	No impact to the overall consequence level reasonably expected.
Physical Features	0	L	No impact to the overall consequence level reasonably expected.
Physical Values and Sensitivities	N/A	N/A	N/A
Natural Features	N/A	N/A	N/A
Natural Values and Sensitivities	0	L	No impact to the overall consequence level reasonably expected.
Socioeconomic Features	N/A	N/A	N/A
Socioeconomic Values and Sensitivities	N/A	N/A	N/A
Heritage and Cultural Features	N/A	N/A	N/A
Heritage and Cultural Values and Sensitivities	N/A	N/A	N/A

9.12.10 ALARP Assessment and Environmental Performance Standards

Table 9-80: ALARP Assessment and Environmental Performance Standards – Second Stage Well Clean-up, Start-up and Operations

Hierarchy of Controls	Control Measure	Adopted ?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
ALARP Assessment						
Elimination	Use of renewable energy (e.g. solar, wind and wave) in lieu of fossil fuels for power generation and marine vessel propulsion.	No	Renewable energy sources like solar, wind, and wave lack the reliability needed for continuous operations and require extra space and capital. Additionally, renewable technology for a full offshore processing facility is neither available nor proven.	N/A	N/A	N/A
Elimination	Use of fired heaters to increase the efficiency of generating heat duty for TEG reboilers.	No	Standalone gas-fired boilers, assessed for heating TEG reboilers (about 50% of the electrical load), were found more efficient than electric heaters. However, their higher maintenance demands would increase complexity and safety exposure offshore, threaten delivery of NNM operations and facility availability. Thus, electric heaters were chosen for their lower complexity, reduced safety exposure and higher reliability.	N/A	N/A	N/A
Elimination	Waste heat recovery units on turbine exhausts to increase the efficiency of generating heat duty for TEG reboilers.	No	Waste heat recovery units (WHRU) from the GTG exhaust were the most efficient for heating TEG reboilers (about 50% of the electrical load). However, their space, weight, complexity, and maintenance demands negatively impacted safety offshore, availability and threaten delivery of NNM operations. Thus, electric heaters were chosen for their better safety profile and lower maintenance.	N/A	N/A	N/A
Elimination	Selection of off gas recovery system to eliminate flaring of low-pressure waste gas stream.	No	Crux requires off gas streams to be safely routed to flare from systems like TEG regeneration and produced water. Recovering, compressing, and reinjecting these gases was assessed but deemed too complex, unsuitable for remote operation, and detrimental to safety, platform reliability and manning. This process would also increase safety risks, energy demand, fuel gas consumption, and GHG emissions, while only partially reducing GHG emissions. Additionally, the flare stream contains water vapor, which does not contribute to GHG emissions. Therefore, Crux opted to minimise gas through these systems to manage safety without affecting the performance or integrity of the export pipeline, TEG regeneration, and produced water systems.	N/A	N/A	N/A
Substitute	Report GHG emissions to the Clean Energy Regulator where required by the NGER Act including; • Vented Crux reservoir carbon dioxide at Prelude FLNG to be subject to ‘zero’ emissions intensity baseline in accordance with Safeguard Mechanism.	Yes	The NGER Act stipulates criteria which trigger NGER reporting. Crux will meet NGER reporting requirements required by the Clean Energy Regulator. GHG emissions will be reported annually to the CER, where required under the NGER Act and, where required, will manage GHG emissions to within the relevant baseline under the National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015. The Safeguard Mechanism requires Responsible Emitters of Designated Large Facilities to ensure their direct GHG emissions are below the relevant baseline or surrender prescribed carbon units equal to the excess. Currently prescribed carbon units comprise Australian Carbon Credit Units (ACCUs) and Safeguard Mechanism Credits (SMCs). The reservoir carbon dioxide from the Crux reservoir that is vented at Prelude FLNG will be subject to the current Safeguard Mechanism requirements, under the NGER Act. The production variable for reservoir carbon dioxide from the Crux reservoir will need to comply with a 'zero' emissions intensity and therefore, these emissions will need to be managed to zero via ACCUs.	10.1	Net GHG emissions on the Crux and Prelude facilities managed to comply with the safeguard mechanism and reported annually to the Clean Energy Regulator, as required by the NGER Act.	Public NGER reporting records.
Substitute	Battery energy storage system (BESS) to store energy and partially substitute fuel combustion.	No	A BESS was considered to stabilise power loads and increase efficiency. However, due to Crux’s lower power demand and simplified layout, the benefits were limited. The increased complexity, space requirements, and remote operation challenges outweighed the potential gains. Shell is developing BESS at the infrastructure level in Australia and globally.	N/A	N/A	N/A
Engineering		Yes		9.1	Refer to EPS 9.1.	Refer to EPS 9.1.

Hierarchy of Controls	Control Measure	Adopted ?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
	Power generation and management systems; • Gas turbine generator configuration optimised and monitored for emissions and performance. • High-Efficiency Particulate Air (HEPA) inlet air filtration system. • Solar Insight Platform equipment health monitoring. • Facility Operating Procedures require GTG's to be started using backflow pipeline gas rather than well gas, to minimise flaring and emissions.		The power system, an equipment control measure, was optimised by selecting three Solar gas turbine generators (GTGs) to be run on fuel gas only (not dual fuelled with diesel), with one in cold standby. This setup is energy-efficient and reduces GHG emissions compared to having three GTGs in operation or hot standby. The Solar Turbines GTGs are efficient, quick to react to load changes, and reliable, minimising shutdowns and associated GHG emissions. They can be remotely monitored and controlled by a Power Management System (PMS) for efficient load shedding and energy management. Normally, two GTGs operate with a spinning reserve, while the third is on cold standby, running in a 2 x 50% configuration. The GTG packages have been fitted with a High-Efficiency Particulate Air (HEPA) inlet air filtration system to minimise any performance/ efficiency degradation due to turbine compressor fouling. The system includes a differential pressure alarm that alerts operators to conditions that may impact efficiency and performance of the system, enabling the investigation and planning of filter maintenance activities (e.g., higher differential pressure alarm may indicate blockages and an indicator of performance and efficiency decline requiring action). This helps ensure that the turbine continues to run at best possible performance between maintenance interventions (compressor washes) managed by CMMS. The Solar InSight System is a proprietary system for equipment health monitoring and management. It combines data acquisition, machine learning and remote diagnostics to monitor the efficiency and condition of gas turbines and related equipment to continuously assess turbine performance, in conjunction with PTM monitoring for trend analysis and proactive management. Factory testing indicates that the thermal efficiency of the GTGs at full load is about 26.7% to 28.3% (depending on ambient conditions). The thermal efficiency changes at different loads and is lower when operating at reduced loads. The GTGs do not have operational controls to optimise GHG performance beyond load management (EPS 9.1) and systems maintenance. Turbine efficiency will naturally decline over time. Key factors influencing degradation include environmental exposure (e.g., salt air), fuel type and quality, maintenance intervals and practices, load cycling and thermal stresses. Initial degradation of GTGs tends to be more rapid in the first few thousand operating hours, often due to compressor fouling, tip clearance increases, and airfoil surface deterioration. Recoverable degradation (e.g., from fouling) can be mitigated through water washing and maintenance. Non-recoverable degradation (e.g., erosion, corrosion, and material fatigue) typically results in a ~2–5% drop in thermal efficiency over several years of operation. Solar InSight Platform monitoring of efficiency trends over the longer term will inform maintenance actions, such as de-fouling, to restore its recoverable degradation/performance.	9.2	Refer to EPS 9.2.	Refer to EPS 9.2.
				9.3	Refer to EPS 9.3.	Refer to EPS 9.3.
				9.4	Refer to EPS 9.4.	Refer to EPS 9.4.
Engineering	Flare tip and ignition system managed in accordance with Operation Environmental Critical Elements and Performance Standards Manual and CMMS detailed in sections 10.4.1.1, 10.4.7 and 10.4.8.	Yes	Flare tip integrity and ignition system functionality minimises potential for venting, incomplete combustion waste products and smoke emissions. This includes the following elements: • To maintain, monitor and record the flare flame to avoid venting scenarios a High Energy Ignition (HEI) system has been designed as the flare ignition system with automatic restart on flame-out. Ignition system control measure shall attempt to relight pilots after flame-out; if this fails the package shall initiate an alarm signal. • A Flame Front Generator (FFG) flare ignition system has been designed and shall act as remotely operated manual system. • A Flare Pilot Monitoring System has been designed and shall include thermocouple flame detection which will indicate pilot status (on/off for each pilot); and transmit signal to the DCS. The	9.5	Refer to EPS 9.5.	Refer to EPS 9.5.
				9.6	Refer to EPS 9.6.	Refer to EPS 9.6.

Hierarchy of Controls	Control Measure	Adopted ?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
			Flare Monitoring System has been designed to include CCTV dedicated to the flare flame (to the maximum practical extent) with a software analytics package to help operators detect simultaneous flame-out. The goal of the flare tip ignition system ECE is 'to prevent and mitigate flame-out occurrences to avoid venting scenarios'. Maintaining the system in accordance with CMMS will help ensure the goal of the ECE is met. Environmental critical equipment is maintained accordance with CMMS, as outlined in section 10.4.1.1, 10.4.7 and 10.4.8 to ensure they are within reliability, availability, and accuracy requirements for the equipment. Section 9.12.4 details the estimated GHG emissions from unplanned flame-out events. Three scenarios were identified: (1) one hour release during a cyclone emitting ~38 tCO_2-e before remote operator intervention (such an event would represent ~0.04% of annual average GHG emissions) and unlikely to exceed ~3 triggering events per year (~114 tCO_2-e); (2) fifteen minute release during an emergency peak blowdown that coincides with unignited flare (e.g., due to cyclone) emitting ~2,372 tCO_2-e before remote operator intervention (such an event would represent ~3% of annual average GHG emissions); and (3) one hour release during a startup emitting ~2.65 tCO_2-e before remote operator intervention (such an event would represent ~0.003% of annual average GHG emissions). Given Scenario (2) replies on coincidental occurrence of both emergency event and flame-out, Scenario (1) is considered a justifiable case given the frequency of squalls and seasonal cyclones at the location. ~38 tCO_2-e emissions is less than those that have been typically reported for Prelude FLNG from 2021-2024 (~35 reports events with emissions of ~1,400 tCO_2-e (Section 6.7.10.1). The design therefore ensures safe disposal of hydrocarbons by combustion instead of cold venting, minimising intentional CH_4 emissions. Flaring hydrocarbons reduces GHG emissions compared to venting. Performance of the flare system will be tracked through the GHGEMP, annual abatement workshop report, and goal setting process described in Section 10.6.8. Any flame-out events will be recorded in the DCS and reported in Sphera.			
			The Crux platform has been designed in such a way, as to minimise the risk of flare flame-out occurring for an extended period, resulting in significant venting of un-combusted gas. Unplanned flare flame outs are expected to be an uncommon event. If a flare flame-out occur, the expected worst case to response to an alarm initiated by a flare flameout event is up to 30 minutes and 40 seconds (rounded down to 30 minutes). This timeframe is based on the scenario where the panel operator commences response to the alarm within 15 minutes from initiation (maximum, standard industry practice for panel operator response time), and then verifying whether the alarm is real, attempting reignition via high energy reignition sequence, and then if this proves unsuccessful, subsequent attempt of reignition via Flame Front Generator (FFG): • 15-minutes (maximum) to recognise/respond and commence action. • 1-minute expected operator response time to alarm. • 3-minutes expected HEI Reignition attempt - this is denoted by a maximum sequence attempt timer (tunable parameter) within the flare ignition control narrative (2200-SMOPME11-C15-00002).	10.2	The flare ignition system will reignite the flare in no longer than 30 minutes from the initiation of the alarm, in the event of flare flame out, except following ESDs where the flare will not operate, by design, until the restart occurs.	DCS/PI records demonstrate the duration of flameout events. Flameout events recorded in Sphera.

Hierarchy of Controls	Control Measure	Adopted ?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
			• 700 seconds (11 minutes, 40 seconds) expected FFG reignition attempt - maximum sequence attempt timer (tunable parameter) within the flare ignition control narrative (2200-SMOPME11-C15-00002). Following an emergency shutdown and associated blowdown flaring event, the Crux flare, by design will not be ignited until a well restart occurs.			
Engineering	Flare flow meters and CMMS as detailed in section 10.4.7 and 10.4.8.	Yes	Flare flow meters are maintained according to the maintenance schedule and maintenance system to ensure they are within reliability, availability, and accuracy requirements for this equipment.	9.7	Refer to EPS 9.7.	Refer to EPS 9.7.
Engineering, Administrative and Procedural	Greenhouse Gas and Energy Management Plan (GHGEMP) for the Crux Project execute phase includes; • Goals and limits for key emissions generating activities and/or risks. • Key measures to minimse GHG emissions. • Process for regularly reviewing performance and feedback to improve performance during key emissions generating activities.	Yes	Shell uses GHGEMPs to manage significant sources of GHG emissions to ALARP throughout project lifecycles. These plans are mandatory during the early project periods to define phase, and a different version is used during operations to manage emissions. The GHGEMP for execute phase includes; • Forecast emissions for key emission generating activities. This is a once off activity for the activities in this EP, carried out prior to commencement. This will include expected worst case, informing EPS limits, and also internal goals, which will be based more on expected performance. • Goals and limits (EPSs) for key emissions generating activities and/or risks. Goals for key activities will be set for 1st stage well clean-up, hot commissioning, and SURU (including 2nd stage well clean-up). Limits (set in EPSs) will be higher values than goals, which will remain internal to Shell, in order to drive the right behaviours in terms of aiming to reduce GHG emissions to ALARP through the phase. • Key measures to minimse GHG emissions. • Process for regularly reviewing performance and feedback to work towards achieving goals and whilst also remaining within the limits during key emissions generating activities. Flaring emissions are where most of the predicted GHG emissions, and risk of increased emissions, is expected to be sourced from throughout 1st stage well clean-up through to SURU (post 6 months). Therefore, flaring is a significant focus of the GHGEMP execute phase. Key measures to assist in minimising emissions throughout the key emissions generating activities include; • A monthly GHG performance review and lookahead (minimum), attended by relevant leadership with authority to authorise corrective actions, will review past performance and tracking against goals and limits (EPS). The review will take actions to further minimise GHG emissions or reduce risk of GHG emissions during future key emission generating activities. The focus is intended to mostly be on flaring reduction opportunities and risks during 1st stage well clean-up, 2nd stage well clean-up and the first 6 months of SURU. GHG emission data is collected on a quarterly basis for business reporting, however, for the execute phase of the project, a more frequent monthly review period is considered a robust solution to ensure actions can be aligned with activity schedules. • Perforation and 1st stage well clean-up well unloading acceptance criteria that define the well objectives will be established. Well objectives are subject to detailed engineering and plans and procedures that will be finalised prior to work commencing activities. This will inform both the establishment of GHG emission goals (Section 10.6.8) and limits (Section 10.6.9) for these activities.	10.3	Flaring emissions for hot commissioning, 2nd stage well clean-up and SURU activities will not exceed the limit of 0.224 $MtCO_2$-e (Appendix H.3).	Records demonstrate flaring was restricted to a duration necessary to achieve the hot commissioning and start-up objectives.
				10.4	Refer EPS 10.4 (limit for first stage well clean-up phase).	Refer EPS 10.4 (limit for first stage well clean-up phase).
				10.5	Establish and track goals for GHG emissions during 1st stage well clean-up, hot commissioning, 2nd stage well clean-up and SURU. Manage performance against these through monthly GHG performance review and associated adaptive management measures to further minimise GHG emissions and/or reduce risk of potential future goal or limit (EPS) exceedance.	GHGEMP execute phase contains GHG emissions goals for 1st stage well clean-up, hot commissioning, 2nd stage well clean-up and SURU. Monthly meeting minutes demonstrating tracking of actual performance against goals and limits. Records demonstrating implementation of recommended of actions to reduce GHG emissions or reduce risk of increased GHG emissions, where applicable. PMR quarterly reporting records of GHG emissions.
				10.6	Produce second stage well clean-up to Crux platform permanent systems.	Well clean-up records demonstrate the avoided GHG emissions which would have otherwise gone to flare had they not been produced to the permanent systems.
				10.7	Start-up Integrated Work Execution Flow Scheme (WEFS) will be implemented during start-up and ramp-up (SURU) activities.	Records demonstrate WEFS developed and implemented, including flaring minimisation and risk management measures. Flaring minimisation measures will be documented in the Start-up Integrated Work Execution Flow Scheme (WEFS), and will include: • Optimisation of the schedule and activities to expedite the redirection of gas from the flare to the export pipeline. • Reduction in the number of ESD tests required. • Alignment of topsides facility start-up activities with Prelude FLNG readiness to receive Crux production.

Hierarchy of Controls	Control Measure	Adopted ?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
			• Produce second stage well clean-up to permanent systems on the Crux facility to maximise the production of hydrocarbons for export to Prelude FLNG rather than disposal by flare. Crux has designed a second stage well clean-up post–ready for start-up (RFSU) to minimise flaring, allowing the gas to be exported rather than flared. This significantly reduces the operation's GHG footprint. • Work Execution Flow Scheme (WEFS) will be used during start-up and ramp-up activities to assist in optimising activities through things like sequencing and process optimisation in order to reduce emissions associated with the start-up and ramp-up activities. Flaring minimisation measures will be documented in the Start-up Integrated Work Execution Flow Scheme (WEFS), and will include: – Optimisation of the schedule and activities to expedite the redirection of gas from the flare to the export pipeline. – Reduction in the number of ESD tests required. – Alignment of topsides facility start-up activities with Prelude FLNG readiness to receive Crux production.			
Administrative and Procedural	Greenhouse Gas and Energy Management System (GHGEMS) as detailed in Section 10.6 includes; • Greenhouse Gas and Energy Management Plan (GHGEMP). • Abatement Workshop and Assessment Process. • OP Process. • Operating Procedures provides guidance to minimise GHG emissions during planned plant shutdowns and start-ups. • Methane Emissions Management process and fugitive emissions management procedure.	Yes	Shell has a GHGEMS which includes a GHGEMP, which receives and incorporates key inputs from the abatement assessment and Operating Plan processes (refer Implementation Strategy, Section 10.6). The annual abatement workshop and assessment process will ensure that further detailed assessment of additional emission reduction opportunities is undertaken and will ensure impacts from GHG emissions are reduced to ALARP on an ongoing basis. The GHGEMP is reviewed annually to incorporate the regular review and optimisation processes that occur, namely the abatement workshop and assessment process and subsequent Operating Plan process, which sets out integrated GHG goals for Crux. The GHGEMS is further described in the Implementation Strategy (Section 10.6).	10.8	Crux facility annual GHG goals will be set and performance against it tracked and managed.	GHG annual abatement workshop report. Reporting records of tracking abatement projects against set goals. GHGEMP records. Greenhouse Gas and Energy Management Plan. GHGEMP records demonstrate it is revised annually. Operational plan GHG and abatement forecasts, verification and goals. Fuel and flare forum meeting records.
				10.9	Crux facility annual abatement goals will be set and performance against it tracked and managed.	GHG annual abatement workshop report. Reporting records of tracking abatement projects against set goals. GHGEMP. GHGEMP records demonstrate it is revised annually. Fuel and flare forum meeting records. Manage threats and opportunities (MTO) records.
				10.2	Refer to EPS 10.2.	Refer to EPS 10.2.
			Crux Operating Procedures will provide a guide and aims to achieve an optimised process shutdown and start-up sequence to minimise process upsets and reduce loss of hydrocarbon inventory to flare. These procedures will be updated periodically to optimise the start-up process and address issues which have resulted in increased flaring.	10.11	The Crux Operating Procedures are available and provides panel operators the steps to be implemented during planned plant shutdowns and start-ups to minimise GHG emissions to ALARP.	Crux Operating Procedures are available to panel operators and provide steps to be implemented during planned plant shutdowns and start-ups to minimise GHG emissions.
			Fugitive emissions, from leaks in valves, flanges, or hydrocarbon processing areas, account for less than 1% of the facility's GHG emissions. Shell Group aims to keep CH_4 emissions intensity below 0.2% and achieve near-zero CH_4 emissions by 2030. Shell will produce a Fugitive Emissions Management Procedure for Crux within 6 months of start-up that outlines the management process for fugitive emissions (including methane) via a Leak Detection and Repair (LDAR) program in accordance with Shell Recommended LDAR Practice, as described in Section 10.6.7.	10.12	Shell will annually conduct a LDAR survey and a source-level methane quantification survey for the Crux Platform, in alignment with OGMP 2.0 Level 4 requirements. An annual reconciliation of OGMP Level 4 and Level 5 data will be completed. Equipment identified as leaking shall be recorded in a leaks inventory (or equivalent), and repair carried out in accordance with the CMMS.	Records of methane emissions including: • Copy of the Crux topsides component count. • Records of OGMP Level 4 and Level 5 completed annually and inclusive of reconciliation efforts. • Records of leak sources identified via OGMP Level 4 (LDAR with leaks quantified) added to a suitable asset leak register or equivalent. • CMMS records
Administrative and Procedural	Prelude FLNG Environment Plan.	Yes	The Prelude FLNG Environment Plan, which is being prepared at time of writing, will be used as the primary management plan for overseeing management of GHGEM on the Prelude FLNG facility following	7.19	Refer to EPS 7.19.	Refer to EPS 7.19.

Hierarchy of Controls	Control Measure	Adopted ?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
			introduction of Crux production fluids to the facility. This will be supported by the Prelude GHGEMS, which will be described in the Prelude FLNG Environment Plan. This EP is required to be accepted by NOPSEMA prior to the Prelude facility receiving Crux products during the Crux second stage well clean-up which occurs during the course of this EP. Therefore, through the NOPSEMA assessment process, we can be assured that the controls which will be implemented to continue to manage GHGEM on the Prelude facility post Crux hydrocarbons coming onto the facility will be managed to ALARP and acceptable levels on an ongoing basis through the implementation of the Prelude FLNG Environment Plan, and its associated control measures, processes and systems.			
Administrative and Procedural	Vessels (as appropriate to vessel class) will comply with MARPOL Annex VI (Prevention of Air Pollution from Ships), the *Navigation Act 2012* (Cth), the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) and subsequent Marine Orders.	Yes	Reduces GHG emissions through operating and maintaining vessels in accordance with industry standards and regulatory requirements.	9.11	Refer to EPS 9.11.	Refer to EPS 9.11.
				9.12	Refer to EPS 9.12.	Refer to EPS 9.12.
				9.13	Refer to EPS 9.13.	Refer to EPS 9.13.
Administrative and Procedural	Shell Group supports customers to help reduce their emissions through a system which includes: • a target to reduce the net carbon intensity (NCI[88]) of the energy products we sell by 9-12% by 2024, 9-13% by 2025, 15-20% by 2030, and 100% by 2050, compared to a base year of 2016 (Scope 3 emissions target); • investing in lower carbon platforms. Shell Group currently has $20 billion of capital employed across its lower carbon platforms (low carbon fuels, hydrogen, CCS and gas fired and renewable power) and expects to have up to 10% of capital employed in lower carbon platforms by 2030[89]. Further, between 2025 - 2028 Shell expects to invest $2-3 billion per year in its Renewables & Energy Solutions business.	Yes	Shell Group supports customers to help reduce their emissions.	10.13	Shell Group to progress its scope 3 emissions target and investment, aligned with stated timeframes[90].	Shell Group, disclosures and publications (e.g. Energy Transition Strategy) to review, update and report on these targets and investments, at least triennially, to demonstrate the EPS has been met.
Administrative and Procedural	Shell Group to: • continue to assess the role of gas in the energy transition, including in	Yes	Shell Group will continue to assess the role of gas in the energy transition, including in providing energy security (e.g. through review of relevant literature and studies from credible sources, participating in or commissioning studies, assessing relative carbon intensity of energy	10.14	Shell Group to: • continue to assess the role of gas in the energy transition, at least triennially, through Shell Group	Records demonstrate listed actions have been undertaken.

[88] Reference to Shell's "net carbon intensity" includes Shell's carbon emissions from the production of energy products, our suppliers' carbon emissions in supply energy for that production and our customers' carbon emissions associated with their use of energy products we sell. Shell only controls its own emissions. The use of the term Shell's "net carbon intensity" is for convenience only and not intended to suggest these emissions are those of Shell plc or its subsidiaries.

[89] Investment in the Crux Project is not part of the Shell Group's investment in low-carbon energy. However, the Shell Group's investment in low-carbon energy solutions will contribute to reducing the net carbon intensity of the products the Shell Group sells, including from the Crux Project, on a net portfolio basis.

[90] Investment in the Crux Project is not part of the Shell Group's investment in low-carbon energy. However, the Shell Group's investment in low-carbon energy solutions will contribute to reducing the net carbon intensity of the products the Shell Group sells, including from the Crux Project, on a net portfolio basis.

Hierarchy of Controls	Control Measure	Adopted ?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
	providing energy security (e.g. through review of relevant literature and studies from credible sources, participating in or commissioning studies, assessing relative carbon intensity of energy generation in customer nations, compared to LNG, using data published or available from business partners in the value chain); and • apply additional measures if the assessment concludes that gas is not contributing to the global energy transition (directly or indirectly).		generation in customer nations, compared to LNG, using data published or available from business partners in the value chain). The energy transition is a long-term, complex process involving infrastructure, technology, regulation, and market shifts. Shell believes that a triennial (3-yearly) review better captures meaningful trends and avoids short-term shifts. Shell Group publishes its Energy Transition Strategy (ETS) every three years—most recently ETS24, with updates currently expected in 2027 and 2030. Shell reports on its business activities (including updates concerning gas-related projects) and progress against its business targets, including climate-related targets, on an annual basis in its Annual Report. It also publishes an annual LNG Outlook. Given the rigor and expertise behind these various reports, it is appropriate for Shell Australia to align with this cadence. If required, Shell Group will apply additional measures if the assessment concludes that gas is not contributing to the global energy transition (directly or indirectly).		disclosures and publications (e.g. Energy Transition Strategy and/or Shell LNG Outlook); and • implement adaptive management measures if the assessment concludes that gas is not contributing to the global energy transition.	
Administrative and Procedural	Shell Group will continue to implement systems to work with industry, governments and others to help inform policy and share best practices with the aim to reduce methane emissions across the full natural gas value chain.	Yes	Shell Group supports the reduction of methane emissions across the full natural gas value chain.	10.15	Shell Group to continue to: • support voluntary initiatives such as the UN-led Oil and Gas Methane Partnership (OGMP) 2.0 reporting framework, World Bank's Global Flaring and Methane Reduction (GFMR) fund and Oil and Gas Decarbonization Charter; and • advocate with governments and policymakers offering relevant information views and policy recommendations on new proposals.	Shell Group disclosures and publications (e.g., Methane Guiding Principles Signatory Reporting, Methane emissions | Shell Global, Climate and energy transition advocacy updates | Shell Global) review, update and report on the implementation and outcomes of these measures to demonstrate the EPS has been met.
Administrative and Procedural	Verify Prelude FLNG facility emissions once NNM Phase 1 operations commence, or no later than 24 months after start-up, whichever comes first.	Yes	Ensures Prelude FLNG facility emissions are within the bounds as outlined within this EP. Commencement of this verification at NNM Phase 1 is deemed an appropriate timeframe as this signals the transition to Operations (NNM Phase 1) after satisfactory completion of the inspections, checks and tests during start-up phase demonstrating safe and reliable production and Prelude FLNG emissions will therefore align with the Operating Plan emissions forecast provided in Appendix H.5. Should there be any delay to commencement of NNM Phase 1, a 24-month limit has also been set to give surety that the activity will be completed in a timely manner.	10.16	Prelude FLNG emissions from processing Crux gas are aligned with estimates described in this EP, verified once NNM Phase 1 operations commence, or no later than 24 months after start-up, whichever comes first.	Records demonstrate verification has been undertaken and change managed as appropriate.
Administrative and Procedural	Contracting strategy and evaluation for deployment of support vessels includes consideration of vessel emissions parameters and low carbon fuels.	Yes	Fuel cost over contract lifecycles are considered in the evaluation of contractor tenders, allowing for competitive consideration of low carbon alternatives. Minimises costs and emissions through eco-efficiency approach recognising cost of fuel and carbon emissions over the contract term. Control effectively allocates a cost to emissions to recognise that higher emitting fuel sources with other lower operating costs do not represent overall best value.	10.17	Support vessel tenders will evaluate: • fuel cost over the term of contracts, • vessel emission parameters, and • low carbon fuel alternatives.	Contract request for tenders and/or tender evaluation records.
Administrative and Procedural	Vessel specific biofouling management and/or risk assessment.	Yes	Implementing biofouling controls reduces the potential for project vessel water drag. Hence, project vessel hull integrity improves vessel fuel efficiency, assisting in reducing GHG emissions to ALARP.	6.1	Refer to EPS 6.2.	Refer to EPS 6.2.
				6.3	Refer to EPS 6.3.	Refer to EPS 6.3.
				6.4	Refer to EPS 6.4.	Refer to EPS 6.4.

Hierarchy of Controls	Control Measure	Adopted ?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
ALARP Demonstration Statement						
Based on the impact assessment outcomes and control measures adopted, Shell considers implementing the control measures appropriate to manage the potential impacts associated with GHG emissions during Second Stage Well Clean-up, Start-up, and Operations. These measures include the use of efficient gas turbine generators, minimisation of diesel combustion, and operational controls to reduce flaring and venting. GHG management planning is aligned with regulatory frameworks such as the NGER Act and the Safeguard Mechanism. Shell therefore considers the potential impacts associated with GHG emissions to be reduced to ALARP.						

Table 9-81: ALARP Assessment and Environmental Performance Standards – First Stage Well Clean-up

Hierarchy of Controls	Control Measure	Adopted ?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
ALARP Assessment						
Engineering	Define well objectives for first stage clean-up.	Yes	Well unloading acceptance criteria that define the well objectives will be established.	2.2	Refer to EPS 2.2.	Refer to EPS 2.2.
Engineering	Installation of a thermocouple with auto reignition functionality to detect and reignite flame-outs.	Yes	To maximise the flare performance in all wind conditions, two sets of ignition systems will be run on both the flare tip and the oil burner. The primary ignition system uses a conventional spark-lit burner, with a pilot assembly on each burner head assembly and the flare tip. A thermocouple detects flame-outs and initiates re-ignition on the primary ignition system.	10.18	Thermocouple with reignition functionality will be used on the well test equipment control panel.	Quality assurance/ quality control (QA/QC) and inspection records. Pre-flow checklist records.
Engineering	Installation of a secondary flare ignition system to minimise common-mode failures with separate power and pilot gas supply.	Yes	To maximise the flare performance in all wind conditions, two sets of ignition systems will be run on both the flare tip and the oil burner. The primary ignition system uses a conventional spark-lit burner, with a pilot assembly on each burner head assembly and the flare tip. A secondary (redundant) manual ignition system is designed to minimise common-mode failures with separate power and pilot gas supply.	10.19	A secondary ignition system will be installed and tested.	Approved engineering drawings. QA/QC and inspection records. Pre-flow checklist records.
Engineering	Low-velocity tip to improve combustion efficiency.	Yes	The gas flare to incorporate a low-velocity tip to improve combustion efficiency, and reduce lift-off / flame-outs, particularly of gas with a high inert-content.	10.20	A low-velocity tip will be installed and in operation for first stage well clean-up.	Approved engineering drawings. Pre-flow checklist records.
Engineering	High efficiency liquid burners designed with multiple burner nozzles to maximise air ingestion and atomisation.	Yes	The temporary flare boom and incineration system is expected to use proprietary high efficiency liquid burners designed with multiple burner nozzles to maximise air ingestion and atomisation to optimise combustion efficiency and minimise potential for smoke emissions and flame-out.	10.21	High efficiency liquid burners designed with multiple burner nozzles will be installed and in operation for first stage well clean-up.	Approved engineering drawings. Pre-flow checklist records.
Engineering	Installation of manual emergency shutdown and rendition buttons on the control panel.	Yes	The clean-up package (which sends fluids to the flare system) includes an electronic emergency shutdown system. Activating the shutdown will stop new gas and condensate from entering the clean-up system, which will result in the flaring coming to a rapid conclusion.	10.22	Installation of emergency shutdown and manual ignition controls will be installed and tested for all clean-up stages.	Approved engineering drawings. ESD system check records. QA/QC and inspection records. Pre-flow checklist records.
Administrative and Procedural	Permanent manned flare watch duty.	Yes	Three personnel will be dedicated on each shift to perform flare watching duty to ensure the flare is always supervised. The personnel will rotate between watching the flare and performing safety checks and other duties to manage fatigue. At no point will the flare be unsupervised, and the person watching the flare is both watching for flare outs/unstable conditions and monitoring the sea for any sign of fall-out. The well test area is permanently manned by ~6 experienced personnel.	10.23	There will be continuous visual monitoring of flare throughout first stage well clean-up by flare watch duty officers. The person monitoring the flare will rotate between watching the flare and performing safety checks and other duties.	Well clean-up records of personnel on flare watch duty.
				10.24	Flare watch duty officers will be briefed on their obligations for monitoring of flare condition prior to commencing the task.	Signed briefing documentation.
Administrative and Procedural	Manual shutdown and ignition controls.	Yes	As contingency to auto-detection / re-ignition and emergency shutdown, the clean-up system has manual shutdown, manual flow control, and manual ignition control panels which can be used to prevent or minimise the extent of flame-out and enable reignition or shutdown. Radio communications will be used between flare watch duty personnel and control panel operators.	10.25	Clean-up operators will be trained in the use of manual emergency shutdown and manual ignition controls prior to commencing the task.	Personnel training records.
				10.26	Flare watch duty officers and panel operators will be trained in radio communication protocols prior to commencing the task.	Signed briefing documentation.

Hierarchy of Controls	Control Measure	Adopted ?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
Engineering, Administrative and Procedural	Greenhouse Gas and Energy Management Plan (GHGEMP) for the Crux Project execute phase includes; • Goals and limits for key emissions generating activities and/or risks. • Key measures to minimise GHG emissions. • Process for regularly reviewing performance and feedback to improve performance during key emissions generating activities.	Yes	Shell uses GHGEMPs to manage significant sources of GHG emissions to ALARP throughout project lifecycles. These plans are mandatory during the early project periods to define phase, and a different version is used during operations to manage emissions. The GHGEMP for execute phase includes; • Forecast emissions for key emission generating activities. This is a once off activity for the activities in this EP, carried out prior to commencement. This will include expected worst case, informing EPS limits, and also internal goals, which will be based more on expected performance. • Goals and limits (EPSs) for key emissions generating activities and/or risks. Goals for key activities will be set for 1st stage well clean-up, hot commissioning, and SURU (including 2nd stage well clean-up). Limits (set in EPSs) will be higher values than goals, which will remain internal to Shell, in order to drive the right behaviours in terms of aiming to reduce GHG emissions to ALARP through the phase. • Key measures to minimse GHG emissions. • Process for regularly reviewing performance and feedback to work towards achieving goals and whilst also remaining within the limits during key emissions generating activities. Flaring emissions are where most of the predicted GHG emissions, and risk of increased emissions, is expected to be sourced from throughout 1st stage well clean-up through to SURU (post 6 months). Therefore, flaring is a significant focus of the GHGEMP execute phase. Key measures to assist in minimising emissions throughout the key emissions generating activities include; • A monthly GHG performance review and lookahead (minimum), attended by relevant leadership with authority to authorise corrective actions, will review past performance and tracking against goals and limits (EPS). The review will take actions to further minimise GHG emissions or reduce risk of GHG emissions during future key emission generating activities. The focus is intended to mostly be on flaring reduction opportunities and risks during 1st stage well clean-up, 2nd stage well clean-up and the first 6 months of SURU. GHG emission data is collected on a quarterly basis for business reporting, however, for the execute phase of the project, a more frequent monthly review period is considered a robust solution to ensure actions can be aligned with activity schedules. • Perforation and 1st stage well clean-up well unloading acceptance criteria that define the well objectives will be established. Well objectives are subject to detailed engineering and plans and procedures that will be finalised prior to work commencing activities. This will inform both the establishment of GHG emission goals (Section 10.6.8) and limits (Section 10.6.9) for these activities. • Produce second stage well clean-up to permanent systems on the Crux facility to maximise the production of hydrocarbons for export to Prelude FLNG rather than disposal by flare. Crux has designed a second stage well clean-up post–ready for start-up (RFSU) to minimise flaring, allowing the gas to be exported rather than flared. This significantly reduces the operation's GHG footprint. • Work Execution Flow Scheme (WEFS) will be used during start-up and ramp-up activities to assist in optimising activities through things like sequencing and process optimisation in order to reduce emissions associated with the start-up and ramp-up activities. Flaring minimisation measures will be documented in the Start-up	10.4	A perforation/first stage well clean-up flaring 'limit', in $MtCO_2$-e, will be set at least 1 month prior to commencing the activity based on final completions design. The limit will be consistent with GHG emissions predictions within this EP. Flaring emissions will not exceed the limit set.	GHGEMP execute phase and/or other supporting note for file contains limit linked to EPS 10.4 within 1 months of commencing activity.
				10.5	Refer to EPS 10.5.	Refer to EPS 10.5.

Hierarchy of Controls	Control Measure	Adopted ?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
			Integrated Work Execution Flow Scheme (WEFS), and will include: – Optimisation of the schedule and activities to expedite the redirection of gas from the flare to the export pipeline. – Reduction in the number of ESD tests required. – Alignment of topsides facility start-up activities with Prelude FLNG readiness to receive Crux production.			
ALARP Demonstration Statement						
Based on the impact assessment outcomes and control measures adopted, Shell considers implementing the control measures appropriate to manage the potential impacts associated with GHG emissions. These measures include design-phase abatement options, operational controls, and execution-phase GHG management planning aligned with regulatory frameworks such as the NGER Act and the Safeguard Mechanism. Shell therefore considers the potential impacts are reduced to ALARP and acceptable levels.						

Table 9-82: ALARP Assessment and Environmental Performance Standards – Hot Commissioning[91]

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
ALARP Assessment						
Engineering	Facility Operating Procedures require GTG's to be started using backflow pipeline gas rather than well gas, to minimise flaring and emissions.	Yes	The Crux design includes the capability to receive of clean gas backflow from Prelude as an alternative fuel gas required for hot commissioning. This design feature minimises the duration of flaring required to meet fuel gas specifications, thereby reducing reduces GHG emissions. As a contingency, Crux well gas may be used where Prelude backflow gas is unavailable or if, due to unforeseen circumstances, the measure is no longer considered to be ALARP in reducing environmental impacts and risks in accordance with operating procedure. As plans and procedures develop, any changes will be managed in accordance with Shell Management of Change processes (Section 10.3.5).	2.1	Refer to EPS 2.1.	Refer to EPS 2.1)
Engineering and Administrative and Procedural	Greenhouse Gas and Energy Management Plan (GHGEMP) for the Crux Project execute phase includes; • Goals and limits for key emissions generating activities and/or risks. • Key measures to minimse GHG emissions. • Process for regularly reviewing performance and feedback to improve performance during key emissions generating activities.	Yes	Shell uses GHGEMPs to manage significant sources of GHG emissions to ALARP throughout project lifecycles. These plans are mandatory during the early project periods to define phase, and a different version is used during operations to manage emissions. The GHGEMP for execute phase includes; • Forecast emissions for key emission generating activities. This is a once off activity for the activities in this EP, carried out prior to commencement. This will include expected worst case, informing EPS limits, and also internal goals, which will be based more on expected performance. • Goals and limits (EPSs) for key emissions generating activities and/or risks. Goals for key activities will be set for 1st stage well clean-up, hot commissioning, and SURU (including 2nd stage well clean-up). Limits (set in EPSs) will be higher values than goals, which will remain internal to Shell, in order to drive the right behaviours in terms of aiming to reduce GHG emissions to ALARP through the phase. • Key measures to minimse GHG emissions. • Process for regularly reviewing performance and feedback to work towards achieving goals and whilst also remaining within the limits during key emissions generating activities.	10.3	Refer to EPS 10.3.	Refer to EPS 10.3.
				10.5	Refer to EPS 10.5.	Refer to EPS 10.5.
				10.7	Refer to EPS 10.7.	Refer to EPS 10.7.

[91] Table 9-82 does not duplicate broadly relevant points from the ALARP Table 9-80. Table 9-82 details where there are bespoke differences to Table 9-80 which are most relevant to consider. Table 9-82 also details all relevant EPSs, as they apply to the activities.

Hierarchy of Controls	Control Measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
			Flaring emissions are where most of the predicted GHG emissions, and risk of increased emissions, is expected to be sourced from throughout 1st stage well clean-up through to SURU (post 6 months). Therefore, flaring is a significant focus of the GHGEMP execute phase. Key measures to assist in minimising emissions throughout the key emissions generating activities include; • A monthly GHG performance review and lookahead (minimum), attended by relevant leadership with authority to authorise corrective actions, will review past performance and tracking against goals and limits (EPS). The review will take actions to further minimise GHG emissions or reduce risk of GHG emissions during future key emission generating activities. The focus is intended to mostly be on flaring reduction opportunities and risks during 1st stage well clean-up, 2nd stage well clean-up and the first 6 months of SURU. GHG emission data is collected on a quarterly basis for business reporting, however, for the execute phase of the project, a more frequent monthly review period is considered a robust solution to ensure actions can be aligned with activity schedules. • Perforation and 1st stage well clean-up well unloading acceptance criteria that define the well objectives will be established. Well objectives are subject to detailed engineering and plans and procedures that will be finalised prior to work commencing activities. This will inform both the establishment of GHG emission goals (Section 10.6.8) and limits (Section 10.6.9) for these activities. • Produce second stage well clean-up to permanent systems on the Crux facility to maximise the production of hydrocarbons for export to Prelude FLNG rather than disposal by flare. Crux has designed a second stage well clean-up post–ready for start-up (RFSU) to minimise flaring, allowing the gas to be exported rather than flared. This significantly reduces the operation's GHG footprint. • Work Execution Flow Scheme (WEFS) will be used during start-up and ramp-up activities to assist in optimising activities through things like sequencing and process optimisation in order to reduce emissions associated with the start-up and ramp-up activities. Flaring minimisation measures will be documented in the Start-up Integrated Work Execution Flow Scheme (WEFS), and will include: – Optimisation of the schedule and activities to expedite the redirection of gas from the flare to the export pipeline. – Reduction in the number of ESD tests required. – Alignment of topsides facility start-up activities with Prelude FLNG readiness to receive Crux production.			
Administrative and Procedural	Report GHG emissions to the Clean Energy Regulator where required by the NGER Act.	Yes	The NGER Act stipulates criteria which trigger NGER reporting. Crux will meet NGER reporting requirements required by the Clean Energy Regulator. GHG emissions will be reported annually to the CER, where required under the NGER Act and, where required, will manage GHG emissions to within the relevant baseline under the National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015.	10.1	Refer to EPS 10.1.	Refer to EPS 10.1.

ALARP Demonstration Statement

Based on the outcomes of the impact assessment and the control measures adopted, Shell considers that the implemented measures are appropriate to manage the potential impacts associated with greenhouse gas (GHG) emissions from the activity. These include design-phase abatement options, operational controls, and execution-phase GHG management planning aligned with regulatory frameworks such as the NGER Act and the Safeguard Mechanism. No additional, alternative, or improved controls were identified that would further reduce the impacts—beyond negligible environmental benefits if any—without disproportionate effort and cost. Therefore, the impacts are considered to be reduced to ALARP and to an acceptable level.

9.12.11 Acceptability of Impacts

Given the controls proposed, the assessment of risks from the incremental contribution of this activity are considered negligible and below an acceptable level. The proposed controls are industry best practice and consistent with:

- principles of Ecological Sustainable Development (ESD)
- relevant legislative and industry requirements;
- relevant requirements in relation to Matters of National Environmental Significance (MNES);
- internal and external context; and
- the defined acceptable level of GHG emissions as set out in Section 8.

The potential impacts and risk are considered acceptable if the proposed controls are implemented.

Table 9-83: Acceptability of Impacts – Greenhouse Gas Emissions

Receptor		Acceptable Level of Impact	Acceptable?	Acceptability Assessment
Category	**Subcategory**			
Physical Values and Sensitivities	Australian environment	No significant impacts to the Australian environment attributable to the activity.	Yes	It is important to recognise that potential climate change impacts cannot be directly attributed to a single project. Therefore, there is no direct connection between direct or indirect GHG emissions from the activity and potential impacts to specific receptors. The Activity is an insignificant contributor to annual Australian and global emissions. Shell acknowledges that, to be acceptable, Activity emissions must be reduced to ALARP through the adoption of the control measures outlined in Table 9-80, Table 9-81 and Table 9-82. The achievement of the EPOs listed in Section 9.12.12 and the implementation of control measures will minimise the potential impacts from the activity. As a result, GHG emissions attributable to the activity are unlikely to have a significant impact and considered to be acceptable.

Principles of ESD

The activity aligns with the principles of ESD in several key ways to minimise the environmental impacts and promote sustainability:

- Principle of integration: This principle emphasises the need to balance long-term and short-term economic, environmental, social, and equitable considerations in decision-making. The Crux Project has integrated measures to reduce GHG emissions, while factoring in safety considerations and balancing other project trade-offs such as cost and availability of alternatives. The Crux Offshore Project Proposal was subject to public comment and regulatory scrutiny, ensuring community involvement and addressing concerns.
- Precautionary principle: This principle requires that where there are 'threats of serious or irreversible environmental damage, lack of full scientific certainty should not postpone measures to prevent environmental degradation.' While it is not feasible to meaningfully link the GHG emissions associated with the activity to climate change impacts globally and its impact on potential Australian receptors, this impact assessment is nonetheless framed by reference to the incremental contribution that this activity will make to Australian and global GHG emissions.

- Principle of inter-generational equity: This principle ensures that the health, diversity, and productivity of the environment are maintained or enhanced for the benefit of future generations. Crux Activities meet this principle by ensuring GHG emissions do not exceed the defined acceptable level and comply with all relevant laws, thus protecting future generations.
- Conservation of biological diversity and ecological integrity: This principle emphasises the importance of conserving the biological diversity and ecological integrity in decision-making. The Crux Offshore Project Proposal thoroughly assessed potential environmental impact in accordance with relevant laws (OPGGS Act and OPGGS(E) Regulations). The assessment followed Shell's requirements to identify and minimise negative environmental, social and health impacts while optimising positive impacts. This framework has been continued through the execution of the Activities in this EP (see Sections 6, 8, and 9).
- Improved valuation, pricing, and incentive mechanisms: This principle promotes the use of valuation, pricing, and incentive mechanisms to support sustainable practices. The Crux Project considers global policies and actions related to GHG emissions and complies with Australian legislation, including the Safeguard Mechanism. ALARP principles are used to support risk assessment and decision-making, ensuring environmental risks are minimised and managed effectively.

Relevant Legislative and Industry Requirements

The activity is consistent with the strategy and frameworks put in place by the Australian Government to support Australia's transition to net zero.

DISR's 'Future Gas Strategy' (DISR 2024a) (the DISR Strategy) provides a comprehensive framework for how gas will support Australia's transition to net zero. It balances the need for reliable energy supply with the goal of reducing GHG emissions, ensuring public and regulatory involvement, and aligning with international commitments. The NGER Act and Safeguard Mechanism play crucial roles in monitoring and managing GHG emissions, supporting Australia's broader climate goals.

The DISR Strategy provides a framework which recognises that Australia is, and will remain, a reliable trading partner for energy, including LNG and low emission gases. The DISR Strategy emphasises Australia's ambition to become a renewable energy superpower by developing new, low GHG emissions energy exports to support the energy security and decarbonisation efforts of its trade partners. The DISR Strategy provides an in–depth analysis of gas supply, consumption, and GHG emissions. The public consultation which shaped the DISR Strategy revealed the barriers and opportunities in gas supply and consumption for Australian households, businesses, and international trade partners. The DISR Strategy acknowledges that the role of gas will evolve as Australia strives to reach net zero by 2050. Even in net zero scenarios, Australia and the world will need gas through to 2050 and beyond. Australia's commitment under the Paris Agreement includes reducing net GHG emissions to 43% below 2005 levels by 2030 and achieving net zero emissions by 2050 (DCCEEW 2023k). The *Climate Change Act 2022* (Cth) legislates these targets, with a multi-year emissions budget set at 4,381 $MtCO_2$-e from 2021–2030.

The NGER Act provides a national framework for reporting GHG emissions, energy production and energy consumption. Its objectives are to:

- inform government policy;
- inform the Australian public;
- help meet Australia's international reporting obligations;
- assist Commonwealth, state, and territory governments to implement GHG reduction projects; and
- avoid duplicating similar reporting requirements in the states and territories.

Under the NGER Act, corporations that meet certain thresholds are required to report on GHG emissions, energy production and energy consumption. This reporting captures data about energy flows and energy transformations occurring throughout the economy. The NGER Act aligns with the GHG Protocol, a globally accepted set of standards for accounting for GHG emissions.

The Safeguard Mechanism under the NGER Act ensures Australia's largest emissions intensive industries measure, report and reduce their Scope 1 GHG emissions. It applies a decline rate to facilities' baselines so that they are reduced predictably and gradually over time on a trajectory consistent with achieving Australia's emission reduction targets of 43% below 2005 levels by 2030 and net zero by 2050.

Key elements of the mechanism include (DCCEEW 2023k):

- Facilities with GHG emissions exceeding 100,000 tCO_2-e (0.1 $MtCO_2$-e) per year must keep GHG emissions at or below set baselines;
- If a facility exceeds its baseline, it must manage excess GHG emissions, such as by purchasing and surrendering Australian Carbon Credit Units;
- A requirement to offset 100% reservoir CO_2 from new reservoirs feeding existing LNG facilities;
- Facilities must meet reporting and record-keeping requirements, including audits;
- Penalties for non-compliance.

Although Shell does not anticipate that Scope 1 emissions from the Crux facility will exceed 100,000 tCO_2-e (0.1 $MtCO_2$-e) per year during normal operations, it is possible this threshold may be exceeded during initial start-up. In that case, the Safeguard Mechanism would be directly applicable to this activity.

The Safeguard Mechanism will also be relevant to GHG emissions at the Prelude FLNG facility (which is a Designated Large Facility under the NGER framework), including emissions generated at that facility while processing Crux gas. Specifically, the Responsible Emitter of the Prelude FLNG facility will be required to surrender prescribed carbon units equal to 100% of reservoir CO_2 separated from Crux feed gas at the facility, being an estimated 9.78 $MtCO_2$-e over the life of the reservoir. The Crux reservoir CO_2 is the responsibility of the facility from which it is emitted, in this case, the Prelude FLNG for the Crux reservoir.

Matters of National Environmental Significance

The potential incremental GHG emissions from the activity are considered to be negligible in the context of Australian (0.02%) and global (0.03%) GHG emissions and are unlikely to have a significant impact on marine parks, threatened and migratory species or the Commonwealth Marine Environment.

Marine Parks

The Australian Marine Parks – North-west Marine Parks Network Management Plan 2018 (DNP 2018b) considers the effects of climate change and the potential impact on marine park values such as habitats, KEFs and marine fauna species. Implementing the EPO listed in Section 9.12.12 and the control measures outlined in Table 9-80 to Table 9-82 will manage the GHG emissions from the activity. Shell has assessed no impact to the overall consequence level reasonably expected. The activity is therefore unlikely to have a significant impact on marine parks or associated conservation values and is therefore considered acceptable.

Threatened and Migratory Species

Table 9-84 lists the relevant EPBC publications that recognise climate change as a potential threat and summarises the demonstration of alignment. Shell has assessed no impact to the overall consequence level reasonably expected. The activity is therefore unlikely to have a significant impact on threatened or migratory species and is therefore considered acceptable.

Commonwealth Marine Environment

The associated potential incremental impacts of the activity on the Commonwealth marine environment were assessed against the significant impact criteria for MNES, and Shell considers they are not significant.

Table 9-84: Summary of Alignment with Relevant Requirements for MNES

MNES	MNES Acceptability Considerations (Significant Impact Guidelines, EPBC Management Publications)	Demonstration of Alignment
Threatened and Migratory Species – Marine Mammals	Significant impact guidelines for critically endangered, endangered, vulnerable and migratory species (Table 8-1).	It is not feasible to meaningfully link the GHG emissions associated with the activity to climate change impacts globally or its impact on potential MNES receptors. The incremental increase in GHG emissions from the
	Conservation management plan for the blue whale: A recovery plan under the *Environment Protection and Biodiversity Conservation Act 1999* 2015–2025 (CoA 2015a).	
	Approved Conservation Advice *Balaenoptera borealis* (sei whale) (DoE 2015c).	

MNES	MNES Acceptability Considerations (Significant Impact Guidelines, EPBC Management Publications)	Demonstration of Alignment
	Conservation Advice *Balaenoptera physalus* fin whale (TSSC 2015b).	activity will be negligible in the context of Australian (0.02%) and global (0.03%) GHG emissions and therefore Shell has assessed no impact to the overall consequence level reasonably expected. The Activity is therefore unlikely to have a significant impact on MNES and is therefore considered acceptable. Nonetheless, the control measures outlined in Table 9-80 to Table 9-82 will minimise the potential impacts of the incremental contribution of the GHG emissions associated with this Activity to ALARP.
Threatened and Migratory Species – Marine Reptiles	Significant impact guidelines for critically endangered, endangered, vulnerable and migratory species (Table 8-1).	
	Recovery plan for Marine Turtles in Australia 2017–2027 (CoA 2017b).	
	Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) (TSSC 2008a).	
	Conservation Advice for *Aipysurus fuscus* (dusky sea snake) (DCCEEW 2024h).	
Threatened and Migratory Species – Birds	Significant impact guidelines for critically endangered, endangered, vulnerable and migratory species (Table 8-1).	
	Wildlife Conservation Plan for Migratory Shorebirds (DoE 2015a).	
	Wildlife Conservation Plan for Seabirds (CoA 2020).	
	Approved Conservation Advice for *Calidris canutus* (Red knot) (DCCEEW 2024b).	
	Approved Conservation Advice for *Limosa lapponica menzbieri* (Yakutian bar-tailed godwit) (DCCEEW 2024d).	
	Conservation Advice for Abbott's Booby – *Papasula abbotti* (TSSC 2020b).	
	Conservation Advice for *Calidris acuminata* (sharp-tailed sandpiper) (DCCEEW 2024a).	
	Conservation Advice *Calidris ferruginea* curlew sandpiper (DCCEEW 2023f).	
	Conservation Advice for *Charadrius leschenaultii* (greater sand plover) (DCCEEW 2023g).	
	Conservation Advice for *Limnodromus semipalmatus* (Asian dowitcher) (DCCEEW 2024h).	
	Conservation Advice for *Phaethon rubricauda westralis* (Indian Ocean red-tailed tropicbird) (DCCEEW 2023h).	
	Conservation Advice *Limosa lapponica baueri* (Alaskan bar-tailed godwit) (DCCEEW 2024c).	
	Conservation Advice *Numenius madagascariensis* eastern curlew (DCCEEW 2023e).	
	National Recovery Plan for the Australian Painted Snipe (*Rostratula australis*) (COA 2022).	
Threatened and Migratory Species – Sharks and Rays	Significant impact guidelines for critically endangered, endangered, vulnerable and migratory species (Table 8-1).	
	Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (DOE 2014).	
	Conservation Advice *Rhincodon typus* whale shark (DoE 2015e).	
	Recovery plan for the white shark (*Carcharodon carcharias*) (DSEWPaC 2013b).	
Commonwealth Marine Environment	Significant impact guidelines for Commonwealth marine environment (Table 8-1).	

MNES	MNES Acceptability Considerations (Significant Impact Guidelines, EPBC Management Publications)	Demonstration of Alignment
Marine Conservation Reserves	Australian Marine Parks – North-west Marine Parks Network Management Plan 2018 (DNP 2018b).	

Internal and External Context

The Shell Group has an important role to play in the energy transition and aims to lead where it has competitive strengths, sees strong customer demand, and identifies clear regulatory support from governments. In this context, Shell Australia's delivery of the Crux Project is an important part of delivering on the Shell Group's LNG Strategy and target to be a net-zero emissions energy business by 2050[92].

Australia is well-positioned to lead in the energy transition due to its resources, export markets, and skilled workforce. The Shell Group collaborates with governments and partners to support low-carbon energy production. Fossil fuels currently meet over 80% of global energy demand. As demand for energy continues to grow, driven by rising populations and increased prosperity, the world must transition from fossil fuels to low-carbon energy in a balanced and orderly way to achieve net-zero emissions, including by increasing electrification and renewable energy. The transition to net zero will not be linear, as different countries take different approaches and move at different paces.

The Global Stocktake Agreement of December 2023 recognises that transitional fuels, such as LNG, 'can play a role in facilitating the energy transition while ensuring energy security'[93].The Shell Group believes that LNG will play a critical role in the energy transition, including replacing coal in electricity generation and in heavy industry. The global LNG market is expected to grow by 40% from 2015–2040, mostly driven by industrial decarbonisation in China and strengthening demand for energy supply in other Asian countries.

The Shell Group is committed to reducing GHG emissions and has made good progress towards its targets and ambitions. By the end of 2023, Shell Group had achieved more than 60% of its target to halve emissions from its operations by 2030, compared with 2016. Shell Group was one of the first companies to set a target to achieve near-zero CH_4 by 2030. It continues to keep its CH_4 emissions intensity well below 0.2% and has reduced its total CH_4 emissions by 70% since 2016. Shell Group is also working with partners, industry, and universities to develop and implement technologies that reduce CH_4 emissions associated with the use of LNG.

Shell Group has also:

- set a new ambition to measure its progress, to reduce customer emissions from the use of its oil products by 15-20% by 2030 compared with 2021 (Scope 3, Category 11)[94].
- set a target to reduce the net carbon intensity (NCI)[95] of its products by 15-20% compared to 2016 by 2030 (6.3% reduction achieved by the end of 2023)[96].

[92] Shell Group's Operating Plan, outlook and budgets are forecasted for a ten-year period and are updated every year. They reflect the current economic environment and what we can reasonably expect to see over the next ten years. Accordingly, they reflect our Scope 1, Scope 2 and NCI targets over the next 10 years. However, Shell Group's Operating Plan cannot reflect our 2050 net-zero emissions target, as this target is currently outside our planning period. In the future, as society moves towards net-zero emissions, we expect Shell Group's Operating Plan to reflect this movement. However, if society is not net zero in 2050, as of today, there would be significant risk that Shell Group may not meet this target.

[93] Customer emissions from the use of our oil products (Scope 3, Category 11) were 517 $MtCO_2$-e in 2023 and 569 $MtCO_2$-e in 2021.

[94] Customer emissions from the use of Shell's oil products (Scope 3, Category 11) were 517 $MtCO_2$-e in 2023 and 569 $MtCO_2$-e in 2021. This ambition does not apply directly to the Crux project as it relates to customer emissions from oil products which are not produced at Crux.

[95] Reference to Shell's "net carbon intensity" includes Shell's carbon emissions from the production of energy products, our suppliers' carbon emissions in supply energy for that production and our customers' carbon emissions associated with their use of energy products we sell. Shell only controls its own emissions. The use of the term Shell's "net carbon intensity" is for convenience only and not intended to suggest these emissions are those of Shell plc or its subsidiaries.

[96] The net carbon intensity of emissions associated with the Crux Project will be considered when measuring progress towards this target. The target will be delivered by the Shell Group on a net portfolio basis and reflects anticipated changes in the Shell Group's sales of oil and gas products, and changes in sales of low and zero-carbon products- such as biofuels, hydrogen and renewable electricity.

- set a target to eliminate routine flaring in upstream operations by 2025[97].
- investing $10–15 billion in low-carbon energy solutions between 2023–end 2025, in areas including electric vehicle charging, biofuels, renewable power, hydrogen and carbon capture and storage[98]. In 2023 alone, Shell invested $5.6 billion in low-carbon energy solutions.

Shell Australia is one of Australia's largest producers of LNG and a significant contributor to the delivery of the Shell Group's LNG Strategy.

Acceptability Summary

For the reasons set out above, the assessment of risk, level of analysis and evaluation are commensurate to the magnitude of the impacts and risks arising from GHG emissions attributable to the activity.

Shell estimates the total GHG emissions for the lifecycle of the activity are ~185.71 $MtCO_2$-e. For Crux, the estimated annual scope 1 emissions are equivalent to ~0.02% of national Australian emissions and total emissions ~0.03% of global emissions. Shell does not consider the activity will result in any Scope 2 GHG emissions.

It is not feasible to meaningfully link the GHG emissions associated with the activity to climate change impacts globally and its impact on potential Australian receptors. Nonetheless, this impact assessment is framed by reference to the incremental contribution that this activity will make to Australian and global GHG emissions.

The assessment of risks from the incremental contribution that this activity will make to Australian and global GHG emissions has been considered in the context of:

- principles of ESD;
- relevant legislative and industry requirements;
- MNES;
- internal and external context; and
- defined acceptable level of GHG emissions as set out in Section 8.

The incremental increase in GHG emissions from the activity is considered to be negligible in the context of Australian and global GHG emissions and therefore Shell has assessed no impact to the overall consequence level reasonably expected. While Shell considers this to be an acceptable level, it will nevertheless manage its GHG emissions and any potential impacts to ALARP.

9.12.12 Environmental Performance Outcome

EPO #	EPO	Measurement Criteria
10.1	Shell group supports customers to reduce their GHG emissions through; • target to reduce the net carbon intensity of the energy products we sell by 9-12% by 2024, 9-13% by 2025, 15-20% by 2030, and 100% by 2050; • investing in low carbon solutions[99]. Shell Group is currently investing $10-15 billion in low-carbon energy solutions between 2023 and the end of 2025.	Progress against targets and investments reported in the relevant Shell Group reporting, at least triennially (EPS 10.21 and EPS 10.13).
10.2	Undertake the activity in a manner that is compliant with the national requirements set out in the Safeguard Mechanism.	Public NGER reporting records (EPS 10.1).

[97] Subject to the completion of the sale of Shell Petroleum Development Company of Nigeria Limited (SPDC). The target is consistent with the World Bank Zero Routine Flaring by 2030 initiative, which targets routine flaring of gas during oil production (upstream operations). While this target does not apply to gas projects including the Crux project, Shell intends to minimise flaring to ALARP and acceptable levels.

[98] Investment in the Crux Project is not part of the Shell Group's investment in low-carbon energy. However, the Shell Group's investment in low-carbon energy solutions will contribute to reducing the net carbon intensity of the products the Shell Group sells, including from the Crux Project, on a net portfolio basis.

[99] Investment in the Crux Project is not part of the Shell Group's investment in low-carbon energy. However, the Shell Group's investment in low-carbon energy solutions will contribute to reducing the net carbon intensity of the products the Shell Group sells, including from the Crux Project, on a net portfolio basis.

EPO #	EPO	Measurement Criteria
10.3	Undertake downstream processing at the Prelude FLNG facility in a manner that is compliant with the national requirements set out in the Safeguard Mechanism.	Public NGER reporting records (EPS 10.1).

9.13 Minor Releases and Waste

9.13.1 Aspect Context

Incidental dropped solid objects or minor spills and releases of chemicals, hydraulic fluids, diesel, hydrocarbons, waste, and other substances (collectively referred to as minor releases) could accidentally enter the marine environment from vessels (including ROVs) and the Crux platform during all activity phases.

Improper storage and handling of solid objects may result in accidental losses to the marine environment. Solid objects may include:

- equipment (tools, installation aids, hard hats etc).
- materials (e.g. infrastructure parts and supplies).
- waste(s):
  - hazardous wastes (e.g. oil-contaminated materials (e.g. filters, rags, and sorbents), chemical containers, paint and solvents and their containers, light tubes, and batteries).
  - non-hazardous domestic and industrial waste(s) (e.g. bottles, aluminium cans, scrap steel and bottles).

All wastes generated onboard vessels and the platform (other than permitted waste discharge streams addressed elsewhere in this EP) are securely stored, tagged, and transported to shore for re-use, recycling, treatment, or disposal by a licensed waste contractor. Note: Any waste management and disposal within international jurisdictions is out of scope for this EP.

The waste management strategy for the activity is designed to optimise segregation of waste in the offshore location and minimise contamination of recovered waste destined for recycling or disposal. All non-hazardous and hazardous solid wastes will be managed in accordance with the relevant waste management procedure and the vessel-specific waste management plans and procedures. Waste segregation on vessels is established and maintained to realise efficiencies in storage, transport, treatment, recycling and/or disposal of waste. This is done by providing labelled bins, skips or other appropriate receptacles used to commingle similar waste streams in accordance with their classification. The disposal of non-hazardous and hazardous wastes will be tracked to confirm they are disposed of at an appropriately licensed waste facility on shore. The transfer of waste or vessel/helicopter interactions between the Crux platform topsides and the Australian mainland has the potential to pose a biosecurity risk. This interaction provides a potential vector for the translocation and establishment of pests and diseases to Australian waters, should the Crux platform topsides host any. The management and disposal of any quarantine risk material will be in accordance with the relevant requirements of the *Biosecurity Act 2015* (Cth) and Annex V of MARPOL.

Shell's extensive operational experience indicates most accidental releases of solid objects to the marine environment are typically relatively small-scale and infrequent.

The potential environmental impacts from the accidental loss of solid objects to the marine environment depends on the nature and amount released, and the sensitivity of the environmental receptors that may be impacted. Some solid objects (e.g. paper, cardboard) will readily degrade in the marine environment and pose little environmental risk. Other solid objects are more persistent in the environment, particularly plastics.

In the event of an unplanned flame-out of the temporary flare during well completions first stage clean-up, some liquids (such as condensed water, formation water, condensate and completions fluids/base oil) may fall to the sea surface from the flare until the flame is rectified (see Sections 9.11 and 9.12 for flame-out prevention and minimisation safeguards).

Minor releases of liquid hydrocarbons (e.g. equipment and generator fuels, lubricants, and hydraulic fluids) and non-hydrocarbon liquids (e.g. operation chemicals, brine, sewage, cooling agents and paints) have the potential to occur from:

- mechanical failure of, or damage to, equipment, such as tanks, hoses, quick disconnect systems or pipework.
- inadequate transfer during supply drops and handling.
- dropped objects (e.g. swing loading during lifting activities).

If the spill is not contained on deck, a release to the marine environment would likely disperse rapidly within the open waters of the Activity Area restricting the potential for impacts to the vicinity of the spill location.

9.13.2 Description and Evaluation of Impacts and Risks

Table 9-85 indicates the environmental features and values and sensitivities that have been identified to be potentially affected by the minor releases that may occur during the activities covered by this EP, with further evaluation of the impacts and/or risks to each potentially affected receptor category provided in Sections 9.13.2.1 to 9.13.2.4.2. Features or values and sensitivities which could not be credibly affected by minor releases are not discussed further.

Table 9-85: Minor Releases and Waste Receptor Impact Screening Summary

| | Protected Areas | | | Features | | | | | | | | | | | | | | | | Values and Sensitivities | | | | | | | | | | | | | | | |

9.13.2.1 Physical Features

The introduction and establishment of pests and diseases to Australian waters pose significant ecological and socioeconomic impacts. International and domestic vessels, as well as helicopters will interact with the Crux platform, located ~200 km offshore from north-western Australia and ~460 km from north-north-east of Broome, WA. This interaction provides a potential vector for the translocation of pests and diseases to Australian waters, should the Crux platform host any.

In northern Australia, biosecurity risks are particularly pronounced due to the region's unique climate, diverse ecosystems, and geographical location. The tropical environment and seasonal weather patterns create ideal conditions for the proliferation of pests and diseases. Additionally, the region's agricultural activities are vulnerable to these threats.

However, with the stated controls in place to minimise the potential risk of translocating pests and diseases during the activity, the likelihood of introducing pests and diseases that could establish and impact the Australian mainland is considered extremely remote. The residual risk to physical features is ranked Dark Blue (see Table 9-86).

9.13.2.2 Physical Values and Sensitivities

9.13.2.2.1 Water and Sediment Quality

Minor releases may cause temporary and localised reductions in water quality near the release location, with the effects reducing as the constituents of the release are naturally dispersed by currents and diluted in the water column. Volumes of hazardous components (such as residual paint in cans) that may enter the marine environment are generally low and, given the water depths in the Activity Area and the dynamic nature of the offshore receiving environment, water quality is expected to rapidly and effectively recover to ambient conditions with distance and time from the release.

Due to the water depths in the Activity Area, most minor releases of liquids or buoyant solids are unlikely to have any effects on seabed sediments. Heavier materials that reach the seabed may locally decrease sediment quality, including through direct exposure to any hazardous components and/or to degradation products over time. Considering the relatively small scale of most potential minor releases, effects can reasonably be anticipated to be highly localised. The sediment substrates in the Activity Area are widely distributed through the region and the area that might be affected is negligible.

The residual risk to physical values and sensitivities is ranked Dark Blue (see Table 9-86).

9.13.2.3 Natural Features

9.13.2.3.1 Timor Province Bioregion

Minor releases can impact pelagic biota through physical interaction (e.g. entanglement) or localised contamination of water and toxic effects. Materials that are heavy enough to reach the seabed also have the potential to disturb benthic habitats, alter substrate type and/or adversely affect benthic fauna due to the release of residues or decomposition of materials. Potential effects to EPBC Act listed species are described in Section 9.13.2.4.2.

Habitats and benthos within the Activity Area are generally not considered to be sensitive or of high conservation value and are well represented in the region. The area of seabed disturbance due to release of a heavier solid would largely be restricted to the size of the object dropped and potential impacts to the benthic communities very localised. Given the nature of substrates and associated infauna and epifauna within the Activity Area (Section 7.6.4) and their widespread regional distribution, the scale of impact to benthic communities is expected to be negligible.

The release of hazardous materials may expose marine biota to potential toxic effects. However, given the anticipated rapid dispersion and/or dilution of minor hazardous releases in the open ocean environment of the Activity Area, algae and marine fauna are likely to encounter hazardous spills at toxic concentrations for only short durations, and within a highly localised area. Therefore, population-level effects are unlikely to occur from small spills of hazardous materials.

There is a risk that persistent solid materials released into the marine environment, particularly plastics, may cause adverse effects in pelagic fauna through ingestion or entanglement as well as contributing to the overall amount of plastics in the ocean, which can have various impacts on marine fauna as they accumulate in the

food chain. Considering the general absence of important habitats in the Activity Area, lack of fauna aggregations and generally widespread distributions of the species that may encounter minor releases, the proportion of any fauna population that might be affected by the small volumes potentially released is expected to be very low. The residual risk to natural features is ranked Dark Blue (see Table 9-86).

9.13.2.4 Natural Values and Sensitivities

9.13.2.4.1 KEFs

There are no KEFs in the vicinity of the Crux platform with only one KEF (continental slope demersal fish community) which partially overlaps the export pipeline corridor. Project activities within the vicinity of this KEF are expected to be limited to relatively infrequent, temporary and short duration IMR activities only. The Continental slope demersal fish community KEF extends over an area of ~33,182 km^2, and supports fish communities associated with the upper slope (water depth of 225–500 m) and the mid–slope (water depth of 700–1,000 m. Given the potential scale and duration of effects from minor releases on sediment and water quality at these depths, no impacts on the values of the KEF are likely.

9.13.2.4.2 Threatened, Migratory, Marine and Cetacean Species

There are no aggregation sites for EPBC Act listed species in or near the Activity Area and the number of any species that may occur near a minor release at the time of the release is likely to be very low. Air breathing fauna such as marine mammals and reptiles are unlikely to be adversely affected by localised short-term reductions in water quality or to suffer significant toxicity effects. Sharks and rays may be more vulnerable. However, due to the small volumes of hazardous materials that may be released and the rapid dispersion and dilution that is expected to occur following release, an animal would need to remain in very close proximity to the release location beside/under a vessel or the platform during and immediately following the release to be exposed to concentrations likely to result in toxic effects on any fauna.

Marine debris has been identified as a threat for a range of threatened or migratory fauna species, including marine turtles, birds, marine mammals and sharks and rays, and is listed as a key threatening process under the EPBC Act. Persistent solids (e.g. plastics) are of particular concern, as the threat to fauna may remain long after the release. Large plastics have the potential to break down to form microplastics, due to wave, current and UV action, which can be absorbed and ingested by fauna and bioaccumulate (DAWE 2021). The National Plastics Plan (DAWE 2021) supports global action to address marine plastic debris, including implementing the Threat Abatement Plan for the Impacts of Marine Debris on the Vertebrate Wildlife of Australia's Coasts and Oceans (TAP; CoA 2018). This TAP identifies EPBC Act listed species for which there are scientifically documented adverse impacts resulting from marine debris. Potential impacts of marine debris on key fauna species include (CoA 2018):

- entanglement, potentially resulting in restricted mobility, drowning, starvation, smothering and wounding.
- ingestion (particularly of plastics) leading to physical blockage of digestive systems, leading to starvation.
- acute or chronic toxic effects.

None of the threatened or migratory fauna species identified by the TAP as impacted by marine debris have BIAs that overlap the Activity Area and the number of any of these species likely to be exposed to minor releases is very low. While not specifically identified as an impacted species in the TAP, the whale shark is known to have ingested plastics (CoA 2018) and has a BIA that overlaps the Activity Area. However, the proportion of the BIA within the Activity Area is very low and the behaviours of this species in the region suggests that it likely to only transit the area during migratory seasons (Section 7.7.7.3.2).

Comprehensive management is in place to reduce the risk of debris (and other materials) being accidentally released to sea during the activity (Table 9-87). With the management that will be implemented, the potential for minor releases to result in any significant impacts at a population level for any threatened, migratory, marine or cetacean species is considered to be extremely remote.

The residual risk to natural values and sensitivities is ranked Dark Blue (see Table 9-86).

9.13.3 Risk Assessment Summary

Table 9-86 lists the highest residual risk ranking of the relevant environmental receptor groups.

Table 9-86: Minor Releases and Waste Evaluation of Residual Risks

Environmental Receptor	Consequence	Likelihood	Residual Risk
Evaluation – Unplanned Risks			
Protected Areas	N/A	N/A	N/A
Physical Features	Major	A	**Dark Blue**
Physical Values and Sensitivities	Slight	E	**Dark Blue**
Natural Features	Slight	E	**Dark Blue**
Natural Values and Sensitivities	Slight	E	**Dark Blue**
Socioeconomic Features	N/A	N/A	N/A
Socioeconomic Values and Sensitivities	N/A	N/A	N/A
Heritage and Cultural Features	N/A	N/A	N/A
Heritage and Cultural Values and Sensitivities	N/A	N/A	N/A

9.13.4 ALARP Assessment and Environmental Performance Standard

Table 9-87: ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
ALARP Assessment						
Elimination	Eliminate waste generation	No	It is not feasible to operate the offshore facilities and vessels without generating wastes.	N/A	N/A	N/A
Elimination	Eliminate lifting in field.	No	Elimination of lifting would reduce the risk of dropped objects, however, lifting activities are required to conduct the activities covered under this EP (e.g. IMR, transfer of supplies). Lifting is therefore an integral activity and cannot be eliminated completely. Hence, this control is not considered feasible.	N/A	N/A	N/A
Elimination	Eliminate ROV activities.	No	Eliminating ROV use would reduce the potential for accidental hydrocarbon releases to the marine environment due to equipment failure. IMR and other activities require the use of ROVs, these contain negligible volumes of hydrocarbons and as they are regularly inspected and maintained, the risk of failure is very low. The use of ROVs is essential to efficiently assure ongoing asset integrity and safety and therefore outweighs any minor environmental risk involved in deploying them. Hence, implementing this control would not reduce the environment impacts to ALARP.	N/A	N/A	N/A
Substitution	Stock polyfluoroalkyl substances (PFAS) – free fire extinguishers on the topsides.	Yes	PFAS are persistent, bioaccumulate, and have adverse health effects on humans and wildlife. They are a forever chemical and once in the environment persist indefinitely. Safer and more environmentally friendly alternatives are available, and efforts are being made to reduce their use and release into the environment. This procedural control measure, topsides stocking PFAS-free fire extinguishers, will assist in achieving this.	11.1	Topsides will stock PFAS-free fire extinguishers.	Vendor data sheets demonstrate fire extinguisher stocks are PFAS-free. Safety Data Sheet/s demonstrate the fire extinguishers located on the topsides are PFAS-free.
Engineering	Containment around liquid hydrocarbon storage tanks will be installed on the Crux platform to reduce the potential for minor accidental releases of chemicals/hydrocarbons to the environment. For the topsides, treat water collected in the open drain system with an OIW separator before discharge.	Yes	Containment around liquid hydrocarbon storage tanks captures any oil that might be present around the liquid hydrocarbon storage tanks during filling or maintenance activity. The open drain system captures any oil that might be present on the topsides decks before it is discharged to the ocean. The system is an inherently low risk system that will mostly receive rainwater. The oil water separator system is designed to be able to capture the contents of the greatest hydrocarbon inventory tank on the topsides. The topsides design has bunding for the diesel tote tank and waste oil tank, which minimises the potential for significant hydrocarbons to end up in the open drains system.	8.3	Refer to EPS 8.3.	Refer to EPS 8.3.
				8.4	Refer to EPS 8.4.	Refer to EPS 8.4.
Administrative and Procedural	Vessels will maintain a Garbage Record Book (or equivalent) (as required by vessel class, size and type) as per Marine Order 94 and 95.	Yes	Documented requirements for garbage management reduce the risk of release through inadvertent discharge or incorrect storage/handling. Vessels are required to have their own Garbage record book (or equivalent) to manage wastes generated and stored onboard. All wastes that are not permitted for discharge are sent ashore for re-use, treatment, recycling and/or disposal as appropriate. This control measure is in accordance with *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) and Marine Orders 94 and 95.	8.5	Refer to EPS 8.5.	Refer to EPS 8.5.
Administrative and Procedural	The management and disposal of quarantine risk material will be in accordance with relevant requirements of the *Biosecurity Act 2015* (Cth).	Yes	The management and disposal of any quarantine risk material, a system control measure, in accordance with relevant requirements of the *Biosecurity Act 2015* (Cth) will reduce the risk of impact from inappropriate disposal.	11.2	Quarantine risk material is managed and disposed of in accordance with relevant requirements of the *Biosecurity Act 2015* (Cth).	Records demonstrate that any quarantine risk material is managed and disposed of in accordance with relevant requirements of the *Biosecurity Act 2015* (Cth).
Administrative and Procedural	Shipboard Oil Pollution Emergency Plan (SOPEP) or equivalent (appropriate to class of vessel).	Yes	SOPEP (or equivalent) shall be in place for all vessels as required by their class in accordance with AMSA Marine Order 91. This system control measure enables the efficient and prompt response to hydrocarbon releases, thereby reducing potential impacts to the marine environment.	11.3	Vessels have and implement a valid SOPEP (appropriate to class) to respond to spills.	A valid SOPEP (appropriate to class) in place.
Administrative and Procedural	Waste management procedure.	Yes	Effective implementation of waste management procedures will reduce the likelihood of an unplanned release. This procedural control measure ensures environmental impacts of waste disposal minimised through management according to waste type at the disposal facility, in accordance with licensing requirements.	11.4	Waste management procedures are in place and implemented which supports good practice and prevents accidental discharge by focusing on:	Records demonstrate implementation of waste management procedure. Non-conformance with EPS defined as systemic failure of waste management process /plan, or failure to appropriately manage a waste stream to prevent loss to the environment.

Hierarchy of Controls	Control measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
			Topsides bins, skips and receptacles labelled to allow for commingling of similar waste streams and for easy identification of hazardous and non-hazardous wastes and to track these waste streams through to safe disposal.		• waste segregation and storage • safe handling and transport of waste • records of all waste to be disposed, treated or recycled shall be maintained, and shall include (though not limited to) quantity of waste, waste type and disposal/recycle location waste streams shall be appropriately handled, tested, monitored and managed according to their hazard and recyclability class.	
Administrative and Procedural	Lifting procedures and maintenance, including inspection of lifting equipment.	Yes	Likelihood of impacts to the marine environment are minimised by implementing procedures that reduce the risk of dropped objects during lifting operations.	4.2	Refer to EPS 4.2.	Refer to EPS 4.2.
ALARP Statement						
Given the impact assessment outcomes and control measures adopted under the scope of this activity, Shell considers implementing of the control measures appropriate to manage the potential risk and impacts associated with minor releases. Shell believes there are no feasible additional controls identified that could further reduce the impacts. Therefore, the impacts are reduced to ALARP.						

9.13.5 Acceptability of Risks

Table 9-88: Acceptability of Risks – Minor Releases and Waste

Receptor		Acceptable Level of Impact	Acceptable?	Acceptability Assessment
Category	**Subcategory**			
Physical Features, Values and Sensitivities	Australian environment	No significant impacts to the Australian environment.	Yes	The transfer of waste or interaction has the potential to pose a biosecurity risk to the Australian mainland. The proposed control measures will ensure that the likelihood of pests or diseases entering the marine environment is extremely remote.
	Water quality	No significant impacts to water quality. Impact not expected to result in a substantial change in water quality, which may adversely impact biodiversity, ecological integrity[26], social amenity or human health.	Yes	Minor releases have the potential to reduce water and sediment quality at the release location. The proposed control measures will ensure that the likelihood of minor releases entering the marine environment is low. Additionally, the small volumes potentially released would rapidly dilute/disperse in the open ocean environment with no potential for significant impacts anticipated.
	Sediment quality	No significant impacts to sediment quality. Impact not expected to result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity[26], social amenity or human health may be adversely affected.	Yes	
Natural Features	Marine bioregions	No significant impacts to benthic habitats and communities. Impacts to non-sensitive benthic communities limited to a maximum of 5% of the Project Area (as defined in the OPP). No significant adverse impact on demersal or pelagic communities, populations, habitats or spatial distribution of a species. No substantial adverse effect on a population of a marine species or cetacean including its lifecycle and spatial distribution.	Yes	The proposed control measures will ensure that the likelihood of minor releases entering the marine environment is low. Given the remote location and the lack of significantly diverse benthic communities or habitats that support the congregation of threatened or migratory species within the Activity Area, any accidental release of material to the environment would not be expected to interact with or affect a significant number of threatened or migratory MNES species. All vessels will meet MARPOL standards and will be compliant with these for waste management procedures. Internal controls to manage storage and handling

Receptor		Acceptable Level of Impact	Acceptable?	Acceptability Assessment
Category	**Subcategory**			
Natural Values and Sensitivities	Threatened, migratory, marine and cetacean species	Management of aspects of the activity must align with Conservation Advice, recovery plans and threat abatement plans (Table 7-16). No significant impacts to EPBC Act listed threatened, migratory, marine or cetacean species.	Yes	(including lifting) activities and reduce the likelihood of materials being accidentally released to the marine environment will also be implemented. Management of this aspect is not inconsistent with relevant Conservation Advice, recovery plans and threat abatement plans (Table 7-16). Consistent with Table 8-1, the unlikely event of individuals of marine species impacted is not considered to cause a significant impact to MNES.

The assessment of risks from minor releases determined the residual risk rating of Dark Blue (Table 9-86) and Table 9-7. The acceptability of the potential risks of impacts from minor releases associated with the petroleum activities has been considered in the following context.

Principles of ESD

The potential risks of impacts from minor releases are consistent with the principles of ESD because:

- The environmental values/sensitivities within the Activity Area are not expected to be significantly impacted.
- The precautionary principle has been applied to the risk assessment.

Relevant Requirements

Managing the potential risks of impacts from minor releases is consistent with relevant legislative requirements, including:

- MARPOL Annex V as ratified by the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth).
- *Navigation Act 2012* (Cth) and *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth):
  - Marine Order 94 – Marine pollution prevention – packaged harmful substances.
  - Marine Order 95 – Marine pollution prevention – garbage.
- *Biosecurity Act 2015* (Cth)
- AMSA Marine Order 95 (Marine pollution prevention – garbage).
- Policies, strategies, guidelines, Conservation Advice, and recovery plans for threatened species (Table 9-89).

Matters of National Environmental Significance

Threatened and Migratory Species

The evaluation of risks considers that no credible significant risks to threatened and migratory species are predicted to result from the minor releases, because of the limited number of fauna that could potentially be impacted in the unlikely event of an release.

Table 9-89 summarises the alignment of the petroleum activities with management plans, recovery plans and Conservation Advice for threatened and migratory fauna.

Commonwealth Marine Area

The impacts from minor releases are predicted to not exceed any of the significant impact criteria for the Commonwealth Marine Area listed in Table 8-1; as such, it is considered that the aspect does not pose a credible risk of significant impact to the Commonwealth marine environment.

Table 9-89: Summary of Alignment with MNES Considerations

MNES	MNES Acceptability Considerations	Demonstration of Alignment
Threatened and Migratory Species	Approved Conservation Advice *Balaenoptera borealis* (sei whale) (DoE 2015c).	The potential for minor releases will be managed consistent with relevant maritime requirements, international conventions (MARPOL), Marine Orders and Shell's internal management system requirements. This management reduces the likelihood of the accidental release of materials into the marine environment. The frequency, quantities and nature of minor releases are not considered likely to result in effects on threatened/migratory species or the Commonwealth marine environment that exceed any of the applicable significant impact criteria (Table 8-1).
	Conservation Advice on fin whale (*Balaenoptera physalus*) (TSSC 2015b).	
	Conservation management plan for the blue whale: A recovery plan under the *Environment Protection and Biodiversity Conservation Act 1999 20*15–2025 (CoA 2015a).	
	Significant impact guidelines for critically endangered, endangered, vulnerable and migratory species (Table 8-1).	
	Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA 2017b).	
	Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) (TSSC 2008a).	
	Conservation Advice for *Rhincodon typus* (whale shark) (DoE 2015e).	
Commonwealth Marine Area	Significant impact guidelines for the Commonwealth marine environment (Table 8-1).	
	Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (CoA 2018).	

External Context

There have been no objections or claims raised by Relevant Persons regarding minor releases. Shell's ongoing consultation program will consider statements and claims made by Relevant Persons when undertaking future assessment of risks (see Section 5.13).

Internal Context

Shell also considered the internal context, including Shell's Waste Strategy and Guidelines, environmental policy and ESHIA requirements. The EPOs, and the controls which will be implemented, are consistent with the outcomes from consultation for the petroleum activity and Shell's internal requirements.

Acceptability Summary

The assessment of potential risks from minor releases determined the residual risk rating to be Dark Blue (Table 9-88). As outlined above, the acceptability of the potential impacts and risks have been considered in the context of:

- the established acceptability criteria.
- ESD.

- relevant requirements.
- MNES.
- external context (i.e. stakeholder claims).
- internal context (i.e. Shell requirements).

Shell considers residual risks of Dark Blue or lower to be inherently acceptable if they meet legislative and Shell requirements. The discussion above demonstrates that these requirements have been met in relation to the minor releases aspect.

Shell considers the risk of impacts to the environment from the minor releases of associated with the activity to be ALARP and acceptable.

9.13.6 Environmental Performance Outcome

EPO #	EPO	Measurement Criteria
2.2	Refer to EPO 2.2.	Refer to EPO 2.2.
4.3	Refer to EPO 4.3.	Refer to EPO 4.3.

9.14 Emergency Events

9.14.1 Scenario Context

Scenarios that may lead to an emergency event[100] include:

- Loss of well control (LOWC) at the well head leading to the uncontrolled release of Crux condensate into the atmosphere which falls onto the sea adjacent to the platform for a duration of 80 days. This duration was selected as it represents the predicted timeframe required to mobilise a drilling rig, drill a relief well and seal ('kill') the well that is releasing oil.
- Subsea pipeline rupture leading to a short-term (4-hour), subsurface release of Crux condensate from a pressurised subsea pipeline.
- Loss of containment (LOC) of fuel (MDO or MGO) as a result of a fuel tank rupture following a vessel collision within the Activity Area.
- Bunkering incident resulting in a release of fuel (MDO or MGO).

Table 9-90 shows the maximum credible spill volumes for each incident type outlined above, calculated using AMSA's Technical Guidelines for Preparing Contingency Plans for Marine and Coastal Facilities (AMSA 2015). Further description of the scenarios that would result in the greatest release volumes of the different oil types (i.e. condensate and diesel) is provided below. Additional tables are located in the appendix that outline the extent of travel, timeframes and percentage probabilities for different oil phases, including likelihood of impact on receptors for a LOWC (Appendix D) and for a Subsea Pipeline Rupture (Appendix E).

9.14.1.1 LOWC

The topside infrastructure associated with the Crux platform includes surface wellhead systems and blowout preventers. Shell engineering standards require a range of features which manage the risk of a loss of well control to very low levels. However, there is a possibility that a loss of well control may occur during the activities covered by this EP. While the likelihood is very small, a complete loss of well control (a well blowout) has the potential to release large volumes of condensate into the environment. Such a release could result in significant environmental damage.

Industry statistics indicate the likelihood of a major release due to a well blowout are very low. Most loss of well control incidents do not result in a worst-case well blowout scenario, and typically release relatively small

[100] Emergency events are incidents that result in the mobilisation of the Shell emergency response team and/or Incident Management Team (West)(IMT(W)).

masses of hydrocarbons. The likelihood of a well blowout during operations (production) is considerably lower than a loss of containment from an exploration well, as are the release masses (Figure 9-16).

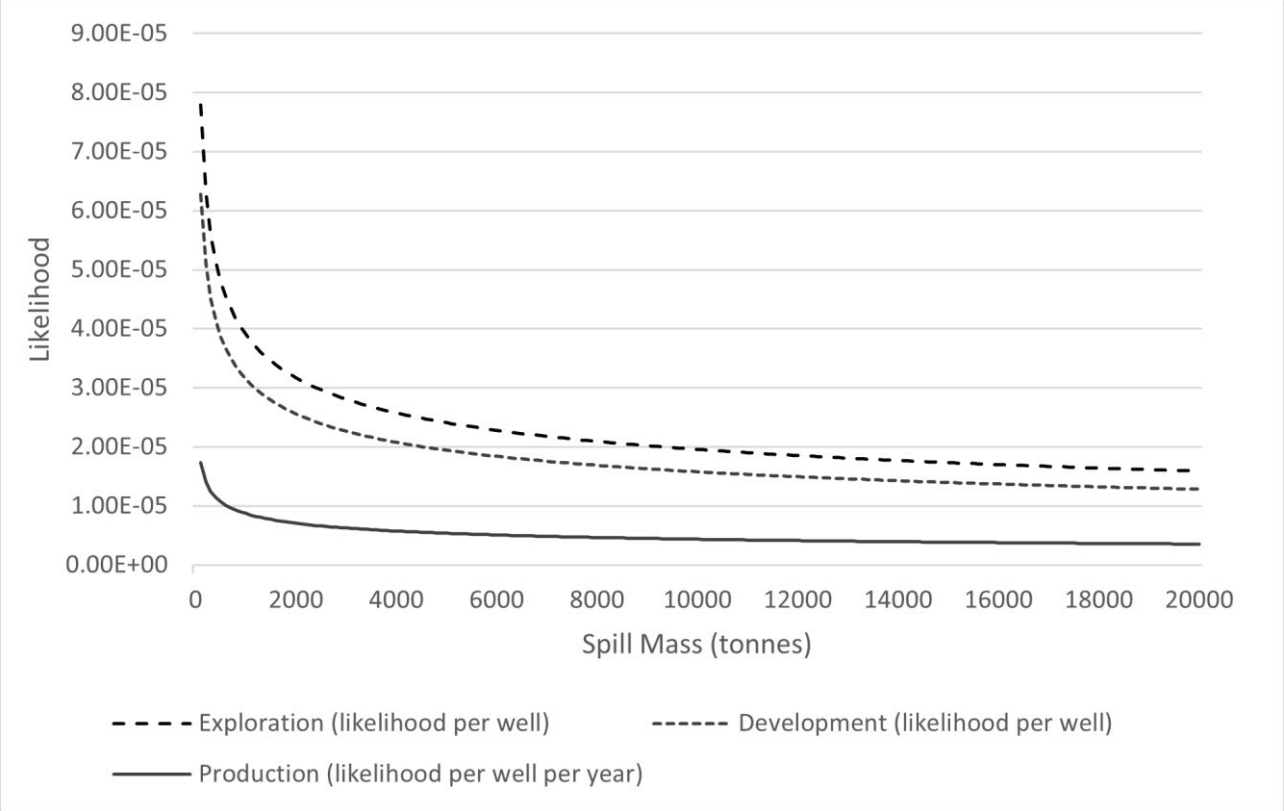


Figure 9-16: Estimated Likelihood and Mass of Well Blowouts for Exploration, Development and Production Wells (after Det Norske Veritas 2011)

Shell has extensive experience with safe and environmentally responsible production operations worldwide. Shell has developed a detailed understanding of the Crux field through historical seismic surveys and drilling. The offshore oil and gas industry has improved environmental performance since the Macondo and Montara catastrophes, and Australian regulations require that all environmental risks be managed to a level that is ALARP and acceptable, as demonstrated in this EP. All wells will be operated in accordance with an accepted WOMP that meets the requirements of the OPGGS Act.

Shell has determined the worst-case credible spill scenario that could occur during the activities within the scope of this EP. This modelled scenario is a complete well blowout, resulting in an 80-day uncontrolled release of 1,088 m^3 per day of condensate, and a total release volume of 87,077 m^3 of condensate. The duration is based on the credible worst-case time required to regain control of the well (by drilling of a relief well) and the volume is based on the maximum credible rate of release derived from the proposed well design and reservoir characteristics. The release location is at the surface (Crux platform). While this scenario is very unlikely, using the worst-case credible spill as the basis for the risk assessment provides an environmentally conservative assessment of the potential impacts and risks posed by the potential spill release scenarios during the activity.

9.14.1.2 Subsea Pipeline Rupture

The subsea pipeline linking the Crux facility and the Prelude FLNG facility which will be used to export pressurised Crux gas and associated condensate extends over ~155 km. Loss of integrity in this pipeline could potentially occur through corrosion or physical damage, resulting in a release of Crux condensate of different nature (ie subsea) and location to the LOWC scenario at the platform. The pipeline has been designed and constructed to withstand all reasonably foreseeable physical forces and will be subject to ongoing IMR activities during operations to ensure continued integrity (Section 6.11.3). Loss of containment and release of substantive volumes of hydrocarbons is therefore extremely unlikely. Nevertheless, to determine whether a release of condensate along the pipeline might result in different or additional exposure to environmental

receptors, a worst-case scenario involving a pipeline rupture and loss of inventory at the seabed was modelled. Modelling applied the maximum credible release volume (1804 m^3) based on the estimated time to isolate and depressurise the pipeline. The release location along the route of the pipeline selected for modelling was chosen due to its proximity to sensitive environmental receptors.

9.14.1.3 LOC from Fuel Tank Rupture Following a Vessel Collision

The activity will require use of a range of vessels, including an accommodation vessel and general vessels. The nature and scale of the environmental risks and impacts from a loss of fuel from a vessel varies significantly based on the vessel type and activities. All vessels will be fuelled with marine diesel (MDO or MGO).

Shell has determined the worst-case credible release is a loss of 529 m^3 of diesel over 1 hour. This scenario was identified as credibly arising from a collision with another vessel or the platform that has sufficient force to pierce the vessel hull, puncture the largest fuel tank on the vessel and result in the entire loss of the tank's fuel volume to sea. Based on the expected types of vessel traffic associated with the activity and standard maritime practices, this scenario is considered extremely unlikely. As MDO is more persistent than MGO, assuming that this worst-case credible spill volume involves MDO is considered to provide an environmentally conservative assessment of potential impacts and risks from a diesel spill scenario.

Smaller volumes of diesel could be spilled during refuelling activities or accidental vessel collision in the Activity Area. These scenarios have not been assessed as they would be within the footprint of the larger spill volume described above.

Table 9-90: Emergency Events: Maximum Credible Spill Volumes

Incident Type	Scenario	Maximum Credible Volume
LOWC (Surface)	A long term (80-day) uncontrolled, release of Crux condensate from the Crux wellhead resulting in a vertical spray into the air and fall onto the sea adjacent to the drilling platform at the rate of 1,085 m^3/d. A release continuing for 80 days is considered the worst-case LOWC scenario based on a conservative estimate of the time required to mobilise a drilling rig and complete a relief well.	87,077 m^3
Subsurface Pipeline Rupture (Subsea)	A short duration (4-hour), subsurface release of Crux condensate from a pressurised subsea pipeline. The export (Crux to Prelude) pipeline contains the greatest inventory and a rupture of this pipeline was selected to represent the worst-case scenario. A period of 4 hours is considered the maximum timeframe from pipeline rupture to valve closure and pipeline pressure equalisation (due to Crux condensate being pressurised within pipeline).	1804 m^3
Vessel collision (MDO release)	All vessels (ASV, Supply, Support and IMR) will be fuelled by diesel (MDO or MGO) – no heavy fuel oil (HFO) or intermediate fuel oil (IFO) vessels will be used. A vessel collision could lead to a LOC and subsequent release if a fuel tank is ruptured. Grounding is not considered credible due to the water depths and absence of submerged features in the Activity Area. The ASV (present only during completions and hot commissioning with the option to bring back in during major turnarounds) is expected to be one of the largest vessels used during operations. The largest fuel tank on the ASV has the capacity to hold 529 m^3 of MDO.	529 m^3
Bunkering (MDO/aviation release)	A bunkering (refuelling) incident caused by failure of a coupling or fuel hose, or overfilling a tank could lead to a LOC and subsequent release of fuel to sea. Spill volumes were determined from transfer hose inventory and spill prevention measures (AMSA), including 'dry-break' or 'breakaway' couplings, rapid shutdown of fuel pumps and spill response preparedness, with 10 m^3 considered the maximum volume that could be released from the hose before shutdown. This incident type has not been assessed as it involves the same oil type and sits within the spatial extent of the larger spill volumes for vessel collisions.	10 m^3

9.14.1.4 Hydrocarbon Characteristics

The physical properties and boiling points of Crux condensate and MDO are presented in Table 9-91 and Table 9-92, respectively.

Table 9-91: Physical Properties of Crux Condensate and MDO

Physical Properties	Crux Condensate	MDO
Density (kg/m^3)	783.6 (at 15° C)	829 (at 15° C)
API	49.0	37.6
Dynamic viscosity (cP)	1,052 (at 20° C)	4.0 at 25° C
Pour point (° C)	9	−14
Hydrocarbon property category	Group I	Group II
Hydrocarbon persistence classification	Non-Persistent Light Oil	Light-Persistent Oil

Table 9-92: Boiling-point Breakdown of Crux Condensate and MDO

Oil Type	Volatiles (%)	Semi-Volatiles (%)	Low Volatiles (%)	Residual (%)	Aromatics (%)
Boiling point (° C)	<180 C4 to C10	180–265 C11 to C15	265–380 C16 to C20	>380 >C20	Of whole oil <380 BP
	Non-persistent			*Persistent*	-
Crux Condensate	54.8	22.8	14.6	7.8	12.3
MDO	6	34.6	54.4	5	20-30

9.14.1.4.1 Crux Condensate

Crux condensate is a non-persistent light oil characterised by low density (783.6 kg/m^3) and medium viscosity (1,052 cP) (see Table 9-91). If released to the environment these properties will result in rapid initial spreading at the water surface under calm conditions but high susceptibility to wave-induced entrainment into the water column under more energetic sea conditions. It is mostly composed (92.2%) of volatile hydrocarbon compounds that would evaporate completely over time if exposed to the atmosphere (see Table 9-92). Around 55% by mass is highly volatile and would evaporate within 6–12 hours of exposure to climatic conditions in the Activity Area. A further 23% would evaporate within 24 hours, resulting in around a 77% reduction of spill mass within 24 hours under high levels of sunlight and with exposure to the atmosphere as a thin film.

Around 12% of the unweathered condensate is comprised of aromatic compounds that are both soluble and volatile. Around 10% of the mass is made up of highly volatile and soluble mono-aromatic hydrocarbons (MAHs), and a further 2.5% is made up of by di-aromatic hydrocarbons (DAHs) with lower volatility and solubility. Soluble, 3-ring PAHs that have relatively low volatility and solubility contribute to a smaller proportion (<2%).

The pour point of the whole condensate (9℃) indicates that the unweathered mixture will remain liquid over the annual temperature range in Northern Australian waters. The whole mixture has low asphaltene content (<0.05%), indicating a low tendency to take up water and form water-in-oil emulsions over the weathering cycle.

The ~8% of the initial oil mass that will not evaporate has a pour point (45° C) higher than prevailing sea temperatures, suggesting that the residues will solidify and float as sheets/flakes on the sea surface. These solid residues typically have low environmental toxicity (e.g. paraffins) and are subject to microbial and photo-degradation over time.

9.14.1.4.2 MDO

MDO is classed as a persistent light oil (Group II oil) with a density of 829 kg/m^3 and a very low viscosity (Table 9-91). Being less dense than sea water and with low viscosity, it will spread quickly on the surface of the water to form a thin film.

MDO is volatile and will begin to evaporate as soon as it is exposed to air (see Table 9-91), the rate of evaporation depends on various factors such as temperature, wind speed, and humidity. MDO also has a strong tendency to entrain within the upper water column, especially where water is turbulent or there are energetic wave conditions. This can reduce evaporation rates and cause the MDO to persist for longer, either in a dispersed or dissolved state. Approximately 5% of the hydrocarbons in MDO could persist for a longer period (Table 9-92). Within one or two months, these residual hydrocarbons will degrade completely through the action of naturally occurring microbes.

9.14.1.4.3 Modes of Environmental Impact

Condensate and diesel are both 'light' oils with a high proportion of aromatic hydrocarbons and limited persistence. Potential impacts to marine receptors in an open ocean environment from these types of oils relate predominantly to effects from hydrocarbon toxicity rather than the physical oiling (smothering) that can result from heavier oils. This toxicity is primarily associated with aromatic hydrocarbons.

Aromatic hydrocarbons are generally highly volatile and, in the warm sea and air temperatures of the region, will rapidly evaporate. Consequently, any spill of these oils will weather rapidly at the surface, leaving lower amounts of less toxic hydrocarbons.

The aromatic components of the hydrocarbons are also, generally, the most soluble. Therefore, dissolution of the aromatic components into the water column will occur both when the hydrocarbons are submerged (e.g. entrained through wave action) and when the hydrocarbons are on the surface. The evaporation of aromatic components from light oil spills in tropical environments will typically be several-fold more rapid than dissolution into the ocean.

As both are light oils, the mechanisms and consequences of exposure to environmental receptors from a condensate and diesel spill are broadly comparable. In offshore deep water spill locations, hydrocarbons at the surface present a risk to those animals that reside in or transit the surface water layer, including seabirds, cetaceans, turtles and plankton, but pose little risk to mid-water or benthic (bottom dwelling) organisms. However, hydrocarbons dissolved or entrained into the water column, either upon release or through subsequent wind/wave action will also affect other pelagic species and, if the spill reaches shallower areas, possibly also benthic organisms.

9.14.1.5 Oil Spill Modelling

To inform the evaluation of impacts and risks from a major spill, the trajectories and fates of hydrocarbons released from the worst-case credible scenarios were investigated. For condensate spills, Shell commissioned the RPS Group to undertake numerical oil spill modelling for both a LOWC scenario at the platform location and a catastrophic rupture of the export pipeline at a location considered to present the greatest potential for impact to sensitive environmental receptors (RPS 2024b). The modelling used the three-dimensional oil spill trajectory and weathering model, SIMAP (Spill Impact Model Application Package), which is designed to simulate the transport, spreading and weathering of specific oil types under the influence of changing meteorological and oceanographic forces. Table 9-93 summarises the modelled parameters used for each scenario.

SIMAP is the evolution of the United States Environmental Protection Agency (US EPA) Natural Resource Damage Assessment model (French & Rines 1997; French 1998; French et al. 1999) and is designed to simulate the fate and effects of spilled oils and fuels for both the surface slick and the three-dimensional plume that is generated in the water column. SIMAP includes algorithms to account for both physical transport and weathering processes. The latter are important for accounting for the partitioning of the spilled mass over time between the water surface (surface slick), water column (entrained oil and dissolved compounds), atmosphere (evaporated compounds) and land (stranded oil). The model also accounts for the interaction between weathering and transport processes.

To define trends and variations in the potential outcomes, a stochastic modelling process was followed, whereby SIMAP was applied to repeatedly simulate the defined spill scenarios using different samples of

current and wind data selected randomly from historic time series data representative of the study area. Estimates of the net currents were derived by interpolating predictions of the drift currents using the Hybrid Coordinate Ocean Model, created by the National Ocean Partnership Program, with estimates of the tidal currents at local space-scales generated by the three-dimensional hydrodynamic model HYDROMAP. To account for the influence of the wind on surface-bound hydrocarbons, representative wind conditions were derived via wind speed and direction time series data sourced from the National Center for Environmental Prediction Climate Forecast System Reanalysis database over the same temporal coverage as the current data (2010–2019, inclusive). For the subsurface release scenario, nearfield modelling with OILMAP Deep and SINTEF models was used to provide inputs to the stochastic modelling.

At least 100 replicate simulations were completed for the scenarios using stochastic modelling, across three season (summer, winter and transitional – totalling 300 replicate simulations for each scenario) to account for trends and variations in the prevailing forcing-conditions over the study region, which would affect the trajectory and weathering of spilled oil. Results of the repeated simulations were then statistically analysed and mapped to define contours of potential effect around the release point. Three randomly selected deterministic simulations of the worst-case LOWC scenario were also plotted to provide an indication of the likely extent of exposure resulting from a single spill event.

Table 9-93: Condensate Spill Modelling Scenarios

Scenario		LOWC	Subsea Pipeline Rupture
Location	**Latitude**	12° 57′ 52.41″ S	13° 12′ 56.57″ S
	Longitude	124° 26′ 33.24″ E	124° 57′ 16.15″ E
Depth (m)		Surface (15 m radius)	Subsea (196 m deep)
Release		Crux Condensate	Crux Condensate
Duration		80 days	4 hours
Total volume (m^3)		87,077 m^3	1804 m^3
Number of modelled simulations		100 per season, over three seasons (summer, winter and transition)	100 per season, over three seasons (summer, winter and transition)

For potential diesel spills, the Automated Data Inquiry for Oil Spills (ADIOS®) model developed by the National Oceanic and Atmospheric Administration (NOAA) and available via WebGNONE (https://gnome.orr.noaa.gov/) was used to predict the behaviour of a worst-case release involving a vessel collision resulting in 529 m^3 of MDO spilt to sea.

The NERA Reference Case (NERA 2018) on Consequence Analysis for an Accidental Release of Diesel was used to determine the spatial extent potentially affected by a worst-case MDO spill. NERA (2018) evaluates the results of multiple modelling studies (~26,000 simulations) to determine the predicted extent of potential consequences to surface water (to ~10 m depth) environments from oceanic spills of up to 700 m^3 of diesel.

9.14.1.6 Hydrocarbon Impact Thresholds

The interaction of spilled hydrocarbons with environmental receptors can occur via different phases of oil presence in the marine environment, including floating, entrained, dissolved and shoreline contact

Impact thresholds for each phase have been applied to the spill modelling and used to inform the assessment of potential impacts and risks. Table 9-94 describes the thresholds applied. These are aligned to the NOPSEMA Oil Spill modelling Guidance Bulletin (NOPSEMA 2019). The low, moderate and high exposure zones represent ranges of hydrocarbon concentrations, grouped on the basis of scientific knowledge of the potential impacts of the various hydrocarbon phases on environmental receptors (Table 9-94). The low exposure thresholds are used to delineate the Planning Area for oil spill response planning, bound the description of the environment (Section 7) and assess potential socioeconomic and cultural heritage impacts. The moderate and high exposure thresholds were used to define the adverse exposure zone within which ecological impacts may occur in the event of a spill.

Table 9-94: Hydrocarbon Exposure Zones and Thresholds

Exposure Zone	Threshold	Justification
Floating		
Exposure zone Low (1–10 g/m^2)	1 g/m^2	The 1 g/m^2 threshold represents the practical limit of observing hydrocarbon sheens in the marine environment and therefore was used to define the outer boundary of the low exposure zone. This threshold is considered below levels that would cause environmental harm and is more indicative of the areas perceived to be affected due to its visibility on the sea surface. There is also the potential for waxy nodules (residue) to be visible within this low threshold due to the nature of Crux Condensate as it undergoes weathering. This exposure zone represents the area contacted by the spill and defines the conservative outer boundary of the Planning Area from a hydrocarbon spill.
Adverse exposure zone Moderate (10–25 g/m^2)	10 g/m^2	Ecological impact has been estimated to occur at 10 g/m^2 because this level of oiling has been observed to mortally impact birds and other wildlife associated with the water surface (French et al. 1996; French 2000). Contact within this exposure zone may result in impacts to the marine environment.
Adverse exposure zone High (>25 g/m^2)	25 g/m^2	The 25 g/m^2 threshold is above the minimum threshold observed to cause ecological impact. Studies have indicated that a concentration of surface oil ≥25 g/m^2 would be harmful for most birds that contact the hydrocarbon at this concentration (Koops et al. 2004; Scholten et al. 1996). Exposure above this threshold is used to define the high exposure zone.
Shoreline		
Exposure zone Low (10–100 g/m^2)	10 g/m^2	A threshold of 10 g/m^2 has been defined as the zone of potential 'low' exposure. This exposure zone represents the area visibly contacted by the spill and defines the outer boundary of the Planning Area from a hydrocarbon spill.
Adverse exposure zone Moderate (100–1,000 g/m^2)	100 g/m^2	French et al. (1996) and French-McCay (2009) have defined an oil exposure threshold of 100 g/m^2 for shorebirds and wildlife (furbearing aquatic mammals and marine reptiles) on or along the shore, which is based on studies for sublethal and lethal impacts. The 100 g/m^2 threshold has been used in previous environmental risk assessment studies (French et al. 2011; French-McCay 2004; French-McCay 2003; French-McCay et al. 2012; NOAA 2013). This threshold is also recommended in AMSA's foreshore assessment guide as the acceptable minimum thickness that does not inhibit the potential for recovery and below which is best remediated by natural coastal processes alone (AMSA 2015). The indicates 1,000 g/m^2 threshold predicts an area likely to require intensive clean-up effort. Thresholds of 100 g/m^2 and 1,000 g/m^2 will define the zones of potential 'moderate' and 'high' exposure on shorelines, respectively. Contact within these exposure zones may result in impacts to the marine environment and coastal areas. Modelling of zones that fall within these exposure thresholds is based on the loading predicted for the shoreline (10 g/m^2, 100 g/m^2 and 1,000 g/m^2).
Adverse exposure zone High (>1,000 g/m^2)	1,000 g/m^2	
Entrained		
Exposure zone Low exposure (10–100 ppb)	10 ppb	The 10 ppb threshold represents the lowest concentration and corresponds generally with the lowest trigger levels for chronic exposure for entrained hydrocarbons in the ANZG (2018) water quality guidelines. Due to the requirement for relatively long exposure times (>24 hours) for these concentrations to have an observable impact, they are only likely to affect those juvenile fish, larvae and

Exposure Zone	Threshold	Justification
		planktonic organisms that might be entrained (or otherwise moving) within the entrained oil plumes, or if entrained hydrocarbons adhere to organisms or are trapped against a shoreline for periods of several days or more. This exposure zone is not considered to have the potential to result in significant biological impacts. This exposure zone represents the area contacted by the spill and conservatively defines the outer boundary of the Planning Area from a hydrocarbon spill.
Adverse exposure zone Moderate (100–500 ppb)	100 ppb	The 100 ppb threshold is considered conservative in terms of potential for toxic effects leading to death for sensitive individuals and early life stages of species. This threshold represents a potential zone of acute exposure, which is more meaningful over shorter exposure durations. The 100 ppb threshold was selected to define the moderate exposure zone. Contact within this exposure zone is likely to result in impacts to the marine environment.
Adverse exposure zone High (500 ppb)	500 ppb	The 500 ppb threshold is considered a conservative high exposure level in terms of potential for toxic effects leading to death for more tolerant species or habitats. This threshold represents a potential zone of acute exposure, which is more meaningful over shorter exposure durations. The 500 ppb threshold was selected to define the high exposure zone.
Dissolved		
Exposure zone Low (10–50 ppb)	10 ppb	It represents a conservative limit for presence of dissolved oil and can be used to define regions of potential socio-economic impact. Establishes planning area for scientific monitoring based on potential for exceedance of ANZG water quality triggers. It also provides a conservative lower limit at which impacts may occur to sensitive species or life stages.
Adverse exposure zone Moderate (50–400 ppb)	50 ppb	A conservative threshold of 50 ppb was chosen because it is more likely to indicate potentially harmful exposure to sensitive fixed habitats over short exposure durations (French-McCay 2002). French-McCay (2002) predicts that an average 96-hour LC50 of 50 ppb could serve as an acute lethal threshold to 5% of biota. The 50 ppb threshold was selected to define the moderate exposure zone. Contact within this exposure zone is likely to result in impacts to the marine environment.
Adverse exposure zone High (>400 ppb)	400 ppb	A conservative threshold of greater than 400 ppb was chosen as it is more likely to indicate potentially harmful exposure to more tolerant species over short exposure durations (French-McCay 2002). French-McCay (2002) predicts that an average 96-hour LC50 of 400 ppb could serve as an acute lethal threshold to 50% of biota. The 400 ppb threshold was selected to define the high exposure zone.

9.14.1.7 Overview of Modelling Results

Table 9-95 lists the sensitive receptors that modelling indicates may potentially be exposed to hydrocarbons at concentrations at or above adverse exposure thresholds in the unlikely event of a worst-case spill scenario. Additional detail on the results of the modelling for each of the worst-case scenarios is provided in Sections 9.14.1.7.1 to 9.14.1.7.3. The combined Planning Area and extent of the EMBA considered in the evaluation of impacts and risks is described in Section 9.14.1.8.

Table 9-95: Summary of Hydrocarbon Spill Modelling Results for Sensitive Receptors that are Likely to be Contacted At or Above Relevant Impact Thresholds

Receptor Category	Hydrocarbon Phase Above Adverse Exposure Threshold		
	Scenario: LOWC	Scenario: Subsea Pipeline Rupture	Scenario: MDO/ Vessel collision
Australian Marine Parks			
Argo-Rowley Terrace MP	✓	✓	✓
Ashmore Reef	✓	✓	-
Cartier Island	✓	-	-
Kimberley	✓	-	✓
Oceanic Shoals	✓	✓	✓
BIAs			
Marine Turtle	✓	✓	✓
Seabirds	✓	✓	✓
Sharks	✓	✓	✓
Whales	✓	✓	✓
Coastlines			
Browse Island	✓	✓	-
Cartier Island	✓	-	-
Exclusive Economic Zone			
Australian	✓	✓	-
Indonesian	✓	-	-
Heritage Places			
Ashmore Reef	✓	✓	-
Protected Wetlands			
Ashmore Reef	✓	✓	-
Marine Bio-Regions			
Northwest Shelf Province	✓	✓	✓
Northwest Shelf Transition	✓	✓	✓
Timor Sea	✓	✓	✓
KEFs			
Ancient Coastline at 125 m Depth Contour	✓	✓	-
Ashmore Reef and Cartier Island and surrounding Commonwealth Waters	✓	-	-
Carbonate Bank and Terrance System of the Sahul Shelf	✓	-	-

Receptor Category	Hydrocarbon Phase Above Adverse Exposure Threshold		
	Scenario: LOWC	Scenario: Subsea Pipeline Rupture	Scenario: MDO/ Vessel collision
Continental Slope Demersal Fish Communities	✓	✓	-
Reefs, Shoals and Banks			
Ashmore Reef	✓	-	-
Barracouta Shoal	✓	-	-
Eugene McDermott Shoal	✓	-	-
Heywood Shoal	✓	✓	-
Jabiru Shoals	✓	-	-
Johnsons Bank	✓	-	-
Sahul Bank	✓	-	-
State Waters			
WA State Waters	✓	-	-
Authorised Fishery Zones (Commonwealth–Managed Fisheries)			
North-West Slope Trawl	✓	✓	-
Southern Bluefin Tuna	✓	✓	-
Western Skipjack (inactive)	✓	✓	-
Western Tuna and Billfish	✓	✓	-
Authorised Fishery Zones (WA–Managed Fisheries)			
Abalone	✓	✓	-
Broome Prawn	✓	✓	-
Kimberley Crab	✓	✓	-
Kimberley Prawn	✓	✓	-
Mackerel	✓	✓	-
Northern Demersal Scalefish	✓	✓	-
South West Coast Salmon	✓	✓	-
Specimen Shell	✓	✓	-
West Coast Deep Sea Crustacean	✓	✓	-

(✓) Indicates contact predicted by modelling (P>0.01%) at this receptor at or above adverse impact thresholds

(-) Indicates no contact predicted by modelling (P<0.01%) at this receptor at or above adverse impact thresholds

9.14.1.7.1 LOWC (Condensate Release)

Figure 9-18 shows the outer boundary of the geographic area (i.e. Planning Area) that might possibly be affected (probability >0.01) by hydrocarbons, for at least an instant, at the most conservatively low thresholds, given the trends and variations in metocean conditions that occur around the spill location. The maximum distance from the release location to the outer edge of the Planning Area is ~1,248 km towards the west and 672 km towards the southwest. No exposure to the Australian mainland coast was predicted under any of the scenario conditions.

The modelling indicates that high rates of evaporation of the highly volatile mono-aromatic hydrocarbons would occur following a release, reducing the collective mass that is entrained, dissolved or floating. The low viscosity of the remnant composition, combined with the high frequency of wind speeds that would generate sufficient wave energy to entrain the condensate, results in the outer boundaries of the Planning Area being defined by the potential area where entrained oil concentrations, containing lower concentrations of soluble aromatic components, might exceed the low (10 ppb) exposure threshold (Figure 9-17).

The greatest spatial extent of potential for exposure above adverse thresholds would be much smaller (Figure 9-18), with entrained hydrocarbons >100 ppb predicted to be carried up to 412 km southwest, following the prevailing ocean currents. The potential for exposure to floating and dissolved hydrocarbon concentrations above adverse thresholds was restricted to within 43 km and 248 km of the spill site, respectively. Maximum depths of exposure to entrained and dissolved hydrocarbons above these thresholds are predicted to be limited to the surface 25 m and 40 m waters within <50 km of the spill site, respectively.

Floating oil above adverse thresholds is not predicted to contact any emergent features or to reach any BIAs, critical habitats or commercial fishing zones that do not overlap the Activity Area (Section 6). The potential for accumulation of oil to concentrations >100 g/m2 on any shoreline was only predicted (6% probability) for Cartier Island where the maximum predicted volume ashore was 121 m^3.

Several banks/shoals are predicted to be potentially exposed to entrained or dissolved hydrocarbons, although none at high (i.e. >400 ppb) concentrations. Eugene McDermott shoals was shown to have the highest probability of exposure above adverse thresholds, with 52% and 28% for entrained and dissolved hydrocarbons respectively. Browse Island is predicted to be potentially exposed to entrained (3% probability) and dissolved (1% probability) hydrocarbons exceeding adverse thresholds, with Cartier Island also predicted to have a low probability (8%) of exposure to entrained concentrations >100 ppb.

The KEFs, Marine Parks and (turtle and seabird) BIAs associated with the waters surrounding Cartier Island have an up to 30% probability of exposure above adverse thresholds for entrained or dissolved oil. There is also a low probability of entrained and dissolved oil above adverse threshold concentrations intersecting a whale BIA (8% and 1% probability respectively) or of entrained hydrocarbons reaching the waters of the Kimberley Marine Park (1% probability). The worst-case maximum concentration of exposure predicted for any of these receptors is <300 ppb.

The whale shark BIA and the management zones for several commercial fisheries (and for traditional Indonesian fishing) overlap the Activity Area and hence would be exposed to all phases of hydrocarbons in the event of a LOWC event. The deterministic model outputs (Table 9-96) indicate that the exposure above adverse thresholds from any single spill event would likely be restricted to a relatively small proportion of the extent of any of these receptor areas (e.g. ~5.8% of the whale shark BIA exposed to entrained hydrocarbons). There is also a low probability of exposure to entrained (27%) and dissolved (1%) hydrocarbons in the Broome Prawn fishery zone.

The probability that entrained oil at >10 ppb contacts the Indonesia EEZ is 40% and the minimum time to impact the Indonesian EEZ at >10 ppb is 198 hours. No Indonesian or East Timorese coastlines were predicted to be exposed to any hydrocarbons above ecological adverse impact thresholds.

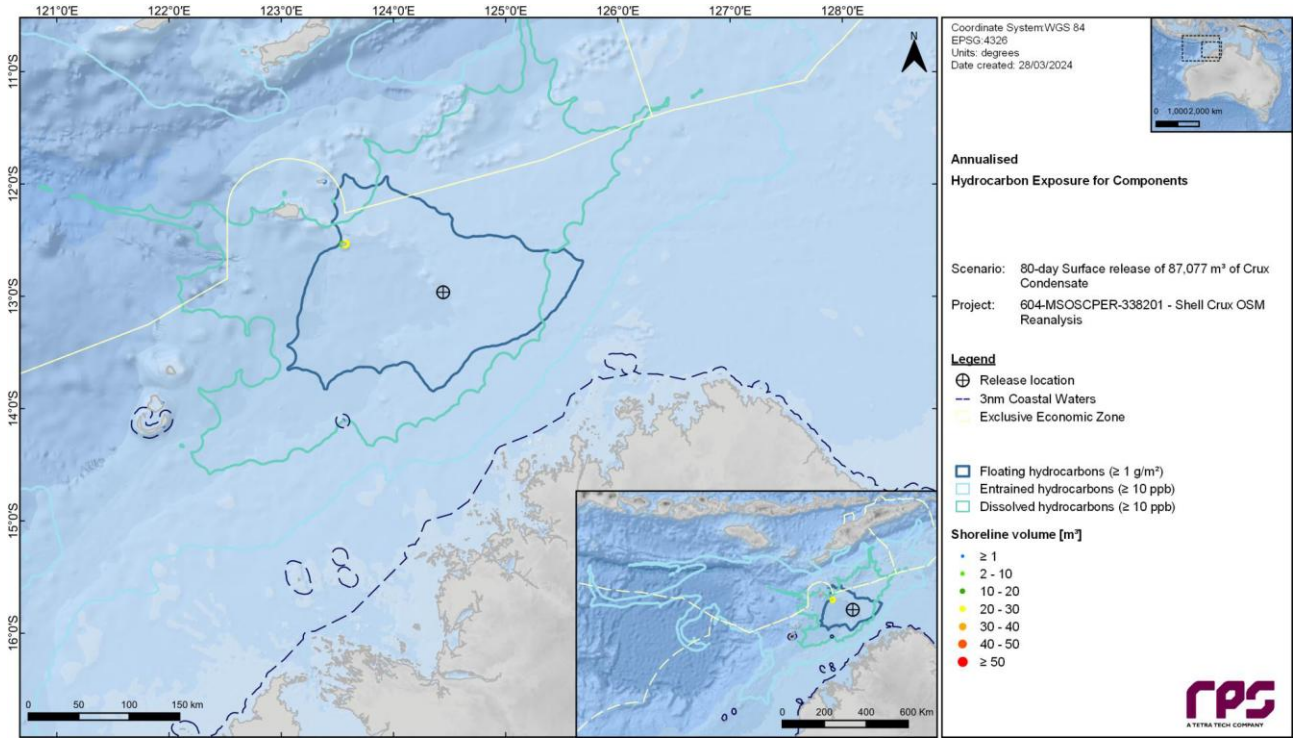


Figure 9-17: Annualised Maximum Extent (Planning Area) of Exposure Above Low Thresholds for Floating, Entrained, Dissolved and Shoreline Hydrocarbons for an 80-day LOWC Release of Crux Condensate

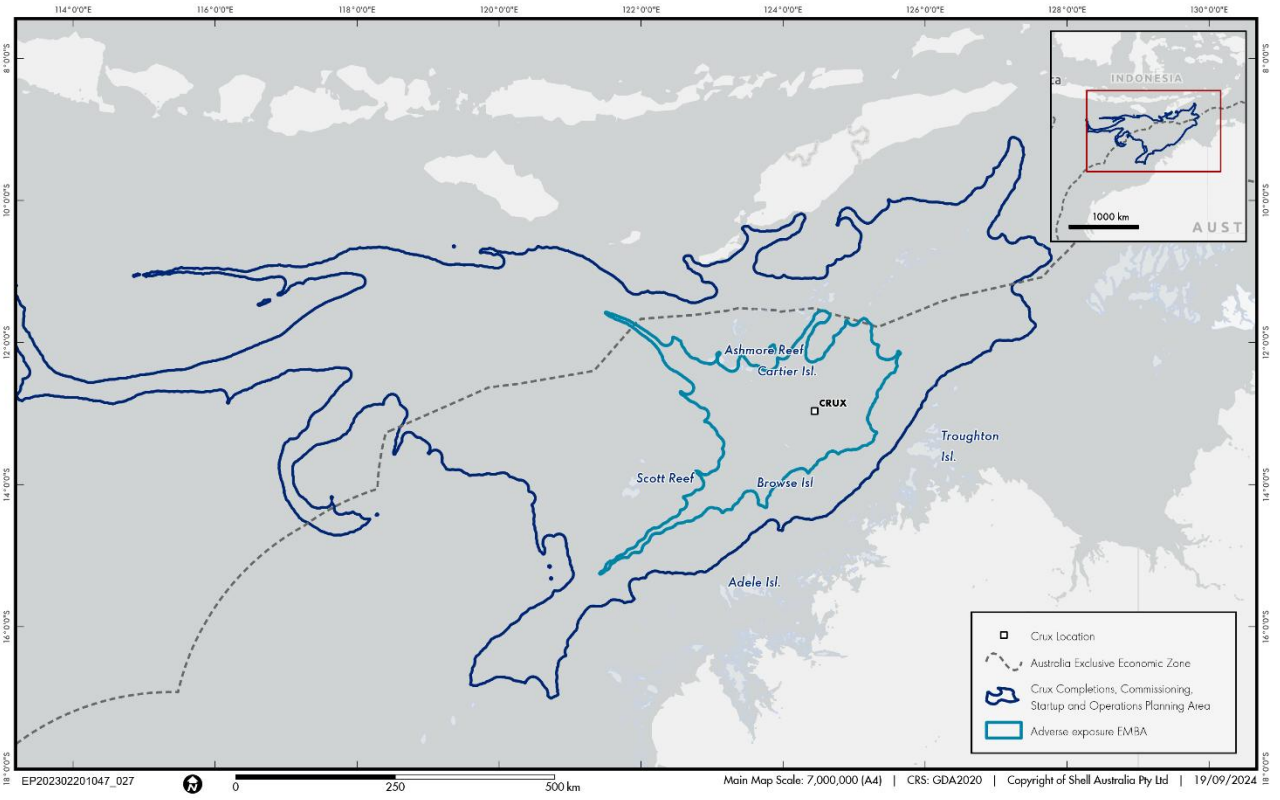


Figure 9-18: Planning Area and Adverse Exposure EMBA from an 80-day LOWC Release of Crux Condensate

9.14.1.7.2 Subsea Pipeline Rupture (Condensate Release)

Figure 9-19 shows the outer boundaries of the geographic area that may be affected (probability >0.01) at the most conservatively low thresholds in the event of a worst-case pipeline rupture, given the seasonal variations on metocean and climatic conditions that occur around the spill location. The predicted (modelled) maximum distance from the spill location to the edge of the spill is 330 km towards the northwest and 266 km towards the northeast. Modelling showed no impact to the Australian mainland coastline under any conditions.

Upon release, a vertical plume is forecast to rise towards the water's surface, gradually slowing and increasing in plume diameter as more ambient water is entrained. The modelling indicates that the plume would rise the full distance to the water's surface, where the diameter of the plume at surface was calculated at ~13 m. High rates of evaporation of highly volatile mono-aromatic hydrocarbons would occur at surface, resulting in a reduction of overall mass and spread of hydrocarbons that are entrained, dissolved or floating. The outer boundaries of the Planning Area are defined by the potential area where entrained oil concentration might exceed the low (10 ppb) exposure threshold.

The greatest extent for potential exposure above adverse thresholds would be much smaller with entrained hydrocarbons (>100 ppb) predicted to be carried a maximum of 170 km southwest, following prevailing ocean currents, and floating and dissolved hydrocarbons above adverse exposure concentrations restricted to within 58 km and 137 km respectively of the release location. Beyond the immediate spill site, the maximum depths of exposure to entrained and dissolved hydrocarbons above these thresholds are predicted to be limited to the surface waters up to ~25 m depth within ~25 km from the spill location.

Floating oil above adverse thresholds is not predicted to contact emergent features or to reach any critical receptors including BIAs and habitats outside of the Activity Area. Cartier Island is the only shoreline predicted to potentially have oil accumulate above the adverse exposure threshold, with a very low (1%) probability of shoreline concentrations >100 g/m^2. Minimum predicted time for this exposure was >120 hours and average maximum accumulated volumes low (<1 m^3).

Heywood Shoal is the only reef, shoal, bank or island predicted to have a >1% probability of exposure to entrained and dissolved hydrocarbons above adverse exposure concentrations, with a 3.5% probability of entrained hydrocarbons >100 ppb.

The whale shark BIA, Continental slope demersal fish communities KEF and commercial fishery management zones (including traditional Indonesia fishing) that overlap the Activity Area are predicted to have low (<10%) to moderate (~50%) probabilities of exposure to entrained hydrocarbons above adverse thresholds for entrained hydrocarbons, with the seabird BIA surrounding Cartier Island Marine Park (8.5% probability) and the Broome Prawn fishery zone also potentially contacted by entrained concentrations >100 ppb. Only the whale shark BIA (6.5% probability) and fishery zones (18.5% probability) would potentially be exposed to dissolved hydrocarbons above adverse thresholds.

The probability of entrained oil at >10 ppb contacting the Indonesian EEZ is very low (<3%) with a minimum travel time of 142 hours. No hydrocarbons above ecological adverse impact thresholds are predicted to reach any Timorese or Indonesian waters or coastlines under any conditions.

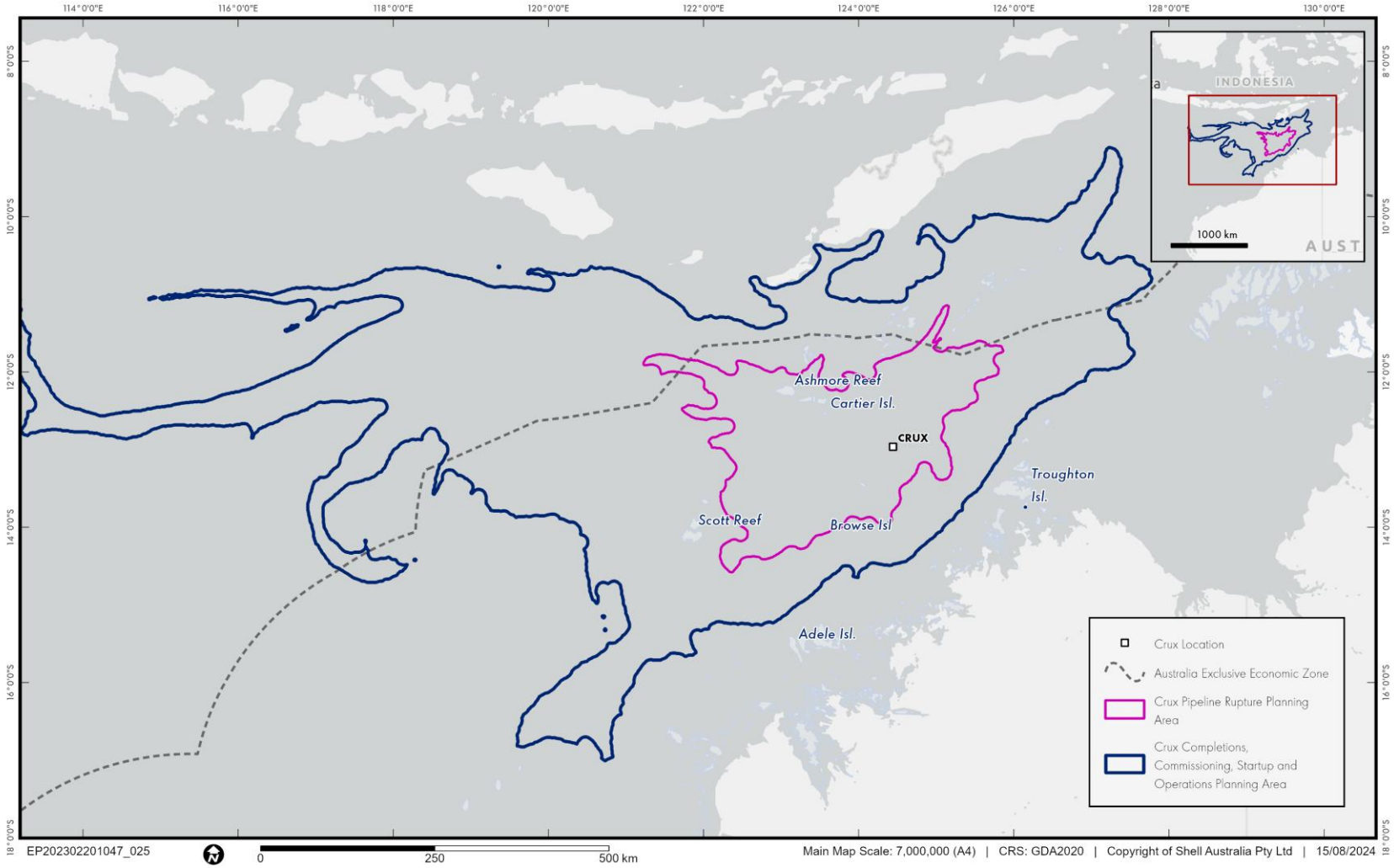


Figure 9-19: Annualised Subsea Pipeline Rupture Planning Area (Overlaid on LOWC Planning Area)

9.14.1.7.3 LOC (MDO)

Figure 9-20 shows the ADIOS-predicted oil budget for an instantaneous loss of 529 m^3 of MDO in the Activity Area with a 10-knot wind. After 36 hours, 268 m^3 is predicted to be removed from the sea surface through evaporation, 259 m^3 disperses naturally into the water column, a small amount (~2 m^3) is lost to sedimentation, leaving nothing on the surface.

Based on the analysis of results from numerous MDO simulations, NERA 2018 (RC 1003, Consequence analysis of an accidental release of diesel, 2018) concludes that a diesel release volume of up to 700 m^3 is likely to result in no impact above thresholds to surface receptors beyond 150 km (spatial extent) from the source. Figure 9-21 shows the maximum expected extent of potential consequences for a vessel collision spill based on modelling of spills of up to 700 m^3 of MDO (NERA 2018) compared with the maximum extent of impact threshold exceedance predicted by the modelling of a worst-case LOWC scenario. Given the high evaporation rates for surface spills of MDO, the warm air and sea temperatures in the Activity Area and the smaller maximum credible MDO release volume from vessels associated with the activity, the spatial extent of an MDO spill due to vessel collision during the operations covered by this EP is expected to fall well within the LOWC Planning Area. A PMST search over the area within the full 150 km spill extent for a 700 m^3 MDO release did not identify any environmental receptors additional to those that occur within the LOWC Planning Area.

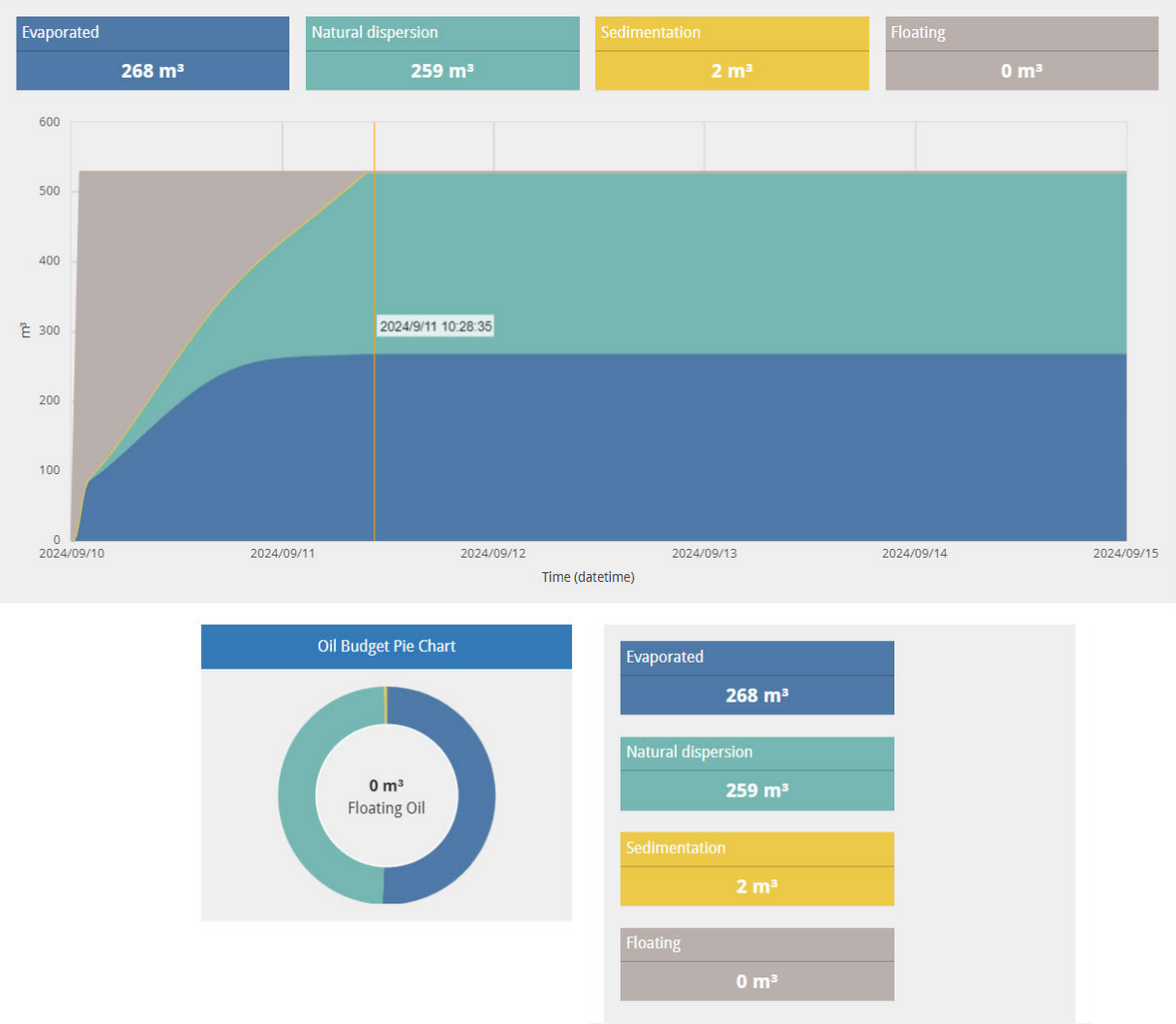


Figure 9-20: Oil Spill Budget for 529 m^3 instantaneous release (1 hour) of Marine Diesel Oil with Wind at 10 Knots Over a 5-day Weathering Period[101]

[101] Source: WebGNOME (WebGNOME (noaa.gov))

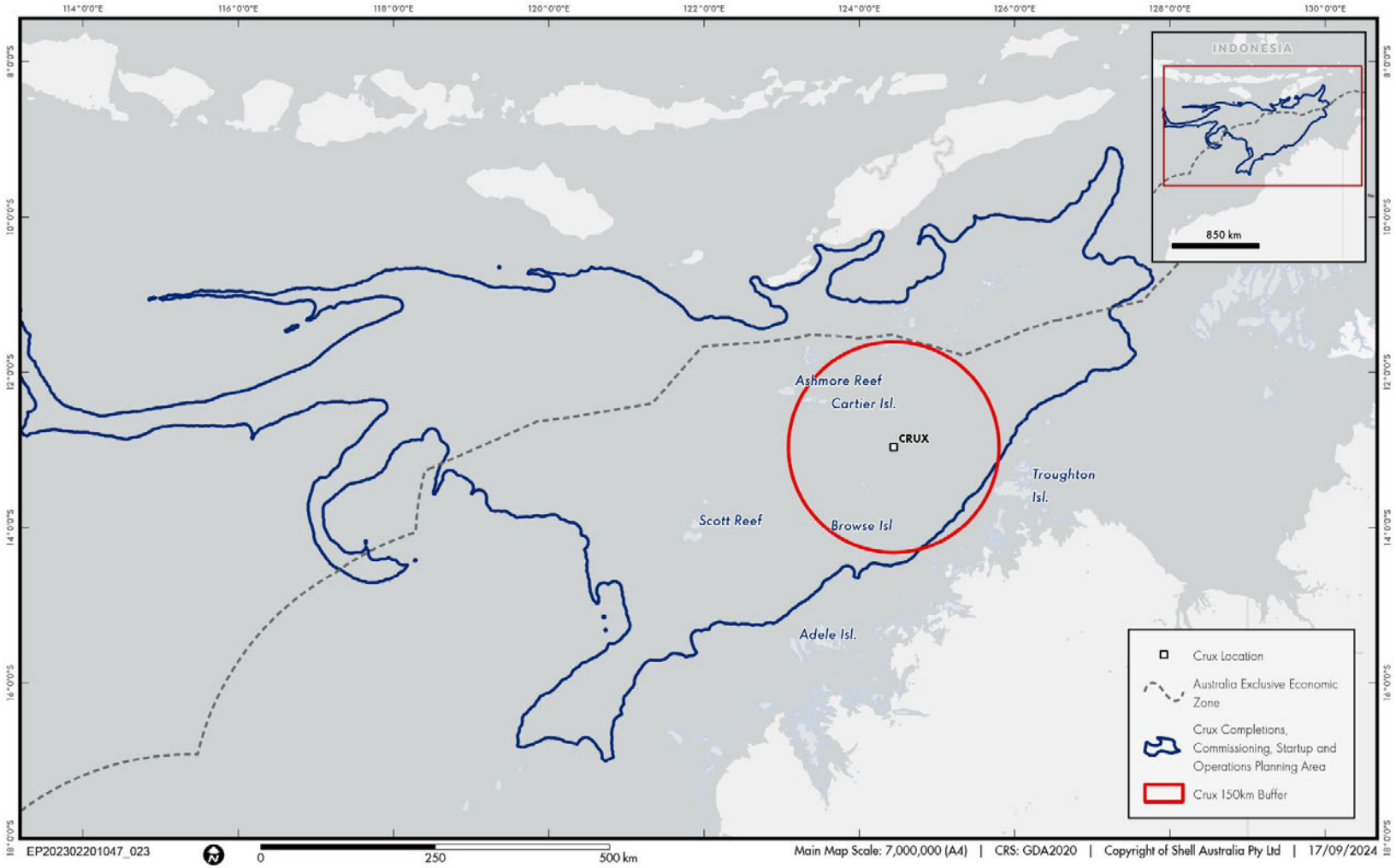


Figure 9-21: MDO spill (700 m^3) Planning Area[102] (overlaid on LOWC Planning Area)

[102] Source: NERA Reference Case (NERA 2018) on Consequence Analysis for an Accidental Release of Diesel

Given that the worst-case release volume for the activities covered by this EP is substantially smaller than 700 m^3, the area (and receptors) potentially affected by an MDO spill is expected to fall within the spatial extent of the Planning Area (based on the worst-case LOWC spill scenario).

9.14.1.8 Determination of Planning Area and Receptors at Risk of Impact

The modelling results indicate that the 80-day LOWC scenario would generate the largest spatial exposure to hydrocarbons and potentially affect the greatest number of sensitive receptors. Accordingly, the area that the stochastic modelling indicates may be exposed to any hydrocarbons above low impact thresholds in the event of a worst-case LOWC scenario has been used to determine the Planning Area for the activity (Figure 7-1).

Table 9-96 lists the sensitive receptors within the Planning Area that modelling indicates may potentially be exposed to surface, entrained, dissolved or shoreline hydrocarbons at concentrations at or above adverse exposure thresholds, and the respective probabilities of exposure, in the unlikely event of a worst-case spill scenario. Figure 9-22 shows the spatial extent of the EMBA for each of these hydrocarbon phases.

The Planning Area and extent of the respective EMBAs, and associated probabilities of exposure for various receptors predicted by the stochastic modelling, has been considered in the evaluation of impacts and risks in Section 9.14.2. Shell considers all environmental receptors identified as potentially (P >0.01) being contacted, regardless of the likelihood. This will identify more receptors than would be impacted by a given release, and hence it is environmentally conservative. It is important to recognise that the stochastic modelling outputs represent the combined exposures of 300 separate spill simulations. The area affected by any one spill is much smaller – Figure 9-23 provides an example of the predicted exposure above adverse thresholds for each of the hydrocarbon phases that would result from a representative single spill.

Table 9-96: Receptors Predicted to be Exposed to Adverse Threshold Hydrocarbon Concentrations in a Worst-case Spill

Receptor	Probability of Exposure (%) at Adverse Threshold			
	Floating	Shoreline	Entrained	Dissolved
Australian Marine Parks				
Ashmore Reef	-	-	2	-
Cartier Island	-	6	10	1
Kimberley	-	-	1	-
Oceanic Shoals	-	-	-	-
BIAs				
Marine Turtle	-	6	16	1
Seabirds	-	6	30	7
Sharks	100	-	100	100
Whales	-	-	8	1
Coastlines				
Browse Island	-	-	3	1
Cartier Island	-	6	8	-
Exclusive Economic Zones				
Australian	100	-	100	100
Indonesia	-	-	4	2
Heritage Places				
Ashmore Reef	-	-	2	-
Protected Wetlands				
Ashmore Reef	-	-	2	-

Receptor	Probability of Exposure (%) at Adverse Threshold			
	Floating	Shoreline	Entrained	Dissolved
KEFs				
Ancient Coastline at 125 m Depth Contour	-	-	-	-
Ashmore Reef and Cartier Island and Surrounding Commonwealth Waters	-	6	10	1
Carbonate Bank and Terrace System of the Sahul Shelf	-	-	24[1]	6[1]
Continental Slope Demersal Fish Communities	-	-	29[1]	7[1]
Reefs, Shoals and Banks				
Ashmore Reef	-	-	1	-
Barracouta Shoal	-	-	15[1]	-
Eugene McDermott Shoal	6[2]	-	52	28
Goeree Shoal	29[2]	-	-	-
Heywood Shoal	-	-	47[1]	9[1]
Jabiru Shoals	-	-	1[1]	1[1]
Johnson Bank	-	-	2[1]	-
Sahul Bank	-	-	3	-
Woodbine Bank	-	-	2[1]	-
Vulcan Shoal	4[2]	-	-	13
State Waters				
WA State Waters	-	-	1	1
Authorised Fishery Zones (Commonwealth-managed Fisheries)				
North-West Slope Trawl	16	-	88	48
Southern Bluefin Tuna	100	-	100	100

Receptor	Probability of Exposure (%) at Adverse Threshold			
	Floating	Shoreline	Entrained	Dissolved
Western Skipjack Tuna	100	-	100	100
Western Tuna and Billfish Fishery	100	-	100	100
Authorised Fishery Zones (WA-managed Fisheries)				
Abalone	100	-	100	100
Broome Prawn	-	-	27	9
Kimberley Crab	100	-	100	100
Kimberley Prawn	100	-	100	100
Mackerel	100	-	100	100
Northern Demersal Scalefish	100	-	100	100
South West Coast Salmon	100	-	100	100
Specimen Shell	100	-	100	100
West Coast Deep Sea Crustacean	100	-	100	100

(-) Indicates no contact predicted by modelling (P<0.01%) at this receptor at or above adverse impact thresholds

[1] Indicates contact at or above adverse impact thresholds at depth of this receptor not confirmed by modelling

[2] Indicates modelling shows floating hydrocarbons pass over but will not contact submerged receptor

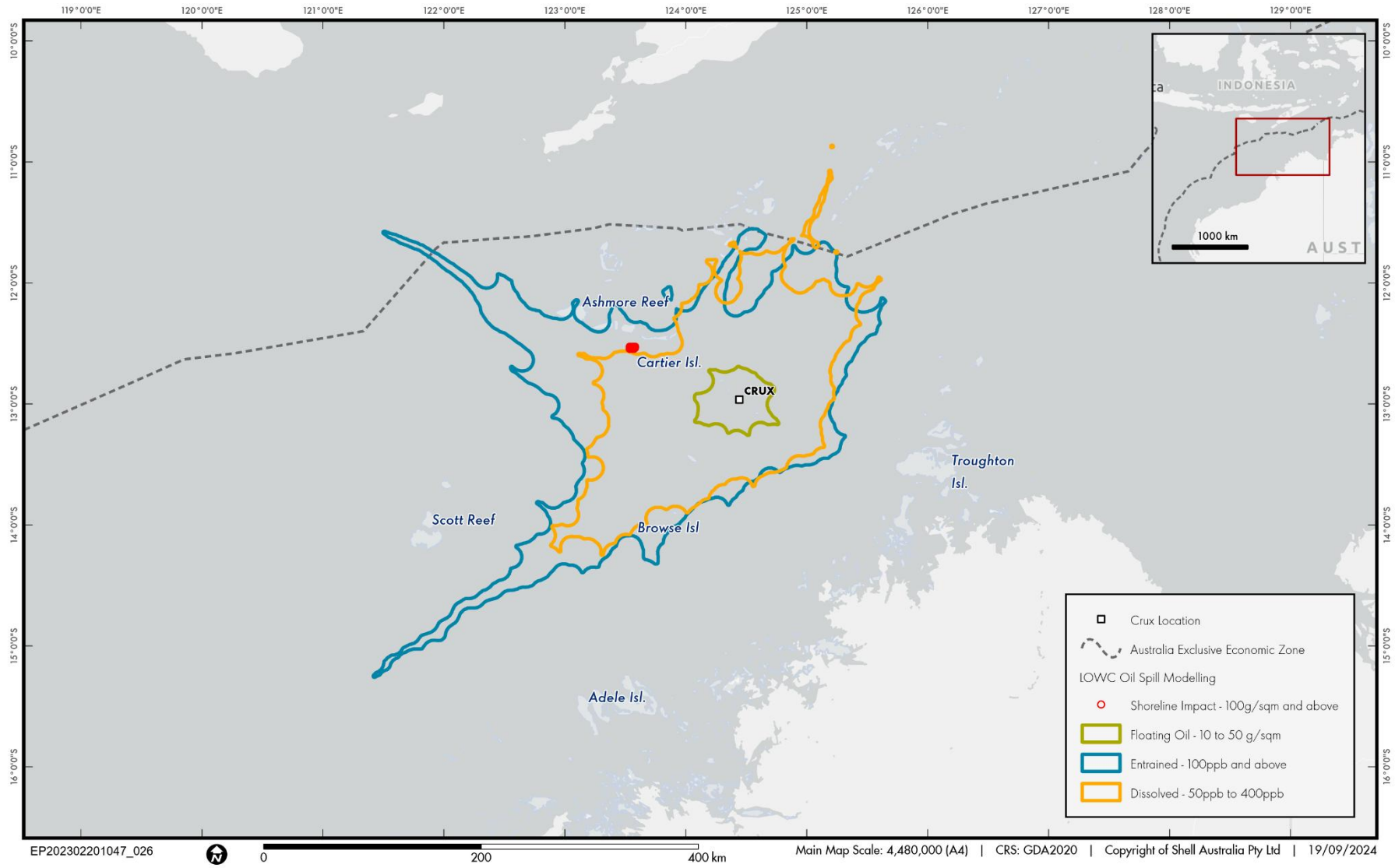


Figure 9-22: Annualised EMBA for Adverse Exposure Thresholds of the Worst-case LOWC Scenario

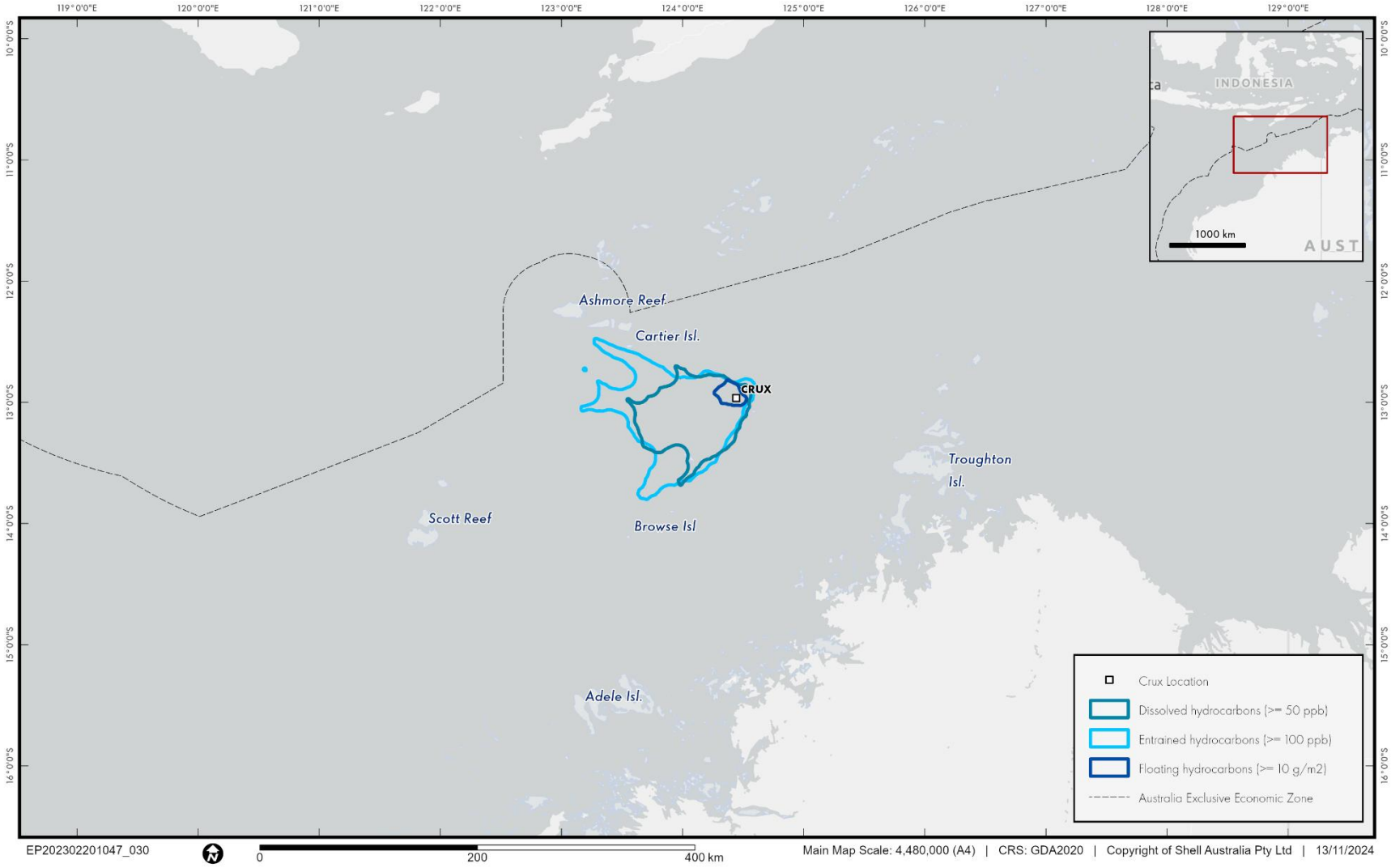


Figure 9-23: Extent of Exposure Above Adverse Thresholds (EMBA) for Floating, Entrained, Dissolved and Shoreline Hydrocarbons from a Single 80-day LOWC Release (Deterministic Simulation)

9.14.2 Description and Evaluation of Impacts and Risks

Table 9-97 indicates the environmental features and values and sensitivities that have been identified to be potentially affected by a worst-case spill scenario during the Activities covered by this EP, with further evaluation of the impacts and/or risks to each potentially affected receptor category provided in Sections 9.14.2.1 to 9.3.2.4. Features or values and sensitivities which could not be credibly affected are not discussed further.

Table 9-97: Emergency Events Receptor Impact Screening Summary

	Protected Areas			Features																Values and Sensitivities																											
				Physical		Natural				Socioeconomic								Heritage and Cultural			Physical				Natural							Socioeconomic								Heritage and Cultural						
Aspect	**Receptor**	Marine Conservation Reserves	Wetlands of International and National Importance	Commonwealth and National Heritage Places	Marine Regions	Australian Environment	Northwest Shelf Province Bioregion	Northwest Shelf Transition Bioregion	Northwest Transition Bioregion	Timor Province Bioregion	People and Communities	Fishing Industry	Tourism and Recreation	Defence	Shipping	Scientific Research/Restoration	Oil and Gas Industry	Indonesian and Timor-Leste Coastlines	Underwater Cultural Heritage	Traditional Indonesian Fishing	Indigenous Cultural Connections	Air Quality	Water Quality	Sediment Quality	Underwater Noise	BIAs	Critical Habitat	Shoals and Banks	Offshore Reefs and Islands	Coastal Reefs and Islands	KEFs	Threatened, Migratory, Marine and Cetacean Species	Fishing Industry	Tourism and Recreation	Defence	Shipping	Scientific Research/Restoration	Oil and Gas Industry	Indonesian and Timor-Leste Coastlines	Underwater Cultural Heritage	Traditional Indonesian Fishing	Indigenous Cultural Heritage

Legend:		
		Potentially affected
	×	Predicted impact

9.14.2.1 Protected Areas

9.14.2.1.1 Marine Conservation Reserves

Modelling of a worst-case condensate spill indicates that Cartier Island marine park would potentially (6% probability) be exposed to shoreline oiling, with a low probability of exposure to entrained hydrocarbons also predicted at Ashmore Reef (probability 2%) and Kimberley (probability 1%) marine parks. No exposure to floating oil above adverse thresholds is predicted for any marine conservation reserves.

Worst-case maximum concentrations of hydrocarbon exposure are relatively low (e.g. <180 ppb entrained at Cartier Island marine park) and minimum transport timeframes relatively long (>300 hours) suggesting significant weathering would have occurred and the magnitude of impacts to the environmental values of these marine parks are likely to be limited.

9.14.2.1.2 Wetlands of International and National Significance

Ashmore Reef is the only wetland of international (Ramsar) or national importance within the Planning Area (Table 7-16). There are migratory bird species associated with this Ramsar site that may be particularly vulnerable to floating and entrained oil and any resulting accumulations of oil along shorelines. However, the modelling shows there is no contact by floating films of oil and a low (2%) probability of exposure to entrained hydrocarbons above adverse thresholds at this site in the event of a worst-case LOWC incident. No shoreline accumulations above adverse threshold are predicted by the modelling.

Ashmore Reef is located ~128 km from the Crux Platform and the modelling indicates that there would be an extended period (>7 weeks) until exposure above the moderate entrained threshold concentration. This suggests that the residues arriving at the site would be substantially weathered, and the maximum entrained levels predicted to occur under any conditions would be relatively low (117 ppb). The likelihood of widespread and/or significant adverse effects to the values of this wetland site is therefore low.

9.14.2.1.3 Commonwealth and National Heritage Places

Ashmore Reef National Nature Reserve is the only Commonwealth Heritage Place predicted to be exposed to oil above adverse exposure thresholds in the event of a worst-case spill, with a low probability of contact by entrained (2% probability) hydrocarbons. Worst-case maximum concentrations of entrained oil in the unlikely event of exposure were relatively low (117 ppb) and the minimum time following a spill to exposure above adverse thresholds is predicted to be >1,000 hours.

Ashmore Reef National Nature Reserve's heritage values relate to it's natural features (see Table 7-6), including breeding and foraging habitat for marine turtles and a small population of dugong (DCCEEW 20023ae) as well as providing an important staging and feeding area for many migratory shorebirds (Environment Australia 2002). Potential impacts to these natural features and values are discussed under the relevant sections below.

The residual risk to protected areas is ranked Dark Blue (see Table 9-98).

9.14.2.2 Physical Features

9.14.2.2.1 Marine Regions

The Planning Area is situated entirely within the NWMR. This region extends along the WA-NT border down to Kalbarri, Western Australia, encompassing an area of ~1,067,731 km^2. The region is characterised by shallow-water tropical marine ecosystems and is home to globally significant populations of internationally threatened species.

The key physical features of the NWMR (Section 7.4.1) that may be affected by hydrocarbons are generally associated with the seafloor and, apart from shallow reefs/shoals/banks (assessed in Sections 9.14.2.5.3 and 9.14.2.5.4) are at depths that preclude significant exposure to the surface and near-surface (<40 m depth) hydrocarbon plumes that would result from a worst-case spill scenario during the activity. In the event of a subsea pipeline rupture there is the potential for impact to substrate features within the immediate vicinity of the pipeline as the condensate is released under pressure, but these impacts are predicted to be of short duration and highly localised.

The deterministic modelling outputs indicate that the spatial extent of exposure above adverse impact thresholds from a single spill event would involve an area of ~1.3% of the NWMR. This could potentially result

in adverse effects across a number of features within the area affected. However, most impacts are expected to be short lived in duration and most features are expected to recover rapidly post-spill.

The residual risk to physical features is ranked Dark Blue (see Table 9-98).

9.14.2.3 Physical Values and Sensitivities

9.14.2.3.1 Air Quality

The environment around the Crux Platform is largely free of industrial air pollution with the main sources of pollutants being commercial shipping, other (e.g. fishing) vessels and oil and gas industry activities located nearby (see reference Air Quality). In the event of a worst-case spill there would likely be a localised, temporary impact to air quality within the area affected. This would include the temporary gas plume from a release of Crux production fluids and the evaporation into the atmosphere of the volatile hydrocarbons within a surface slick. This is likely to result in reduced air quality at and above the ocean surface which could pose a risk to air breathing fauna that remained within the area affected, as well as a human health and safety risk. Significant adverse effects on air quality are likely to be restricted to the immediate vicinity of the release, with a gas plume and/or evaporated hydrocarbons expected to disperse rapidly in the open, offshore environment of the Activity Area.

Given the localised and temporary nature of impacts on air quality and the rapid recovery to ambient quality once the source of impact ceased, the consequences for air quality in the Activity Area and/or surrounding region are considered to be limited.

9.14.2.3.2 Water Quality

A worst-case spill of oil would affect water quality within the resulting plume, notably through the dispersion and dissolution of hydrocarbons into the water column as well as the introduction of other constituents of the oil, including metals. The physical presence of the surface slick may also cause changes in water quality indirectly, such as through reduction in light penetration and oxygen levels, and/or as a result of subsequent changes in biotic activity, such as increased microbial activity associated with biodegradation of the oil. Given the nature of the oils that might be released during an emergency event, the greatest potential for adverse changes to water quality, in intensity, spatial extent and environmental implications, relates to hydrocarbons.

Light oils such as Crux condensate have a high proportion of aromatic hydrocarbon compounds (e.g. BTEX, naphthalenes) which are highly volatile, evaporating rapidly on release to the sea surface but also dissolving readily either at the surface or following entrainment of fresh oil into the water column. This process would be ongoing for the duration of the release in the immediate vicinity of the platform, but more temporary at other locations due to the dynamic nature of the resulting surface and subsurface oil distributions. The modelling indicates that in the event of a worst-case LOWC, maximum dissolved hydrocarbon concentrations could reach 1285 ppb near the release point (approaching the ANZG 80% species protection DGV for the soluble aromatic hydrocarbon benzene of 1300 ppb). These concentrations would reduce with depth and with distance from the release point, with the modelling indicating concentrations of dissolved hydrocarbons >400 ppb would be limited to surface waters <25 m depth and would fall below 50 ppb (comparable to the 99% species DGV for naphthalene) beyond ~40 m water depth in the area within ~50 km of the spill site. Isolated areas of dissolved hydrocarbon concentrations >50 ppb could occur up to ~250 km from the spill site.

There is no specific ANZG DGV for entrained oil, however the modelling results indicate entrained concentrations in the water column would reduce to below the designated adverse exposure thresholds within ~415 km of the platform under all conditions modelled. No effects above this threshold were predicted for waters >25 m depth under any conditions from a worst-case LOWC.

Due to the low persistence of the oils that might be released during the activity, water quality would be expected to return to pre-existing conditions soon after the release stopped.

9.14.2.3.3 Sediment Quality (Seabed)

Regional sediment quality is not expected to be significantly affected by any of the worst-case spill scenarios. Elevated levels of water column hydrocarbons (e.g. BTEX, PAHs) that may occur in the vicinity of a surface release are unlikely to reach the seabed due to the water depth at the release location and low natural sedimentation rates in the region. A worst-case subsea release (pipeline rupture) may contaminate sediments by advective transport of the plume that will be formed during the release (Romero et al. 2015). However, given the highly buoyant nature of Crux condensate, the tendency of the pressurised gas mixture release to

physically drive adjacent sediments away from the rupture point, and the relatively short duration (4 hours) of the release, any resulting contamination will likely be highly localised around, and down-current from the rupture.

Modelling of a worst-case LOWC indicates that there is a low probability that Cartier Island could be exposed to surface hydrocarbons, and that other coastlines and/or shallow subtidal features might be exposed to low levels of hydrocarbons that could strand on sediments. However, generally the concentrations involved are low and timeframes to exposure relatively long, suggesting this would likely involve lower-toxicity weathered residual hydrocarbons.

The residual risk to physical values and sensitivitties is ranked Yellow (see Table 9-98).

9.14.2.4 Natural Features

9.14.2.4.1 Marine Bioregions

Marine bioregions (see Figure 7-6) that fall within the area of potential exposure to hydrocarbons above adverse thresholds include:

- Northwest Shelf Province Bioregion.
- Northwest Shelf Transition Bioregion.
- Timor Province Bioregion.

The likely impacts of a worst-case spill on the features within these bioregions that are potentially susceptible to adverse effects from hydrocarbons are detailed below.

Benthic and Demersal Communities

Benthic and demersal communities would be buffered from the potential effects of surface hydrocarbons by the water column above them. The modelling of a worst case spill scenario indicates that entrained and dissolved hydrocarbons would also not reach the seabed, except in the shallow waters associated with shoals and banks (discussed in Section 7.7.3) or reefs and islands (Sections 7.7.4 and 7.7.5).

A subsea pipeline rupture might expose benthic and/or demersal communities adjacent and immediately down current of the release location to oil droplets in the gas and condensate plume, but this is expected to be highly localised and for a short duration (i.e. 4 hours). Benthic surveys within the Crux development area recorded a very low microbenthic fauna abundance (AECOM 2017) and reported that the benthic habitats in the area do not support the highly diverse benthic communities characteristics of shoals and banks within the region. It is recognised that the AECOM (2017) sampling was limited and may not have captured areas of higher abundance/diversity benthic fauna that may be subject to acute and chronic toxic effects from exposure to hydrocarbons. However, potential impacts are expected to be localised to the vicinity of the release and the extent of affected habitat to represent a very small proportion of similar habitat in the region.

Many benthic fauna species (e.g. corals, echinoderms, sponges etc.) have planktonic larval phases. Organisms with planktonic larval phases typically produce very high numbers of larvae. A worst-case credible spill may result in increased mortality of planktonic larvae (which are subject to high natural mortality); however, this is not expected to result in population-scale impacts.

A small section of the pipeline traverses the Continental slope demersal fish communities KEF, and in the unlikely event of a rupture in this part of the pipeline the associated fish communities could be exposed to condensate – this is discussed in Section 9.14.2.5.5.

Pelagic Communities

Pelagic communities in the EMBA for a worst-case spill scenario include planktonic communities and pelagic fish and invertebrates. EPBC Act listed species of fish (including sharks and rays) are discussed in Section 9.14.2.5.6.

Within the waters of the bioregions potentially affected by a worst-case spill scenario there are a range of phytoplankton and zooplankton. Direct contact with hydrocarbons, particularly the aromatic compounds present in unweathered condensate, has the potential to cause short-term acute toxic effects to these organisms. Planktonic communities are characterised by relatively rapid turnover rates of short-lived biota. The high turnover rate will lead to rapid recovery as the spilled hydrocarbons decay in the environment as a result of weathering and biodegradation processes. Within plankton communities, there is evidence from

laboratory studies that some taxonomic groups, particularly zooplankton (e.g. copepods) may be more sensitive to hydrocarbon pollution (Almeda et al. 2013; Jiang et al. 2010). Ichthyoplankton, including that associated with SBT spawning, may also be more susceptible to impacts (see below) although the proportion of the SBT spawning ground (Section 7.6) potentially exposed to adverse concentrations of hydrocarbons is very low. Few reliable studies have shown any impacts of hydrocarbon spills on planktonic communities, with most studies concluding that impacts from hydrocarbon pollution cannot be distinguished from natural variability (Abbriano et al. 2011; Davenport et al. 1982; Varela et al. 2006).

The concentrations of toxic hydrocarbons in the water column will decrease with time and distance from release due to processes such as dispersion, dilution, physical and biological degradation, and evaporation. For short duration release scenarios (e.g. diesel from a vessel collision), these processes will begin to reduce the total amount of hydrocarbons in the water column shortly after the release, limiting the duration of potential effects on pelagic communities. The worst-case LOWC will continue to release fresh hydrocarbons into the waters surrounding the platform for the duration of the release, but these will be subject to rapid evaporation and degradation such that elevated concentrations, particularly of aromatic components, are unlikely to be persistent at any location further away.

Stochastic modelling results indicate that hydrocarbons are likely to be concentrated in surface waters of <40 m depth. As a result, demersal fish are unlikely to be directly affected unless near a subsea release (see above), and pelagic fish are more likely to encounter dissolved and entrained hydrocarbons above adverse exposure thresholds. Fish respire through gills, which makes them more vulnerable to dissolved hydrocarbons than air-breathing fauna, such as cetaceans, marine reptiles and birds. Despite this apparent vulnerability, significant fish mortalities are rarely observed to occur because of hydrocarbon spills (Fodrie and Heck 2011; International Tanker Owners Pollution Federation 2011b), although instances of fish mortality from spills in confined areas (e.g. bays) have been recorded. These observations may be consistent with fish moving away from hydrocarbons in the water (Hjermann et al. 2007).

Exposure of fish to hydrocarbons may result in acute and chronic effects which would vary depending on a range of factors such as exposure duration and concentration, life history stage, inter-species differences and other environmental stressors (Westera and Babcock 2016). Environmental monitoring of pelagic and demersal fishes immediately following the Montara oil spill indicated that fish were exposed to hydrocarbons, although no adverse effects were detected (Gagnon and Rawson 2012, 2011). Further sampling and testing over time indicated that fish captured in close proximity to the Montara wellhead were comparable to those collected from reference sites (Gagnon and Rawson 2012, 2011).

Most marine fish species produce very high numbers of eggs, which then undergo a planktonic larval development phase. Early life history stages of fish (planktonic eggs and larvae) may be more vulnerable to hydrocarbon pollution than juvenile and adults, as these early life history phases cannot actively avoid water with high concentrations of hydrocarbons. Fish embryos and larvae may exhibit genetic and developmental abnormalities from long-term exposure to low concentrations of hydrocarbons (Fodrie and Heck 2011), although such long exposures may not be representative of real-world conditions. PAHs have also been linked to increased mortality and stunted growth rates of early life history (pre-settlement) of reef fishes, as well as behavioural impacts that may increase predation of post-settlement larvae (Johansen et al. 2017). Given the temporal and spatial scale of the worst-case credible spill scenarios (as shown by a single deterministic run), and the typically high supply of eggs and larvae, it is unlikely that any of the worst-case credible spill scenarios will result in significantly reduced recruitment of fish due to impacts during early life history phases. This conclusion is supported by studies of fish stocks following large-scale hydrocarbon spills, which have shown relatively little evidence of reduced recruitment at the scale of fish stocks/populations (Fodrie and Heck 2011).

The residual risk to natural features is ranked Dark Blue (see Table 9-98).

9.14.2.5 Natural Values and Sensitivities

9.14.2.5.1 BIAs

The Whale Shark BIA overlaps the Activity Area and hence would be exposed to any spill releases. The modelling for a worst-case LOWC indicates a low to moderate probability that BIAs outside the Activity Area may be exposed to hydrocarbon concentrations above adverse impact thresholds, including BIAs for birds (30% probability for entrained exposure), marine turtles (16% probability for entrained exposure) and whales (8% probability for entrained exposure). The BIAs likely to be impacted by a LOWC spill are discussed under the relevant species-specific sections below.

9.14.2.5.2 Critical Habitats

There are no critical habitats listed on the Register of Critical Habitats within the Planning Area (Appendix F). However, the recovery plan for marine turtles (CoA 2017b) identifies areas considered to represent critical habitat for internesting activity in green turtles that the modelling indicates may be affected in the event of a worst case LOWC scenario. Specifically, the modelling shows a low probability of exposure to entrained (16%) and shoreline accumulated (6%) hydrocarbons above adverse thresholds at the nesting/internesting habitats at/around Cartier Island and at Browse Island (3% probability of entrained exposure). Section 9.14.2.5.6 describes the potential impacts from oil exposure in marine turtles.

9.14.2.5.3 Shoals and Banks

The Timor Sea region contains numerous named shoals and banks, including over 21 that fall within the Planning Area. The modelling indicates that 8 shoals and banks (Barracouta, Goeree, Eugene McDermott, Echuca, Heywood, Sahul, Jabiru, Johnson and Woodbine) might be exposed to entrained or dissolved hydrocarbons above adverse effect thresholds in the event of a worst-case spill event, although only two (Eugene McDermott and Heywood Shoals) have more than a 5% probability of being contacted. No exposure above high impact thresholds for entrained or dissolved oil was predicted, but minimum times to contact at both these shoals were relatively short, suggesting acute toxicity effects to some species would be expected.

Studies of the shoals and banks in the region show these features host biological communities distinct from the surrounding, relatively deep, bare sediment habitat (e.g. Heyward et al. 2017, 2012, 1997). The banks were found to be broadly similar, each hosting a range of light-dependent ecosystems characterised by benthic primary producers, such as coral and macroalgae. Surveys of shoals near the Crux project following the Montara oil spill indicated these communities did not exhibit obvious impacts as a result of the spill (Heyward et al. 2013, 2012, 2010). However, considerable natural variation both over time and between locations was observed (Heyward et al. 2013). Reviews of the ecological function of the shoals and banks in the Timor Sea east of the Activity Area concluded there is a relatively high degree of connectivity between shoals and banks, with the banks acting as a series of ‘stepping stones’ (Heyward et al. 2017, 2013). In the event of a disturbance to benthic communities as the result of a hydrocarbon spill, the upstream shoals and banks may act as a source of propagules or larvae, which could enhance recovery.

Contact with dissolved and entrained hydrocarbons above adverse exposure thresholds may result in mortality of benthic biota. Corals and, to a lesser extent seagrasses and macroalgae, are susceptible to acute and chronic impacts from exposure to entrained or dissolved hydrocarbons (Shigenaka 2001; Loya and Rinkevich 1980). The loss of habitat-forming biota such as corals, macroalgae or sponges at shoals and banks could result in changes to habitats, with consequent changes to associated fauna assemblages.

The time required for recovery following any disturbance due to hydrocarbon exposure will depend on the nature and scale of the impact. Although predicted to exceed adverse threshold concentrations, the maximum entrained and dissolved concentrations at Eugene McDermott and Heywood Shoals identified by modelling are below the ANZG 99% species protection DGV for benzene. Shoals and banks in the region have been exposed to significant intermittent disturbance for long periods of time, such as damage from cyclones and changes in water temperature associated with the El Niño-Southern Oscillation. Differences in benthic communities over time within and between shoals and banks (such as those observed by Heyward et al. 2013) may represent different phases of ecological succession.

9.14.2.5.4 Offshore Reefs and Islands

Reefs and islands predicted to potentially be exposed to adverse threshold concentrations of hydrocarbons in the event of a worst-case LOWC include Ashmore Reef, Cartier Island and Browse Island.

Ashmore Reef falls under the protection of a national Marine Park and is also designated a Ramsar wetland of international significance (Sections 7.3.1.3 and 7.3.1.2) consisting of a large platform reef complex with lagoons and large areas of drying flats that are exposed at low tide. Cartier Island and surrounding reefs are protected by the Cartier Island Marine Park (see Section 7.3.1.2), with the island comprising unvegetated sand on a large platform rising from the seabed. Browse island and surrounding waters sit within WA State Territorial Waters, with the island itself consisting of sand and limestone situated on a foundation of coral reef (Shell 2009). The island is an important breeding ground for green turtles (Chelonia mydas) and for nesting seabirds whilst the reef is home to soft and hard corals. These reefs and islands host a range of biological communities that are distinct from coastal islands and the mainland. Like the shoals and banks described in Section 9.14.2.5.3, offshore reefs and islands typically host light-dependent ecosystems characterised by benthic primary producers.

Oil spill modelling predicted that of these reefs and islands, Cartier Island has the highest likelihood of exposure above adverse impact thresholds for hydrocarbons, with a 6% chance of oil accumulating on shorelines, 10% probability of entrained hydrocarbons reaching surrounding waters and 1% probability of dissolved concentrations >50 ppb. The potential impacts to submerged receptors associated with offshore reefs and islands will be similar to those for shoals and banks (Section 9.14.2.5.3). Floating hydrocarbons from a worst-case Crux condensate spill are not predicted to impact reefs and islands, and the minimum predicted time to exposure to shoreline oil at any island is >800 hours at Cartier Island. Given the time required to reach this receptor, any oil would have had a high level of weathering and would be expected to largely comprise of relatively inert waxy hydrocarbons.

Stranding of oil on emergent islands and reefs may result in a band of weathered oil between the low and high-water marks on shorelines and intertidal corals. This may also result in impacts to fauna using these habitats, such as nesting turtles and wading birds. The modelling results suggest the magnitude of these impacts in the event of a worst-case spill scenario are likely to be limited.

9.14.2.5.5 KEFs

Modelling results indicate that the only KEF that may be directly exposed to hydrocarbons from a worst-case LOWC event is Ashmore Reef and Cartier Island including surrounding Commonwealth Waters. The depths of the other KEFs (e.g. Continental slope demersal fish communities) that fall within the spatial extent of the areas potentially affected by a worst-case release and the nature of the values (e.g. Ancient Coastline at 125 m Depth Contour) of these KEFs generally precludes significant impacts.

The potential impacts to Ashmore Reef and Cartier Islands and surrounding Commonwealth waters are considered above for Offshore Reefs and Islands (Section 9.14.2.5.4) and Shoals and Banks (Section 9.14.2.5.3), respectively.

A subsea pipeline rupture scenario, if it occurred where the pipeline traverses the Continental slope demersal fish communities KEF, could potentially affect the demersal fish communities in the vicinity of the release. However, modelling indicates the resulting plume of entrained hydrocarbons would tend to surface rapidly and vertically with only localised potential for impact near the seabed. Consequently, the proportion of the KEF that might be affected is relatively small and the duration of impacts would be relatively short (i.e. 4 hours) until the pipeline was shut-in.

The nature of the KEFs and the scale of potential impacts mean that recovery of impacted parts of a KEF are expected to be facilitated by movement and recruitment of biota from unaffected areas within other parts of the KEF.

9.14.2.5.6 Threatened, Migratory, Marine and Cetacean Species

Marine Mammals

A range of cetaceans may occur within the adverse exposure zone for a worst-case credible spill scenario, as described in detail in Section 7.7.7.1, but there are no recognised aggregation areas potentially affected. The modelling indicates that there is a low (8%) probability of entrained oil above adverse threshold levels reaching the blue whale migration BIA with a 1% probability of exposure to dissolved hydrocarbons above 50 ppb. This BIA is ~121 km from the Crux platform location and the modelling indicates an extended period (>400 hours) after release until contact, suggesting any exposure would involve substantially weathered hydrocarbons. Worst-case maximum exposure concentrations are predicted to be relatively low (i.e. 250 ppb entrained).

Cetaceans exposed to hydrocarbons may exhibit avoidance behaviour. Geraci and St Aubin (1988) documented apparent avoidance of floating hydrocarbons by bottlenose dolphins, suggesting that at least some cetaceans exhibit the ability to detect and avoid surface slicks. However, observations from spill events have noted whales and dolphins travelling through and feeding in oil slicks. The Deepwater Horizon spill in the Gulf of Mexico saw observers sighting cetaceans regularly swimming in surface slicks offshore (and nearshore) (Aichinger Dias et al. 2017). Cetaceans were also observed during the spill response for the Montara oil spill, these included false killer whales, bottlenose dolphins, spotted dolphins, and spinner dolphins (Watson et al. 2009).

Cetaceans exposed to dissolved, entrained or surface hydrocarbons may suffer external oiling, potential ingestion of oil and inhalation of toxic vapours (especially if close to the release location) (Deepwater Horizon Natural Resource Damage Assessment Trustees 2016). Impacts from direct exposure are expected to be irritation of eyes and mucous membranes. Some protection is provided by thick skin and blubber. Entrained

hydrocarbons may be ingested by cetaceans during feeding, particularly by baleen whales. Some species of baleen whale, such as blue whales, may be seasonally present in areas affected by a worst-case spill during their migrations. There are no recognised areas of importance for whale feeding within areas predicted to be exposed to adverse concentrations of hydrocarbons, however opportunistic feeding may occur.

Dugong may also occur within the area affected by a worst-case spill event, although the modelling does not predict (P <0.01) any exposure above adverse hydrocarbon thresholds for the dugong BIA near Ashmore Reef. There is a lack of studies examining the effects of hydrocarbon spills on dugongs, although it is believed that the direct impacts of exposure would be similar to those on cetaceans. Like cetaceans, dugongs have thick skin and blubber which is expected to make them resilient to direct exposure. Dugong habitat is largely considered to consist of seagrass meadows, which are restricted to shallow waters. The distance from known dugong habitat to the worst-case spill locations means that any oil that reaches dugong habitat will have been heavily weathered prior to arrival.

Marine Reptiles

Stochastic modelling results indicate adverse exposure zones may overlap the known distribution of several species of marine turtles and sea snakes. Marine turtles may be exposed to floating or evaporated hydrocarbons if they surface within a slick (e.g. for breathing, basking etc.), or to entrained or dissolved oil if they swim through a subsurface plume. There is also a possibility of ingestion of weathered residues, although the potential for this exposure is limited given the characteristics (i.e. low persistence) of the oils that might be released in a worst-case spill scenario. Exposure to floating or entrained hydrocarbons may result in external oiling, which could result in impacts such as inflammation or infection (Gagnon and Rawson 2010; Lutcavage et al. 1995; NOAA 2010). Dissolved hydrocarbons may result in toxic effects on marine turtles, however their relatively impermeable skin reduces the potential for these impacts.

Several shoals and banks occur in the vicinity of the Activity Area, which may be used as foraging areas by marine turtles (although none are recognised as BIAs). Impacts to benthic habitats and biota at these shoals and banks may result in a reduction of food for marine turtles. See Section 9.14.2.5.3 for further information on potential impacts to shoals and banks.

Stochastic modelling indicates that the turtle BIAs at Cartier and Browse Islands may be exposed (16% probability) to hydrocarbons above adverse exposure thresholds. Breeding and nesting activity occurs at these locations and they are classified as habitat critical for the survival of marine turtles in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017a). Given the distance of these locations from the Activity Area, worst-case credible spills of Crux condensate reaching these areas will be highly weathered and unlikely to result in significant impacts.

Sea snakes have similar exposure pathways to sea-borne hydrocarbons as marine turtles. Sea snake mortality has been linked to exposure to hydrocarbon spills, with dead sea snakes recovered from the region of the Montara oil spill showing high levels of petroleum hydrocarbons (including PAHs) in the trachea, lungs and stomach (Gagnon 2009). These results are consistent with exposure through ingestion and respiration of hydrocarbons. Ashmore Reef and Hibernia Reef are noted as being one of the few sites where the critically endangered leaf-scaled sea snake and short-nosed sea snake have been recorded, along with other species of sea snake, including the endangered dusky sea snake. The dusky, leaf-scaled and snort-nosed sea snakes have not been detected at Ashmore Reef or Hibernia Reef since 2001, despite increased biological survey effort (DCCEEW 2024h). The stochastic modelling indicates a very low probability and extended travel times for hydrocarbons above adverse exposure levels to affect these areas, with more than 300 hours minimum before entrained concentrations >100 ppb at Ashmore Reef (1% probability) or in surrounding waters (2% probability). In addition to Ashmore and Hibernia reefs, the known or likely dusky sea snake distribution within the Planning Area (DCCEEW 2024h) includes areas closer to the Crux platform and pipeline, notably Heywood Shoal and the waters surrounding Cartier Island. The stochastic modelling indicates that, for a worst case release, there is a low to moderate probability of entrained hydrocarbons above adverse exposure levels (ie 100 ppb) reaching these areas after relatively extended travel periods following release (eg 180 hrs for Heywood Shoal). However, maximum entrained concentrations would be relatively low (ie) and no (P <0.01) exposure to floating hydrocarbons above adverse thresholds was predicted at these locations, suggesting inhalation or ingestion impacts in areas considered known or likely to support dusky sea snakes (DCCEEW 2024h) may be unlikely. Shoals closest to the platform, such as Goeree, Vulcan and Eugene Mcdermott, where the dusky sea snake or its habitat may occur (DCCEEW 2024h) have a correspondingly higher probability of exposure to hydrocarbons above adverse thresholds, with a 29% probability of surface concentrations >10 g/m^2 predicted to occur at Goeree Shoal (the shoal nearest to the release location) within 17 hours of release and moderate-high probabilities of entrained hydrocarbons with average maximum concentrations of

up to 403 ppb. No exposure to floating or entrained hydrocarbons above the high thresholds (ie 50 g/m^2 and 1000 ppb respectively) were predicted for any of these locations under any conditions modelled.

Sharks and Rays

Fish (including sharks and rays) respire through gills, which makes them more vulnerable to exposure to dissolved and entrained hydrocarbon fractions than air breathing fauna (e.g. cetaceans, marine reptiles, birds etc). However, despite this apparent vulnerability, increased mortality has rarely been observed to result from open-water hydrocarbon spills (Fodrie and Heck 2011; ITOPF 2011). Environmental monitoring of pelagic and demersal fishes immediately following the Montara oil spill indicated that fish were exposed to hydrocarbons, although no adverse effects were noted (Gagnon and Rawson 2011, 2012). Additional discussion of the likely mechanisms and consequences of exposure to hydrocarbons in fish is provided in Section 9.14.2.4.1.

Several species of transitory or resident threatened and migratory sharks and rays may occur within the adverse exposure zones identified by the stochastic spill modelling. Of these, only the whale shark has a BIA that modelling predicts would be exposed to hydrocarbons above adverse threshold concentrations in the event of a worst-case oil spill. This BIA overlaps the Activity Area and individual sharks are likely to be present within the areas that may be affected by a spill if it occurs during their migration to and from the aggregation area off Ningaloo Reef. While no aggregation areas are present within the area potentially affected by a spill, migrating whale sharks may be exposed to entrained and dissolved hydrocarbons through contact with their gills or by ingestion during opportunistic feeding. The large volume filter feeding behaviour of whale sharks may result in a relatively high potential for exposure to entrained hydrocarbons compared to many other marine species (Campagna et al. 2011).

Tagging studies off Ningaloo Reef have shown that whale sharks disperse broadly (Meekan and Radford 2010; Wilson et al. 2006). Genetic studies of whale sharks have shown low genetic diversity, which suggests flow of genetic material through the movement of individual sharks over large spatial scales (Schmidt et al. 2009). On this basis, only a portion of the whale shark population in the Timor Sea would be within the area above the adverse exposure threshold at any one time and impacts such as toxic effects leading to mortality would be expected to affect a small number of individual animals.

Other oceanic and/or resident species of sharks and rays are likely to occur throughout the adverse exposure zone, including around reefs and shoals/banks. However, Heyward et al. (2017) noted that shark numbers were lower than expected at these sites, potentially due to fishing pressure. Potential impacts to other oceanic shark species are likely to be similar to fish (see Section 9.14.2.4.1). Any reduction of shark numbers may take longer to recover due to the relatively long lifespans and low reproductive output compared to finfish species.

Birds

Many seabirds and migratory shorebird species have been identified as potentially occurring within a worst-case exposure zone (over 30 species of shorebird listed as migratory under the EPBC Act have been recorded at Ashmore Reef (DCCEEW 2024). Additionally, several BIAs for seabird and migratory shorebird species occur throughout the adverse exposure zone, centred around offshore islands.

Seabirds and migratory birds are particularly vulnerable to contact with floating hydrocarbons, which can coat feathers. This can lead to hyperthermia from loss of insulation and may lead to toxic effects due to ingestion of hydrocarbons when preening; both impacts may result ultimately result in mortality (Hassan and Javed 2011). The stochastic modelling does not indicate any (P <0.01) exposure to floating hydrocarbons above adverse thresholds within the bird BIAs that occur in the Planning Area, but entrained and dissolved oil is predicted to be present in the waters in and/or surrounding these areas.

The most likely cause of seabirds encountering spilled hydrocarbons is during foraging for food. Seabird foraging is typically concentrated around roosting locations, such as offshore and coastal islands and reefs. Potential roosting locations lie a considerable distance from the Activity Area; the nearest significant roosting location is Ashmore Reef/Cartier Island, which lies ~106 km away. Ashmore Reef is a Ramsar-listed wetland which hosts significant seabird colonies and is an important stopping area for migratory shorebirds. Hydrocarbons reaching these locations would be significantly weathered, reducing the potential for toxicity effects.

Migratory shorebirds are seasonally abundant during summer months, and a spill during this period would have greater potential to impact migratory shorebirds. These birds are not likely to encounter floating oil at sea but may be affected by shoreline accumulation of oil and waxy residue, or oil where shallow foraging habitats such as intertidal mudflats are present. Unlike seabirds, shorebird mortality due to hyperthermia is relatively uncommon but indirect impacts, such as reduced prey availability and bioaccumulations of PAHs, may occur

(Henkel et al. 2012). Exposure to hydrocarbons that reduces the ability of shorebirds to use an important area of habitat for roosting or foraging, or reduces the availability of food, may have a significant impact (CoA 2017c). The spill modelling indicates that there is a low probability (6%) and extended (>35 days) minimum time after release for shoreline acccumulations above threshold at Cartier Island, by which time the residues would likely be low toxicity wax flakes. Average maximum concentrations of entrained or dissolved hydrocarbons reaching the surrounding waters would be below adverse thresholds, suggesting widespread impacts are unlikely.

The residual risk to natural values and sensitivities is ranked Yellow (see Table 9-98).

9.14.2.6 Socioeconomic Features, Values and Sensitivities

This section describes the potential impacts to socioeconomic features and values within the Planning Area in the event of a worst-case spill.

9.14.2.6.1 Fishing Industry

There are a number of commercial fisheries (Table 7-18) that have fishing zones that could be exposed to hydrocarbons in the event of a worst-case spill event. Potential impacts to commercial fishing activities from a worst-case hydrocarbon spill include (ITOPF 2011):

- displaced fishing effort from areas impacted by a spill or spill response activities.
- damaged fish stocks, largely due to mortality or toxicity.
- closing of fisheries by management agencies.
- the inability to sell catch due to perceived or actual fish tainting of contamination.
- oiling of fishing gear, particularly by floating or shallow entrained oil.

Several of the fishing zones that overlap the Planning Area do not support fishing activity (Section 7.9.1). A significant hydrocarbon spill would likely result in a temporary closure to fishing within the area of exposure, in particular the areas closest to the spill event. The spatial extent and duration of the closure would depend on the nature and scale of the pollution resulting from the hydrocarbon spill. Given the large spatial extent of managed fisheries in the Planning Area (see Figure 7-27), a spill is unlikely to result in complete closure of any fishery. Rather, the closure of areas to fishing is more likely to result in the displacement of fishing effort. Displacement from productive fishing areas may result in impacts to fishers such as increased costs and reduced catch per unit effort.

Exposure of fish to hydrocarbons may result in tainting, which could render landings unsuitable for human consumption. Tainting may occur even at low levels of hydrocarbon exposure. Monitoring of fish for taint immediately following capping of the Montara well detected differences between fish likely to have been exposed to hydrocarbons, however these differences were not conclusively linked to oil contamination and fell within the range of ‘normal’ fish odours (Rawson et al. 2011). Samples collected at the same monitoring locations two and four months after were not distinguishable (Rawson et al. 2011). These results are consistent with other studies of fisheries resources exposed to hydrocarbon pollution, which acknowledge the potential for impacts to fisheries resources but have shown little potential risk for consumers if suitable fisheries management actions are undertaken (Law and Hellou 1999; Law and Kelly 2004).

Fish caught in areas affected by a significant hydrocarbon spill may be perceived as being of poorer quality, even if no decrease in quality is evident. This may result in lower prices at the time of sale and subsequently lead to reduced income for commercial fishers.

9.14.2.6.2 Tourism and Recreation

There are no known tourism or recreational activities in the Activity Area, or surrounds, due to the remoteness of the area. Some nature-based tourism activities may occur at the remote offshore islands and reefs within the adverse exposure zones of a worst-case spill scenario. Impacts to the environmental values associated with these islands and reefs may affect their value for tourism activities. Refer to Offshore Reefs and Islands (Section 9.14.2.5.4) for discussion on the potential impacts to these receptors.

The modelling of worst-case spill scenario does not predict any exposure above adverse thresholds to the environmental values of the mainland coastline and islands which support more intensive nature-based tourist and recreation activities than offshore islands.

Impacts to environmental values that support periodic tourism to outer islands and shoals could result in a loss of revenue for tourist operators (e.g. charter fishing cancellation due to fishery closures). Whilst direct impacts on tourism activities are unlikely to be significant, media, news and general perception of an area in the event of an ongoing spill could reduce visitor numbers and may result in more substantive financial losses for tourism operators.

9.14.2.6.3 Defence

Defence activities within the offshore North Australian Exercise Area (NAXA) are considered unlikely to be affected by the worst-case credible hydrocarbon spills. There is a possibility that activities may have to be temporarily displaced from areas where a spill response is underway or where spilled hydrocarbons may present a risk to vessels, but such displacement would be highly localised and temporary in nature. Open dialog channels exist with Defence allowing for clear communication in the event of a worst-case spill within the Activity Area.

9.14.2.6.4 Shipping

The modelling of a worst-case scenario does not predict any exposure to ports, and potential impacts to commercial shipping are expected to be minor, limited to temporary displacement of marine users from areas near the release and/or where spill response activities are underway, or additional demand for wharf/mooring space for loading/unloading vessels that are active in the field.

9.14.2.6.5 Scientific Research and Restoration

Scientific research programs that are being conducted within the Planning Area could be adversely affected by a worst-case spill. Studies concentrating on communities at shallow water features such as reefs, shoals and around islands, could be disrupted if a spill (or associated response) prevented access to areas, or the aims of the research could be adversely impacted if habitats or species of interest were affected by exposure to spilled hydrocarbons. Long-term studies focused in relatively shallow areas, such as at Scott Reef, may be particularly vulnerable. The stochastic modelling indicates that a number of reefs and shoals/banks, including Scott Reef, may be exposed to very low levels of hydrocarbons in the event of a worst-case spill. However, exposure to adverse threshold concentrations that could result in impacts to environmental resources subject to scientific study was not predicted for Scott Reef and many of the other shallower features in the Planning Area. Potential for impacts to reefs, islands, shoals and banks is discussed in Section 9.14.2.5. Surveys of shoals in the region following the Montara oil spill indicated these communities did not exhibit obvious impacts as a result of the spill (Heyward et al. 2013, 2012, 2010).

9.14.2.6.6 Oil and Gas Industry

Petroleum activities in the region include the Shell operated Prelude FLNG facility, the INPEX operated Ichthys facility and the Montara development (operated Jadestone Energy). In the unlikely event of a worst-case spill scenario there is a risk that a reduction in water quality may occur with this leading to possible affects to the operation of these facilities, especially if seawater is no longer suitable for intake (e.g. for use as cooling water or feed water for RO water generation). This is likely to result in impacts to routine operations and could lead to a reduction in production output and thus a financial impact. A worst-case hydrocarbon spill response is also likely to result in competition for vessels and potentially drilling rigs (if well intervention or a relief well is required).

9.14.2.6.7 Indonesian and Timor-Leste Coastlines

The spill modelling results indicate there is the potential for the worst-case credible spill scenarios to result in entrained hydrocarbons reaching the Indonesian and Timor-Leste coastlines above the lowest exposure threshold, with a low (2%) probability of accumulating on shorelines above the low threshold for shoreline concentrations. The likelihood of entrained hydrocarbons above adverse impact thresholds reaching Indonesian and Timor-Leste waters (EEZ) was low (4%) and maximum worst-case entrained concentrations relatively low (178 ppb), suggesting the potential for adverse effects would be limited. No exposure to floating oil was predicted for any coastlines.

Minimum times to contact for shoreline oil were >60 days, by which time the toxic soluble fraction will have been removed through evaporation and biodegradation processes leaving low quantities of waxy residues. This waxy residue is nontoxic and will degrade naturally over time with negligible environmental impact.

The residual risk to socioeconomic features, values and sensitivities is ranked Dark Blue (see Table 9-98).

9.14.2.7 Heritage and Cultural Features, Values and Sensitivities

9.14.2.7.1 Underwater Cultural Heritage

There are numerous sunken vessels, aircraft and other culturally significant underwater sites and artifacts within the Planning Area. However, these are unlikely to be impacted by a worst-case spill event due to the buoyant nature of the oils that could be involved and the modelling results showing the limited depths affected by entrained and dissolved hydrocarbons.

Due to the nature of oil and the predicted trajectory and fates of a worst-case release, it is unlikely that an oil spill would have a significant impact on UCH within the Planning Area.

9.14.2.7.2 Traditional Indonesian Fishing

Oil spill modelling indicates there is limited potential for adverse effects within Indonesia's EEZ due to a worst-case spill in the Activity Area (Section 9.14.2.6.7). However, traditional Indonesian fishing activity occurs within the MoU Box, which is located ~40 km outside the Activity Area and lies within the Planning Area. Traditional fishing is concentrated around banks, shoals, island and reefs; see Sections 9.14.2.5.3 and 9.14.2.5.4 for discussion of potential impacts to these receptors. The worst-case credible spill scenarios may impact upon the biological resources exploited by traditional Indonesian fishers, such as fish and benthic invertebrates (e.g. sea cucumbers and trochus shells). Impacts to these biological resources may result in effects on traditional fishers, such as reduced catch rates and displacement of fishing effort.

9.14.2.7.3 Indigenous Cultural Heritage

There are no known Indigenous cultural heritage features or values that exist within the Activity Area and Shell has received advice that it is highly unlikely that any tangible cultural heritage values will exist below the 130 m water mark which is the accepted maximum extent of the ancient coastline (Cosmos Archaeology 2023). In shallower water depths it is highly unlikely that underwater cultural heritage features would be impacted as the oil that may be released by a worst-case spill event is buoyant and remains in the surface waters.

Consultation has confirmed that Indigenous people have a strong connection to sea Country (as described in Sections 7.10 and 7.11). Shell has been made aware of the existence of song lines along the West Kimberley Coastline, a culturally sensitive reef in the Kimberly region, as well as an ancient ceremonial site of the Bardi Jawi people underwater on the Dampier Peninsula coast. Oil spill modelling predicts no exposure to any hydrocarbons above threshold levels along Australian shores where tangible and intangible cultural heritage is known to exist. However, in the event of worst-case spill Shell will enact its BROPEP and OSMP and has procedures in place to ensure traditional owners are informed of a spill and dialog remains open between Shell and traditional owners to obtain advice on cultural features and values and inform appropriate response.

The residual risk to heritage and cultural features, values and sensitivities is ranked Dark Blue (see Table 9-98).

9.14.3 Risk Assessment Summary

The risk assessment summary in Table 9-98 is based on the worst-case in terms of consequences spill event, i.e. a LOWC continuing for 80 days. It lists the highest residual risk ranking of the relevant environmental receptor groups for emergency events.

Table 9-98: Emergency Events Evaluation of Residual Risks

Environmental Receptor	Consequence	Likelihood	Residual Risk
Evaluation – Unplanned Risks			
Protected Areas	Moderate	B – Remote	**Dark Blue**
Physical Features	Minor	B – Remote	**Dark Blue**
Physical Values and Sensitivities	Major	B – Remote	**Yellow**
Natural Features	Moderate	B – Remote	**Dark Blue**
Natural Values and Sensitivities	Major	B – Remote	**Yellow**
Socioeconomic Features	Moderate	B – Remote	**Dark Blue**

Environmental Receptor	Consequence	Likelihood	Residual Risk
Socioeconomic Values and Sensitivities	Moderate	B – Remote	**Dark Blue**
Heritage and Cultural Features	Major	B – Remote	**Yellow**
Heritage and Cultural Values and Sensitivities	Major	B – Remote	**Yellow**

9.14.4 ALARP Assessment and Environmental Performance Standards

Table 9-99: ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
ALARP Assessment						
Elimination	None identified.	N/A	No elimination controls were identified beyond those incorporated in design.	N/A	N/A	N/A
Substitution	Use of diesel-fuelled vessels rather than HFO or IFO.	Yes	Diesel has much lower persistence than heavier fuel oils restricting the potential extent of impacts in the event of a major spill from this procedural control measure.	12.1	Vessels are MDO or MGO fuelled.	Vessel fuel records demonstrate only MDO or MGO onboard.
Engineering	Radar/Automatic Identification System (AIS)/Automatic Radar Plotting Aid (ARPA) and associated alarms on vessels and AIS on topsides.	Yes	Using radar/AIS/ARPA and associated alarms, equipment control measures, on vessels and AIS on topsides allows for early identification and notification of approaching vessels and reduces the risk of vessel-to-vessel and vessel-platform collision.	12.2	Vessels are equipped with suitable and operational navigation and collision avoidance equipment, specifically: • ARPA. • AIS. • Associated alarms. • Radar, or • Equivalent system.	Marine Assurance records.
				12.3	Topsides AIS maintained in accordance with the CMMS.	CMMS records for topsides AIS.
Engineering	Real Time Metocean Monitoring System	Yes	Metocean data gathering system provides a Real Time Metocean Monitoring System to alert personnel to adverse weather by providing accurate, continuous, real-time metocean data for decision making when conducting weather sensitive activities to help prevent weather related incidents.	12.4	Topsides equipped with Real Time Metocean Monitoring System.	Platform As Built drawings show the topsides are equipped with Real Time Metocean Monitoring System.
Engineering	Maintain subsea pipeline, risers, SSIVs and hydrocarbon-containing infrastructure integrity to avoid significant loss of containment to environment.	Yes	Conducting inspections and monitoring of critical equipment in accordance with the risk-based inspection process reduces the risk of loss of integrity of pipeline, riser and hydrocarbon containing infrastructure. Installed subsea pipeline shut in systems: • PLET with Subsea Isolation Valve (SSIV) located near the Crux Platform. • Second PLET with Subsea Isolation Valve (SSIV) located near Prelude FLNG. Installation of these valves at either end of the pipeline provides for the pipeline to be isolated, reducing the volumes of hydrocarbons released to the marine environment in the event of pipeline damage. Maintaining subsea equipment in accordance with the CMMS ensures condition remains fit for purpose.	12.5	Subsea pipeline, riser, SSIVs and hydrocarbon containing infrastructure to be inspected in accordance with the risk-based inspection schedule and maintained in accordance with the CMMS to ensure condition remains fit for purpose.	Records demonstrate inspections take place in accordance with the risk-based inspection schedule and maintenance in accordance with the CMMS. Records demonstrate control system implementation and function testing were in accordance with minimum standards expected for operating conditions. Inspection reports show equipment to be in good condition and working order.
Engineering	Riser Emergency Shutdown Valve (RESDV) is installed as the last valve on the Crux platform topsides at the start of the Crux Pipeline to isolate the pipeline.	Yes	An RESDV is provided as the last valve on the Crux Platform at the start of the Crux Pipeline to isolate the pipeline inventory from the Crux Platform and thereby reduce the volumes of hydrocarbons released to the environment a loss of containment event. The CMMS process, a system control measure, will assist in ensuring the RESDV operates as intended.	12.6	RESDV is maintained in accordance with the CMMS.	CMMS maintenance records for the RESDV.
Engineering	Surface-controlled subsurface safety valve (SCSSV) is installed in each well and designed to shut-in well production.	Yes	Installation of SCSSV, an equipment control measure, will reduce the likelihood of a LOWC resulting in the release of hydrocarbons to the marine environment. In the event of a blowout on the topsides the SCSSV is designed to fail shut, isolating the reservoir and limiting the volume of hydrocarbons lost to the environment.	12.7	SCSSV is maintained in accordance with the CMMS.	CMMS maintenance records for the SCSSV.
Administrative and Procedural	Infrastructure and PSZ locations communicated to AHO to allow inclusion on maritime charts.	Yes	Inclusion of facilities and PSZ on maritime charts will allow other marine users to navigate accordingly to avoid adverse interactions with Crux facilities and restricted areas. This control is also consistent with standard industry practice.	1.1	Refer to EPS 1.1.	Refer to EPS 1.1.
Administrative and Procedural	Vessel speed restrictions.	Yes	Reduced vessel speed improves ability to avoid collisions and reduces likelihood of damage that could result in loss of fuel containment.	5.1	Refer to EPS 5.1.	Refer to EPS 5.1.
Administrative and Procedural	Lifting procedures and maintenance, including inspection of lifting equipment.	Yes	Lifting, maintenance and inspection procedures are implemented for all lifting operations on the Crux platform and vessels. Shell Australia has Lifting and Hoisting Standards (OPS_PRE_010176) and (OPS_GEN_010724) which are mandatory for all lifting operations on the Crux facility. The standards specify lifting requirements, performance standards and roles and responsibilities to reduce the risk of dropped	4.2	Refer to EPS 4.2.	Refer to EPS 4.2.

Hierarchy of Controls	Control measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
			objects impacting the seabed and sea infrastructure potentially resulting in damage or a loss of containment of hydrocarbons.			
Administrative and Procedural	Shipboard Oil Pollution Emergency Plan (SOPEP) or equivalent (appropriate to class).	Yes	Vessel SOPEP in place for all vessels as required by class in accordance with AMSA Marine Order 91. The SOPEP, or its equivalent, minimises the environmental impact of unplanned hydrocarbon releases and spills aboard vessels by enabling a quick and efficient response.	11.3	Refer to EPS 11.3.	Refer to EPS 11.3.
Administrative and Procedural	Give a minimum of four weeks' notice of commencement of activities under this EP to the AHO to enable a 'Notice to Mariners' to be issued.	Yes	Allows notifications to be made to other marine users in the area to minimise interaction with vessels and reduce the risk of collisions.	1.2	Refer to EPS 1.2.	Refer to EPS 1.2.
Administrative and Procedural	Prohibit vessel anchoring within the Activity Area.	Yes	Prohibit vessel anchoring within the Activity Area eliminates the risk of damage to subsea infrastructure from anchors.	4.1	Refer to EPS 4.1.	Refer to EPS 4.1.
Administrative and Procedural	Manual of Permitted Operations (MOPO) to manage simultaneous operations (SIMOPs).	Yes	SIMOPs plans, a procedural control measure, will be used during the implementation of the field activities to assist in the management of simultaneous operations. These are recognised tools used to vessel activities, amongst other things, to prevent major accidents such as a major spill from a vessel collision. The MOPO, a procedural control measure, describes what activities are allowable SIMOPS.	12.8	Shell will implement the Manual of Permitted Operations (MOPO) to manage simultaneous operations.	MOPO and SIMOPs implementation records.
Administrative and Procedural	NOPSEMA accepted WOMP.	Yes	Maintenance of well integrity is a key requirement to avoid less of well control. The wells at Crux are covered by NOPSEMA accepted WOMP that details key controls in place for the duration of the well lifecycle.	N/A	N/A	N/A
Administrative and Procedural	NOPSEMA accepted safety case.	Yes	In accordance with the OPGGS (Safety) Regulations 2009, all key activities will be undertaken in accordance with the accepted Crux safety case.	N/A	N/A	N/A
Administrative and Procedural	Vessels equipped and crewed in accordance with Australian maritime requirements.	Yes	The vessels within the Activity Area will adhere to the navigation safety requirements contained within the International Regulations for Preventing Collisions at Sea 1972 (COLREGS), Chapter 5 of the International Convention for the Safety of Life at Sea 1974 (SOLAS Convention), International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW Convention), the *Navigation Act 2012* (Cth) and any subsequent Marine Orders, which specify standards for crew training and competency, navigation, communication, and safety measures. Reduces the likelihood of vessel collision by operating the vessels in accordance with industry standards and regulatory requirements.	1.3	Refer to EPS 1.3.	Refer to EPS 1.3.
Administrative and Procedural	Accepted OPEP and OSMP.	Yes	Implements response plans to deal with an emergency event quickly and efficiently to reduce impacts to the marine environment.	N/A	N/A – refer to the NOPSEMA accepted BROPEP (HSE_GEN_016765) and Browse Regional OSMP (HSE_PRE_016370) for the applicable EPS.	N/A
Administrative and Procedural	Operator Start of Shift Orientation (SoSO) rounds implemented as per section 10.4.5.3 and 10.8.3.	Yes	The SoSO is a time bounded, usually at the start of each shift, initial familiarisation of the Asset generally performed between shift handover and shift team meeting (except for geographically dispersed locations which perform the SoSO after the shift team meeting.) The SoSO is meant to confirm the status of the Asset matches what was heard during the shift handover and prepares the individual to contribute to the shift team meeting. Whilst Crux is unmanned, SoSO will occur remotely, through the use of CCTV and other remote forms of situational awareness. This is an important system control measure to maintain situational awareness of the facility as described in section 10.4.5.3 and 10.8.3.	12.9	Operator Start of Shift Orientation (SoSO) rounds will be implemented daily to maintain situational awareness of the facility.	Daily SoSO round records.
Administrative and Procedural	Bunkering Procedure.	Yes	Bunkering procedures are a useful control measure to reduce the risk of bunkering related incidents resulting hydrocarbons spills to the ocean.	12.10	Bunkering procedure will be implemented to minimise the risk of bunkering spills to the ocean, which includes: • Check hoses prior to commencement. • visually monitor gauges, hoses, fittings and the sea surface during the operation. • Implement a completed PTW and/or JSA for the hydrocarbon bunkering operation.	Records demonstrate bunkering undertaken in accordance contractor or Shell bunkering procedures as required.

Hierarchy of Controls	Control measure	Adopted?	ALARP Discussion and Control Measure Effectiveness	EPS #	EPS	Measurement Criteria
ALARP Statement						
Given the impact assessment outcomes and control measures adopted under the scope of this activity, Shell considers implementing of the control measures appropriate to manage the potential risk and impacts associated with emergency events. No feasible additional controls were identified that could further reduce the impacts. Therefore, the impacts are reduced to ALARP.						

9.14.5 Acceptability of Risks

Table 9-100: Acceptability of Risks – Emergency Events

Receptor		Acceptable Level of Impact	Acceptable?	Acceptability Assessment
Category	**Subcategory**			
Protected areas	Marine conservation reserves	No impacts to the values of marine parks.	Yes	Shell considers large-scale releases of hydrocarbons during the activity to be unacceptable. Such spills have potential to result in significant environmental impacts. This has been reinforced through consultation with groups such as DAC and WGAC. Consequently, Shell will apply its considerable experience and knowledge in the offshore petroleum industry to ensure no such release occurs. Shell has applied a conservative approach to the identification and modelling of the credible worst-case hydrocarbon spills. This information was used to inform the evaluation of the environmental risks and is consistent with the precautionary principle. Shell will implement industry standard controls to manage the risk of emergency events (unplanned hydrocarbon spills). The BROPEP (HSE_GEN_016765) will support the activity that is commensurate to the nature and scale of the hydrocarbon spill risks.
	Wetlands of international and national importance	No impacts to the ecological values of wetlands of international and national importance.	Yes	
	Commonwealth and national heritage places	No impacts to Commonwealth or national heritage places values.	Yes	
Physical features, values and sensitivities	Marine regions	No significant impacts to the physical features of a marine region.	Yes	
	Air quality	No significant impacts to air quality defined as no substantial change in air quality which may adversely impact on biodiversity, ecological integrity[26], social amenity, or human health.	Yes	
	Water quality	No significant impacts to water quality. Impact not expected to result in a substantial change in water quality, which may adversely impact biodiversity, ecological integrity[26], social amenity or human health.	Yes	
	Sediment quality	No significant impacts to sediment quality. Impact not expected to result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity[26], social amenity or human health may be adversely affected.	Yes	
Natural features, values, and sensitivities	Marine bioregions	No significant impacts to benthic habitats and communities. Impacts to non-sensitive benthic communities limited to a maximum of 5% of the Project Area (as defined in the OPP). No significant adverse effect on pelagic communities, populations, habitats or spatial distribution of a species.	Yes	
	BIAs	No significant impact to functional values of BIAs.	Yes	
	Critical habitat	No significant impacts to functional values of critical habitat.	Yes	

Receptor		Acceptable Level of Impact	Acceptable?	Acceptability Assessment
Category	**Subcategory**			
	Shoals and banks	No direct impacts to named banks and shoals. No loss of coral communities at named banks or shoals as a result of indirect/offsite impacts[103]. No known or potential pest species become established in the Commonwealth marine area.	Yes	
	Offshore reefs and islands	No impacts to offshore reefs and islands.	Yes	
	KEFs	No significant impacts to environmental values of KEFs.	Yes	
	Threatened, migratory, marine and cetacean species	Management of aspects of the activity must align with Conservation Advice, recovery plans and threat abatement plans. No significant impact to EPBC Act listed threatened, migratory, marine or cetacean species.	Yes	
Socioeconomic features, values and sensitivities	Fishing industry	No negative impacts to targeted fisheries resource stocks that result in demonstrated loss of income for commercial fisheries. Temporary displacement of fishing activities within the Activity Area (excluding PSZs) is acceptable. Permanent exclusion of fishing activities from PSZs is acceptable.	Yes	
	Defence	Temporary displacement of defence activities within the Activity Area (excluding PSZs) is acceptable.	Yes	
	Ports and commercial shipping	Temporary displacement of commercial shipping within the Activity Area (excluding PSZs) is acceptable.	Yes	
	Scientific research/restoration	No impacts resulting in abandonment of long-term established scientific research or restoration programs.	Yes	
	Indonesian and Timor-Leste coastlines	No impacts to Indonesian and Timor-Leste Coastlines are acceptable.	Yes	
	Oil and gas industry	Temporary displacement of petroleum exploration activities and operations within the Activity Area (excluding PSZs) is acceptable.	Yes	

[103] As defined in the Matters of National Environmental Significance: Significant Impact Guidelines 1.1 (DoE 2013).

Receptor		Acceptable Level of Impact	Acceptable?	Acceptability Assessment
Category	**Subcategory**			
	Tourism and recreation	No negative impacts to nature-based tourism resources resulting in demonstrated loss of income. Temporary displacement of tourism activities within the Activity Area (excluding PSZs) is acceptable.	Yes	
Heritage and cultural features, values and sensitivities	Indigenous cultural connections	No impacts to Indigenous cultural connections.	Yes	
	Indigenous cultural heritage values	No significant impacts to Indigenous cultural heritage values.	Yes	
	Underwater cultural heritage	No damage or destruction to historical shipwrecks and sunken aircraft is acceptable.	Yes	
	Traditional Indigenous fishing	No negative impacts to exploited fisheries resource stocks. Temporary displacement of traditional fishing activities within the Project Area (excluding PSZ) is acceptable. Permanent exclusion of traditional fishing activities from gazetted petroleum exclusion zones is acceptable.	Yes	

A comprehensive assessment of the risks from the worst-case credible spill scenarios arising from the activity has been undertaken. Globally, Shell has experience in similar activities and understands the possible impacts and risks that may arise from the worst-case credible spill scenarios. Shell has undertaken in-depth environmental studies, analytical modelling and consultation to identify the environmental receptors that may be affected and understands the nature and implications of potential hydrocarbon pollution within the Planning Area. The studies undertaken, along with Shell's organisational experience, allows for a high degree of confidence to be placed in the outcomes of the assessment of the risks.

Principles of ESD

EPOs aligned with the principles of ESD and the precautionary principle have been adopted by putting in place extensive controls to prevent marine accidents. In the unlikely event of a spill, plans are in place to mitigate the impact and prevent serious or irreversible environmental damage.

Relevant Requirements

Managing the potential impacts and risks from emergency events is consistent with legislative requirements, including:

Compliance with international maritime conventions, including:

- STCW Convention.
- SOLAS.
- COLREGS.
- MARPOL: Annex I: prevention of pollution by oil and oily water.

Compliance with Australian legislation and requirements, including:

- Navigation Act 2012 (Cth) and Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Cth):
  - Marine Order 21 (Safety of Navigation and Emergency Procedures).
  - Marine Order 27 (Radio Equipment).
  - Marine Order 30 (Prevention of Collisions).
  - Marine Order 71 (Masters and Deck Officers).
  - Marine Order 91 (Marine Pollution Prevention – Oil).
- OPGGS Act and OPGGS(E) Regulations:
  - accepted EP, BROPEP and OSMP for all petroleum activities associated with the activity.
- implementation of recognised industry best practices, such as:
  - agreements in place with oil spill response service providers.
  - development of SIMOPS plans.

Matters of National Environmental Significance

A worst-case hydrocarbon spill may have the potential to result in significant impacts for several MNES. Shell will put in place a range of measures during the activity to ensure that spills of hydrocarbons that may have the potential to result in significant impacts to threatened and migratory species do not occur. Shell considers the residual risk to these MNES to be acceptable, after application of the key management controls proposed in this EP.

Marine Parks

Modelling results of the worst-case credible spill scenarios predicted that Commonwealth marine parks may have the potential to be contacted above impact exposure thresholds.

Commonwealth and National Heritage Places

Although considered very unlikely, predictions from the stochastic spill modelling studies indicate hydrocarbons above impact exposure thresholds may have the potential to contact the Ashmore Reef National Nature Reserve Commonwealth Heritage Place (2% probability without controls in place).

Threatened and Migratory Species

With controls in place, significant impacts (Table 8-1) to threatened and migratory species from a spill are considered unlikely. Pollution from hydrocarbon spills is recognised as a threat in management plans, recovery plans and Conservation Advice for a number of threatened and migratory species.

Table 9-101 summarises the alignment of the activity with these documents.

Wetlands of International and National Importance

Although considered very unlikely (due to the distance from the Activity Area), predictions from the stochastic spill modelling studies predict hydrocarbons above impact thresholds may have the potential to contact the Ramsar wetland at Ashmore Reef (2% probability without controls in place).

Commonwealth Marine Environment

The evaluation of impacts and risks indicates that significant impacts to the Commonwealth marine environment may have the potential to occur in the event of a significant hydrocarbon spill. Any widespread impacts to water quality could result in several marine species being affected.

Table 9-101: Summary of Alignment with MNES Considerations

MNES	MNES Acceptability Considerations	Demonstration of Alignment
Marine mammals	Significant impact guidelines for critically endangered, endangered, vulnerable and migratory species (Table 8-1)	Shell has identified the potential for hydrocarbon pollution, and potential consequential habitat degradation, from an emergency event as a significant environmental risk. Shell has applied a range of controls that are intended to reduce the likelihood of such a release occurring, and mitigative controls to understand and reduce the severity of potential impacts if such a release occurred. Large-scale emergency events pose a significant safety risk for Shell personnel. Control measures and considerable effort will be applied to the project design to reduce the likelihood of hydrocarbon releases occurring.
	Conservation management plan for the blue whale: A recovery plan under the *Environment Protection and Biodiversity Conservation Act 1999* (CoA 2015a)	
	Approved Conservation Advice *Balaenoptera borealis* (sei whale) (DoE 2015c)	
	Conservation Advice *Balaenoptera physalus* fin whale (TSSC 2015b)	
Marine Reptiles	Significant impact guidelines for critically endangered, endangered, vulnerable and migratory species (Table 8-1)	
	Recovery plan for marine Turtles in Australia 2017–2027 (CoA 2017b)	
	Conservation Advice for *Aipysurus fuscus* (dusky sea snake) (DCCEEW 2024h). Refer to Table 9-102 for a summary of acceptability.	
	Approved Conservation Advice for *Aipysurus apraefrontalis* (short-nosed sea snake) (TSSC 2010a)	
	Approved Conservation Advice for *Aipysurus foliosquama* (leaf-scaled sea snake) (TSSC 2010b)	
Birds	Significant impact guidelines for critically endangered, endangered, vulnerable and migratory species (Table 8-1)	
	Wildlife Conservation Plan for Migratory Shorebirds (DoE 2015a)	
	Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (CoA 2017)	
	Wildlife Conservation Plan for Seabirds (CoA 2020)	
	Conservation Advice for *Limnodromus semipalmatus* (Asian dowitcher) (DCCEEW 2024e)	
	Approved Conservation Advice on *Rostratula australis* (Australian Painted Snipe) (TSSC 2013)	
	Conservation Advice *Calidris ferruginea* curlew sandpiper (DCCEEW 2023f)	

MNES	MNES Acceptability Considerations	Demonstration of Alignment
	Conservation Advice *Numenius madagascariensis* eastern curlew (DCCEEW 2023e)	
	Conservation Advice *Anous tenuirostris melanops* (Australian lesser noddy) (TSSC 2015a)	
	Conservation Advice *Calidris canutus* red knot (DCCEEW 2024b)	
	Conservation Advice for *Phaethon rubricauda westralis* (Indian Ocean red-tailed tropicbird) (DCCEEW 2023h)	
	Conservation Advice for *Calidris acuminata* (sharp-tailed sandpiper) (DCCEEW 2024a)	
	Conservation Advice *Charadrius leschenaultii* greater sand plover (DCCEEW 2023g)	
	Conservation Advice *Phaethon lepturus fulvus* (white-tailed tropicbird, Christmas Island) (TSSC 2014c)	
	Approved Conservation Advice for *Limosa lapponica menzbieri* (Yakutian bar-tailed godwit) (DCCEEW 2024d)	
	Conservation Advice *Limosa lapponica baurei* (Alaskan bar-tailed godwit) (DCCEEW 2024c)	
Sharks and Rays	Significant impact guidelines for critically endangered, endangered, vulnerable and migratory species (Table 8-1)	
	Conservation Advice *Rhincodon typus* (whale shark) (DoE 2015e)	
	Recovery plan for the white shark (*Carcharodon carcharias*) (DSEWPaC 2013)	
	Sawfish and river shark multispecies recovery plan (CoA 2015b)	
	Approved Conservation Advice for *Pristis clavata* (dwarf sawfish) (TSSC 2009)	
	Approved Conservation Advice for *Pristis zijsron* (green sawfish) (TSSC 2008b)	
Commonwealth Marine Environment	Significant impact guidelines for Commonwealth marine environment (Table 8-1)	

Table 9-102: Summary of Acceptability and Regard given to the Conservation Advice for Aipysurus fuscus (dusky sea snake) (DCCEEW 2024h)

Threat	Applicable Conservation Advice for *Aipysurus fuscus* (dusky sea snake)	Assessment of Acceptability and Regard given to Conservation Advice *Aipysurus fuscus* (dusky sea snake)
Fossil fuel exploration and extraction		
Oil Pollution	Use scientifically informed planning and regulation to avoid impacts across the known and likely distribution of the dusky sea snake, including for development of the Torosa gas field and elsewhere across the Browse basin. This includes (but is not limited to) eliminating: • The risk of oil spill affecting the dusky sea snake and its habitat.	Shell follows scientifically informed spill response planning and associated regulations that enforce this. This is outlined within the BROPEP and Browse Regional OSMP. Measures to reduce the risk and impact of oil spill to “ALARP” and “acceptable” are set out in Table 9-99 and Table 9-103.

Threat	Applicable Conservation Advice for *Aipysurus fuscus* (dusky sea snake)	Assessment of Acceptability and Regard given to Conservation Advice *Aipysurus fuscus* (dusky sea snake)
	Ensure there is an effective strategy and adequate local resources and knowledge in place to rapidly respond to a large unintentional oil spill from gas and oil projects in the Browse Basin.	Section 9.15 includes a detailed assessment of oil spill response strategies and spill impact mitigation assessment. Attachment 1 of the BROPEP (Basis of Design and Field Capability Assessment) includes a capability assessment for resource availability in the event of an emergency event oil spill. This includes an effective strategy and adequate local resources and knowledge in place to rapidly respond.
	Should an oil spill occur that may impact the known or likely distribution of the dusky sea snake: • Urgently use herding agents, bioremediation agents and mechanical means to contain and break down the oil. See Australian Maritime Safety Authority: oil spill control agents. • Urgently cap or otherwise isolate the source of the oil to prevent further contamination. • Immediately resource and mobilise multiple expert wildlife care teams to search for, and rehabilitate, ill dusky sea snakes (and other threatened and priority taxa). Ensure there is sufficient expertise within the care team to assess the condition of sea snakes at sea for release or rehabilitation, effectively collect samples from live individuals for toxicology and pathology assessments, and safely collect and freeze deceased individuals for necropsy, pathology, and toxicology assessment.	It is noted that not all response strategies are appropriate for application for every oil spill scenario. Given this, Shell utilises a Spill Impact Mitigation Assessment (SIMA) to consider the response strategies that may need to be implemented to provide the most effective response. The SIMA (both strategic and operational) takes into account the broad environmental context of the spill, including environmental values and sensitivities, and potential environmental outcomes for marine reptiles. The intent of the SIMA is to minimise the overall impact environmental impact of the spill (i.e. not just to minimise the impact to a single species). Measures to reduce the risk and impact of an oil spill to “ALARP” and “acceptable” are set out in Section 9.15 and the associated BROPEP; including consideration of a range of response strategies (such as source control and oiled wildlife response). Attachment 1 of the BROPEP (Basis of Design and Field Capability Assessment) includes a capability assessment for oiled wildlife response, including the provision of multiple trained oiled wildlife experts/advisors. The Browse Regional OSMP requires arrangements to be in place for suitably qualified personnel to implement the Operational Monitoring Plan (OMP): Marine Fauna Assessment – Reptiles along with the Scientific Monitoring Plan (SMP) Marine Megafauna Reptiles, which both includes provision for the assessment of sea snakes to determine appropriate management and response actions during an oil spill event to minimise the potential impact to sea snakes. The OMP also includes provisions for necropsy and analytical testing of deceased sea snakes.
	Conclusion of having had regard to the conservation Advice for *Aipysurus fuscus* (dusky sea snake)	The assessment of the Conservation Advice for *Aipysurus fuscus* (dusky sea snake) demonstrates that Shell has given regard to the applicable Conservation Advice in accordance with NOPSEMA and DCCEEW requirements under the Streamlining Offshore Petroleum Environmental Approvals Program Report 2014[33].

External Context

To date, there are no unresolved objections or claims raised by Relevant Persons about emergency events. Shell’s ongoing consultation program considers feedback and claims or objections made by Relevant Persons

throughout the life of this EP. Where new impacts or risks are established these will be subject to the MOC process described in Section 10.3.5.

Internal Context

Shell also considered the internal context, including Shell's environmental policy and ESHIA requirements. The EPOs and the controls that will be implemented for the activity are consistent with the outcomes from consultation for the petroleum activity and Shell's internal requirements.

Shell will continue to maintain an appropriate spill response framework, which includes regular testing of the response arrangements as per Section 10.14.

Acceptability Summary

Given the significant consequences of the risks associated with a worst-case hydrocarbon spill, Shell has undertaken an extensive, conservative risk assessment and will apply a range of controls consistent with relevant requirements and industry best practice.

The acceptability of the potential impacts and risks from unplanned spills associated with the activity has been considered in the context of:

- the established acceptability criteria.
- ESD.
- relevant requirements.
- MNES.
- external context (i.e. stakeholder claims).
- internal context (i.e. Shell requirements).

Shell considers the risk of emergency events associated with the activity to be ALARP and acceptable.

9.14.6 Environmental Performance Outcome

EPO #	EPO	Measurement Criteria
2.2	Refer to EPO 2.2.	Refer to EPO 2.2.
4.3	Refer to EPO 4.3.	Refer to EPO 4.3.

9.15 Oil Spill Response Strategies

9.15.1 Spill Impact Mitigation Assessment

As described in the Spill Impact Mitigation Assessment (SIMA) presented in the BROPEP (HSE_GEN_016765), not all response strategies apply for every spill scenario (Section 9.14.1) and a combination of response strategies may need to be implemented for an effective response dependent on spill location, size and duration.

In all spill scenarios (Section 9.14.1) source control and surveillance, modelling and visualisation spill response strategies will be implemented as relevant to the nature and scale of the spill. For a release of light oils such as condensate and MDO, the success of various response strategies is considered to be limited based on the expected spread, dispersion and evaporation rates in the marine environment making certain strategies, such as 'contain and recover' and 'dispersant application', ineffective.

The available spill response strategies across multiple spill scenarios that are applicable to the Browse Region are assessed in the BROPEP. In the event of a vessel collision, the source control actions described in the vessel(s) SOPEP would also be initiated. An ALARP assessment of the BROPEP oil spill response strategies that are applicable to the activity is provided in Table 9-103.

Capability, readiness, and implementation requirements for the specific spill response strategies are addressed in the BROPEP, which includes control measures and EPSs and EPOs around the required level of performance of each response strategy, and hence are not repeated in this EP.

Table 9-103: ALARP Assessment of Oil Spill Response Capability

Oil Spill Response Strategy	Resources	Environmental Gain from Increasing or Improving Resources	Alternatives Considered	ALARP Assessment
Source Control				
Site survey	**Documents:** • Browse Basin SCERP. **Equipment:** • Vessel. • Aircraft. **Personnel:** • Source Control Branch. • Aerial observers (Shell operations personnel).	A site survey involves the use of a vessel and/or aircraft to conduct visual observations of the surface infrastructure, following a loss of containment event. The information gathered is used to enable further source control planning and establish source control activities that can be implemented. A single vessel and/or aircraft is required to conduct the site survey. Multiple vessels and/or aircraft would not result in a better environmental outcome. If the failure can be immediately isolated remotely then this is the quickest mitigation response to reduce the environmental impact.	Additional vessels (or aircraft) would not result in increased benefit for planning source control activities.	A suitable vessel or aircraft will be sourced by Shell during the timeframe stipulated in the BROPEP. The vessel/aircraft to undertake the site survey would be sourced from within Australia using Shell's established contracting procedures. Shell has third-party call off contracts for helicopters and fixed wing aircraft. These aircraft can be ready for mobilisation in 4–8 hours. The cost of maintaining a vessel (with full crew) or having aircraft on standby at all times to undertake a site survey is considered to be grossly disproportionate to the benefits given that suitable vessels and/or aircraft could be made available on short notice within the region.
Relief well drilling (primary containment method)	**Documents:** • Crux WOMP. • Crux Safety Case. • Browse Basin SCERP. • Relief Well Manual. • Well Kill Modelling & Analysis. • APPEA MoU. **Equipment:**	Improving the timeframes to drill a relief well will reduce the volume of hydrocarbons released to the marine environment.	The relief well injection spool (RWIS) is a spool piece with side outlets installed below the Blowout Preventers (BOP) of the relief well to enable the connection of more surface pumping resources. These additional resources can deliver greater kill fluid rates to the relief well. As all Crux wells can be killed with the pumping capacity of a standard MODU, use of the RWIS would not result in a faster well kill	Compliance with Shell's global standards for well design integrity assure mechanical and functional integrity for all anticipated loads throughout the life of the well. These standards meet or exceed current International and Australian standards. The APPEA MOU allows the signatories to share rigs, equipment, personnel, and

Oil Spill Response Strategy	Resources	Environmental Gain from Increasing or Improving Resources	Alternatives Considered	ALARP Assessment
	• Mobile offshore drilling unit (MODU) to drill a relief well and kill the well in 80 days, kill fluid & pumping equipment, tubulars, ranging equipment. **Personnel:** • Shell Relief Well Task Force with a response time of 24–72 hours. • Specialist personnel from Wild Well Control and Boots and Coots. Specialists are located at various international locations with a response time of +72 hours.		and subsequent environmental benefit.	services to assist other operators in the event of a well blowout. This would potentially enable Shell to source a suitable relief well MODU in a quicker timeframe, and would also provide access to additional equipment, personnel and services. Access to source control specialists is not considered a limiting factor.
Surveillance, Modelling and Visualisation				
Modelling (oil spill trajectory, fate & weathering, metocean data, satellite imagery)	**Processes:** • AMOSC call-off procedure. **Equipment:** • Automated Data Inquiry for Oil Spills (ADIOS2) on IMT computers. • In-house deterministic modelling. **Personnel:** • Shell Geomatics team.	Oil spill trajectory modelling can be commenced using AMOSC call off contract with RPS group within 2 hours of IMT being notified of the spill. The data would be used to inform Incident Action Plans (IAPs) and confirm the selection of other response strategies in the following days. Therefore, there is no environmental gain in improving the activation time frame.	N/A	No alternative or additional controls have been identified that could improve this response.
Surveillance – vessel	**Processes:** • N/A. **Equipment:** • Vessels. **Personnel:** • Trained vessel crew.	Several vessels will be present (during hot commissioning, completions, start-up, and IMR/maintenance activities during operations). Shell has a contract with marine vessel contractors to provide additional vessels for oil spill response activities if required. There is no	N/A	Increasing vessel surveillance capability is not considered to be warranted based on the limitations associated with visual observations made from a vessel platform. Aerial surveillance in conjunction with deployment of tracking buoys is a more effective

Oil Spill Response Strategy	Resources	Environmental Gain from Increasing or Improving Resources	Alternatives Considered	ALARP Assessment
		environmental gain from providing additional vessels.		method of obtaining situational awareness. Vessel surveillance can be undertaken through the use of existing vessels.
Surveillance – aerial	**Processes:** • Third party call-off contract. • Aerial surveillance observation log. **Equipment:** • Aircraft. **Personnel:** • Trained aerial observers (AMOSC/AMSA/OSRL).	Shell has third-party call off contracts for helicopters and fixed wing aircraft. These aircraft can be ready for mobilisation in 4–8 hours. Trained aerial observers are available within 24 hours.	Personnel trained in aerial observation could be on standby in order to provide higher quality data to the IMT. However, in the first 24 hours the spill it is likely to cover a relatively small geographical location close to the release point. Therefore, initial untrained observations are considered to be adequate given other data available to the IMT such as spill modelling, tracker buoy data etc.	Untrained aerial observation opportunities exist via Shell crew change helicopters. This in conjunction with tracking buoys and other surveillance, modelling and visualisation data is expected to provide sufficient information for the IMT in the first 24 hours, until such time as trained aerial observers are available. There is also the opportunity to use crew change helicopters from INPEX operations within close proximity to the Crux/Prelude field of operations for further observation.
Tracking buoys	**Process:** • N/A. **Equipment:** • Tracking buoys. **Personnel:** • Trained vessel/FLNG crew for tracking buoy deployment.	Tracking buoys are available for immediate deployment from various locations including the Prelude FLNG facility. No environmental benefits can be gained by increasing the number of buoys available or time to deploy.	Access to additional buoys is available from the shared stockpile located in Broome.	No alternative or additional controls were identified that could improve this response.
Shoreline Protection and Deflection				
Shoreline and nearshore booming equipment	**Processes:** • Browse Island Oil Spill Incident Management Guide (refer	Shoreline assessment specialised personnel can be deployed to remote shorelines from staging/accommodation facilities within 5–6 days. Undertaking quicker shoreline assessment would be beneficial to obtain pre-impact results, however, shorelines in the Browse Basin	N/A	Shoreline surveys must be conducted systematically to be a crucial component of effective decision-making. Repeated surveys are needed to monitor the effectiveness of ongoing treatment methods (i.e. changes in shoreline

Oil Spill Response Strategy	Resources	Environmental Gain from Increasing or Improving Resources	Alternatives Considered	ALARP Assessment
	Browse Island Oil Spill Incident Management Guide). **Equipment:** • AMOSC/OSRL specialised equipment. **Personnel:** • AMOSC/OSRL trained and experienced personnel.	are difficult to access due to their remoteness and safety risk. Earlier deployment may not result in an overall environmental gain.		oiling conditions, as well as natural recovery). Improving the time for specialised personnel to access remote shorelines to make assessments is not warranted and will not result in an environmental gain. Noting that the decision to commence this strategy may be made by WA DoT as the Control Agency.
Shoreline Clean-up				
Shoreline Clean-up Assessment	**Processes:** • Shoreline Clean-Up Assessment Operational Monitoring Plan (OMP) (refer to the NOPSEMA accepted Browse Regional OSMP (HSE_PRE_016370). • Browse Island Incident Management Guide. • Helicopter call-off contract. **Equipment**: • Staging and accommodation facility. **Personnel:** • AMOSC/OSRL trained and experienced personnel.	Shoreline assessment specialised personnel can be deployed to remote shorelines from staging/accommodation facilities within 5–6 days. Undertaking quicker shoreline assessment would be beneficial to obtain pre-impact results, however, shorelines in the Browse Basin are difficult to access due to their remoteness and safety risks. Earlier deployment may not result in an overall environmental gain.	N/A.	Shoreline surveys must be conducted systematically to be a crucial component of effective decision-making. Repeated surveys are needed to monitor the effectiveness and effects of ongoing treatment methods (i.e. changes in shoreline oiling conditions, as well as natural recovery). Improving the time for specialised personnel to access remote shorelines to make assessments is not warranted and will not result in an environmental gain. Noting that the decision to commence this strategy may be made by WA DoT as the Control Agency.
Manual and mechanical removal (washing, flooding & flushing, sediment reworking & surf washing)	**Processes:**	Predictive oil spill modelling indicated a number of receptors would see shoreline oil in the event of a worst-case spill. Depending on the sensitivity of the shoreline, removal of accumulated oil using heavy machinery and/or large numbers of personnel may result in additional	Costs for additional cleanup equipment are considered to be negligible and are not considered a limiting factor in the effectiveness of this strategy.	Shell has access to shoreline response kits. Given the logistical and safety limitations with shoreline response in the Browse Basin, implementation of the response will take ~1 week to occur from a decision being made

Oil Spill Response Strategy	Resources	Environmental Gain from Increasing or Improving Resources	Alternatives Considered	ALARP Assessment
	• Shoreline Clean-Up Assessment OMP. • Browse Island Incident Management Guide. **Equipment:** • AMOSC/OSRL specialised equipment. **Personnel:** • AMOSC/OSRL trained and experienced personnel.	environmental damage. Access by heavy machinery would also be restricted at offshore islands.	Constraints primarily lie in mobilising equipment and personnel safely rather than source additional equipment.	to commence (noting that this decision may be made by WA DoT as the Control Agency within state waters). Large scale operations involving large numbers of personnel and/or heavy equipment may cause adverse environmental impacts at many sensitive shoreline locations and would not result in an environmental gain. Manual clean-up equipment, using smaller teams for longer periods would be more effective in most of the shoreline locations predicted to be contacted.
Oiled Wildlife Response				
Oiled Wildlife Response implementation	**Processes:** • WA Oiled Wildlife Response Plan (DBCA 2022a). **Equipment:** • AMOSC Oiled Wildlife Response (OWR) containers (2) and box kits. NatPlan, OWR containers (4), OSRL OWR equipment. **Personnel:** • AMOSC/OSRL trained and experienced national and international OWR personnel.	Given access to local OWR equipment and personnel (AMOSC) through existing arrangements the response capability cannot be improved to result in an environmental gain unless an OWR kit is maintained offshore.	Any OWR will be undertaken in consultation with the relevant agencies e.g. WA DBCA, WA DoT and NT DEPWS. Such consultation is more likely to be a time limiting factor than accessing additional OWR resources.	Shell is a participating member of AMOSC with access to Mutual aid arrangements. AMSA MoU and OSRL contracts, enabling access to national and international oiled wildlife expertise. The closest OWR container is located in Fremantle and can be mobilised to Broome within ~30-60 hours by vessel. Additional containers and box kits are available from other locations within Australia (including Broome for the closest box kit). Maintaining a dedicated OWR kit offshore is not considered to be reasonable given the low likelihood of needing to implement an OWR and the requirement for trained OWR personnel.

Oil Spill Response Strategy	Resources	Environmental Gain from Increasing or Improving Resources	Alternatives Considered	ALARP Assessment
Waste management				
Waste management	**Processes:** • Oil Spill Waste Management Plan Template. **Equipment:** • Assorted waste receptacles and trucks from waste contractor with additional stocks from sub-contractors located in Darwin, Broome and/or Dampier. • 635 m^3 capacity of offshore storage in Darwin. **Personnel:** • Waste contractor personnel.	There are no limitations to obtaining the required waste storage capacity for this EP and no environmental benefit obtained by accessing additional waste storage capacity.	Costs for additional waste management resources are considered to be negligible.	Based on the BROPEP, the volume of waste generated by the worst-case spill is up to 5,500 m^3. Decanting from contain and recover operations will also generate waste for disposal (if and where practical). Typically, this oily liquid waste would be held within the inboard storage tanks of the vessels and disposed at a licensed onshore facility. Based on Shell's waste contractor capability the available resources are considered to be suitable for the worst-case spill scenario.

9.15.2 Aspect Context

This section describes any new or unique environmental impacts or risks presented by implementing the emergency events response strategies included in the BROPEP (HSE_GEN_016765), which may be enacted to respond to hydrocarbon and chemical spills as described in Section 9.14.

Typically, environmental aspects, impacts and risks that arise from conducting the emergency response activities are similar to those already described in Sections 9.3 to 9.14 for the planned and unplanned activities, particularly for vessel-based operations. Where additional impacts or risks exist for the identified aspects, these are described in the following subsection. Table 9-104 summarises the aspects generated by implementing the spill response activities and identifies any that are new or unique aspects for further assessment. If impacts and risks are adequately addressed in the preceding sections of this EP, as indicated in Table 9-104, they are not discussed further in this section.

As can be seen in Table 9-104, the drilling of a relief well (as part of the Source Control response) and shoreline clean-up activities (as part of the Shoreline Clean-up Assessment Technique (SCAT) and Shoreline Clean-up response) introduce aspects that require further assessment. Additional context on these response activities is provided in Section 9.15.2.1 and Section 9.15.2.2 respectively.

Table 9-104: Spill Response Strategies and Associated Environmental Aspects Identified for Each (Including Those Considered New or Unique)

		Aspects Generated												
		Physical Presence	Lighting[2]	Noise	Seabed Disturbance	Disturbance to Ground[1]	Vessel movements	Introduction of Invasive Marine Species	Produced Water	Activity Discharges	Atmospheric Emissions	Greenhouse Gas Emissions	Minor Releases and Waste	Emergency Events
Response Strategies	Source Control[3]	✓	✓	✓	✓		✓	✓	✓	×	✓	✓	✓	✓
	Surveillance, Modelling and Visualisation	✓		✓			✓	✓	✓	✓	✓	✓	✓	✓
	Natural Recovery													
	Protection of Sensitive Resources	✓		✓		×	✓	✓	✓	✓	✓	✓	✓	✓
	SCAT and Shoreline Clean-up		×			×				✓	✓	✓	✓	
	Oiled Wildlife Response	✓		✓				✓	✓	✓	✓	✓	✓	✓
	Operational and Scientific Monitoring	✓		✓			✓	✓	✓	✓	✓	✓	✓	✓

Notes:

✓ The aspects and associated impacts and risks are already adequately addressed in this EP (Sections 9.3 to 9.13).

× There is an aspect of the response activity that may produce a new or unique impact/risk not already addressed in this EP.

1 New or different aspect not previously described in this EP

2 Due to daylight operations only for typical vessel-based activities, lighting impacts for stationary, non-operating vessels at sea during night will not present a credible impact to sensitive receptors.

3 As described further in the BROPEP, source control activities to respond to a LOWC emergency event may include drilling a relief well. All source control activities will be managed in accordance with the accepted BROPEP, Safety Case and WOMP.

9.15.2.1 Relief Well Drilling

The Crux relief wells are designed in accordance with Shell's Relief Well Manual and Browse Basin experience. Relief well planning and well kill modelling has been documented in the Crux Relief Well Plan (SAPL-TECCRU-18431).

Relief Well Locations

The Crux relief wells locations and trajectories were developed for each well accounting for seasonal metocean conditions and safe offset distance from the Crux well centres.

The proposed relief well spud locations, relief well trajectories and subsea intersection point used for relief well design planning purposes are illustrated in Figure 9-17 and Table 9-105.

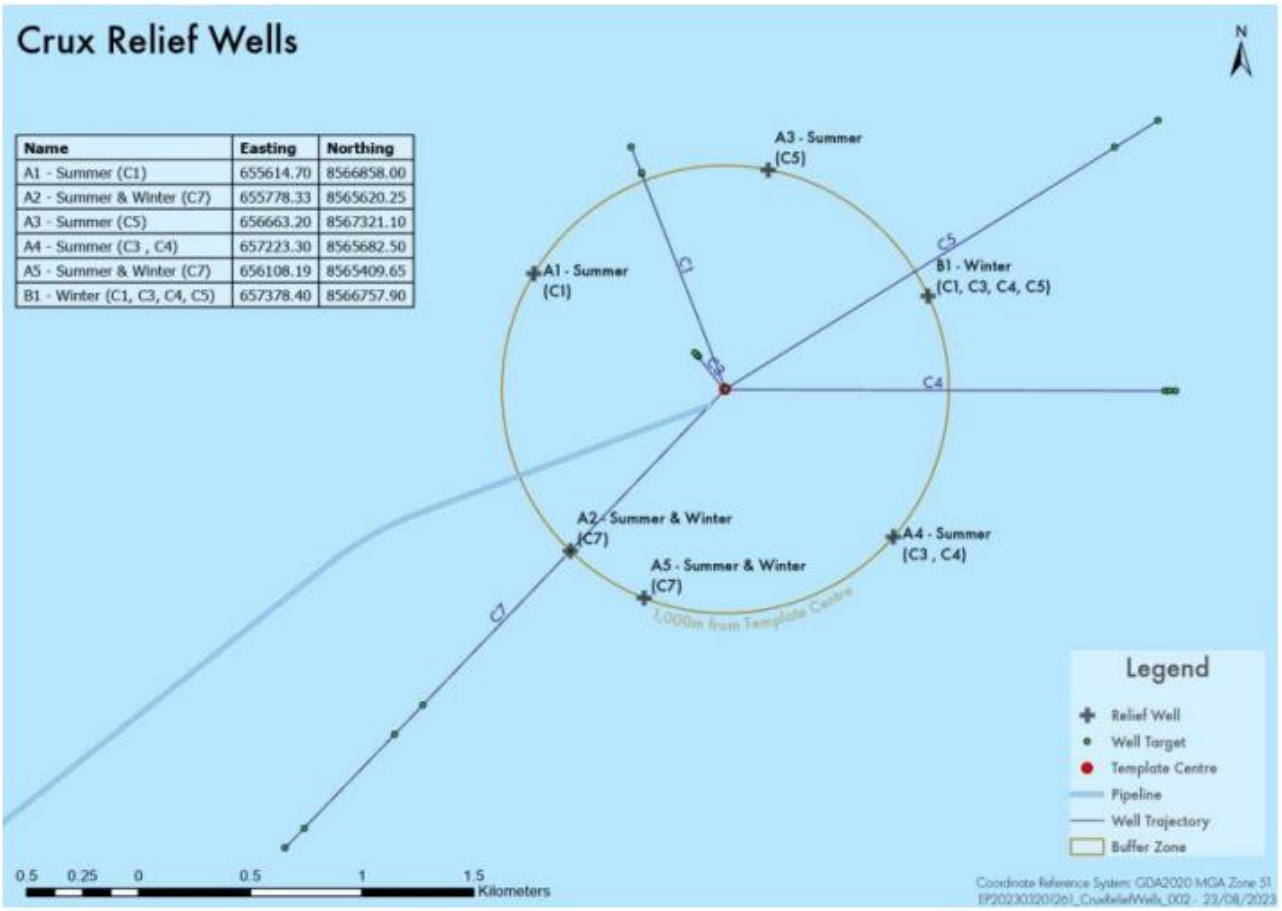


Figure 9-24: Illustration of Proposed Relief Well Spud Locations, Relief Well Trajectories and Subsea Intersection Points

Table 9-105: Preliminary Relief Well Surface Location Coordinated for the Crux Development at 1.0 km Offset from The Well (drill) Centre

Name	Target	East (GDA2020 Zone 51)	North (GDA2020 Zone 51)
A1 (Summer)	C1	655614.70 m	8566858.00 m
A2 (Summer & Winter)	C7	655778.33 m	8565620.25 m
A3 (Summer)	C5	656663.20 m	8567321.10 m
A4 (Summer)	C3 & C4	657223.30 m	8565682.50 m
A5 (Summer & Winter)	C7	565108.20 m	8565409.65 m

Name	Target	East (GDA2020 Zone 51)	North (GDA2020 Zone 51)
B1 (Winter)	C1, C3, C4 & C5	657378.40 m	8566757.90 m

A review of the seafloor was conducted using survey data collected in 2017 and is suitable for the mooring of a semi-submersible for drilling purposes. Generally, the seafloor is flat and featureless within a distance of at least 350 m from all proposed relief well locations. Within an assumed 1 km radius mooring spread, anchor scours from historical Crux exploration drilling operations and carbonate mounds may be found, but do not prevent the mooring of the relief well drilling unit at these locations.

Relief Well Design Criteria

The criteria below were adopted to define the relief well trajectories for planning purposes, as described in the Crux Relief Well Plan. Actual relief well trajectories may be adjusted as deemed necessary.

- Intersection point at the deepest casing shoe.
- Bypass the target well at least 900 ft (300 m) before intersection.
- The combined position uncertainty of both target and relief well is less than circa 45ft (15 m) at the bypass depth.
- No anticollision issues with other nearby Crux wells, either drilled or planned.
- Incident angle between relief and target well between 2 and 8 degrees.
- Maximum 3 deg/100 ft Dog Leg Severity used for planning purpose.
- 9⅝″ casing set in the relief well prior to intersecting target well with well with 8½″ Bottom Hole Assembly.
- Relief well shoe setting depth criteria similar as the target well, with the exception of the 9⅝″ casing that is set slightly shallower prior to intersecting the 8½″ hole in the target well.

Relief Well Design & Inventory

The relief well design follows the Shell Casing and Tubing Design Manual requirements. The relief well configuration follows a similar design rationale as the Crux Development wells:

- Conductor: provides structural support for the installation of the inner conductor and provides structural and fatigue integrity for the well. The low-pressure housing is welded to the first conductor joint. For the Crux development wells a 36″ conductor setting depth up to circa 62 m True Vertical Depth below mudline is targeted.
- Inner conductor: provides structural and fatigue integrity of the well, including all subsequent casing strings and the weight of the Blowout Preventor (BOP). For the Crux development wells a 26″ inner conductor is used with a setting depth at circa 350 m True Vertical Depth below mudline.
- Surface casing: provides pressure integrity when drilling the subsequent 12¼″ section with BOP installed. For the Crux development wells the high-pressure wellhead housing is welded to a 22″ extension joint and swaged to 13⅜″ casing (or similar).
- Intermediate casing: The last casing set prior to drilling the intersect section. This string is designed to withstand all loads associated with the dynamic kill. On the Crux development a tapered 10¾″ x 9⅝″ casing is used.
- Wellhead systems: A dedicated wellhead system is held in storage as part of the Crux relief well inventory, which is the same wellhead system as used on the Crux development wells. Service agreements will be in place for running tools and associated wellhead services.

Casing and liner, associated accessories and wellhead equipment will be maintained to ensure there is always equipment readily available to drill a Crux relief well. The minimum relief well equipment inventory is defined in the Crux Relief Well Plan and shown below in Table 9-106.

Table 9-106: Minimum Relief Well Equipment Inventory

String	Quantity
36″ 553ppf 1.5″ WT X65-M Viper-3ST M95 or similar	2 jts
36″ 553ppf 1.0″ WT X65-M Viper-3ST M95 or similar	2 jts
36″ 553ppf 1.0″ WT X65-M Viper-3ST M95 shoe joint or similar	1 jts
26″ 202ppf 0.75″ WT X70-M Viper-3ST M95 or similar	350 m
26″ 202ppf 0.75″ WT X70-M Viper-3ST M95 shoe joint or similar	1 jts
13⅜″ 72ppf P110 VAM21 or similar	2213 m
10¾″ 65.7ppf L80 VAM21 or similar	600 m
9⅝″ 53.5ppf Q125R VAM21 or similar	4050 m
Wellhead	**Quantity**
LB-2M Low-pressure wellhead housing	1 x
LB-2M 15ksi High-pressure wellhead housing	1 x

Well Kill Modelling Summary

Dynamic well kill simulations are documented in the Crux Relief Well Plan, confirming the Crux Development wells can be killed with a single relief well.

Relief Well Drilling Rig Specifications

Relief well drilling rig specifications are capture within the Crux Relief Well Plan, with key specifications summarised in Table 9-107 below.

Table 9-107: Relief Well Drilling Rig Specifications

Specification	Value
Water depth rating	>170 m
Station keeping	Anchor moored
BOP rating	10,000psi or more
Fluid storage capacity	>4050bbl (Min. 3 x Crux Development Well volume)
Mud pump system	4 x National Oilwell Varco 14-P-220 or Lewco W-2215 triplex or similar mud pumps
Cement unit	>2,000 HP
Choke & kill lines	3 1/16″ or more
Hookload	860,000lbf (Min. required for the drilling of Crux Dev. Wells)
Max drilling depth	Min. circa 4,000 m (Deepest planned intersect point)

Relief Well Drilling Rig Sourcing

Shell is a signatory to an Australian Petroleum Production and Exploration Association (APPEA) memorandum of understanding 2022 (MoU) between Australian offshore operators to provide mutual aid to facilitate and expedite mobilising a MODU and drilling a relief well in the event of a loss of well control incident. The MoU enables the signatories to share rigs, equipment, personnel and service to assist another operator in need.

MODU availability is tracked on a monthly basis. Shell has access to Clarksons Sea/response software platform through its OSRL membership. The software uses its patented technology to identify emergency vessels, rigs and equipment most suitable for source control operations and those that are closest to the incident location.

Sea/response real-time vessel tracking has been set up to search vessels on pre-identified mission requirements covering Capping, Containment and Offset Installation Equipment (OIE). Vessels that already have an approved Safety Case for working in Australia are tracked.

Shell Australia has arrangements in place for specialist assistance to help with engineering and operational support for relief well planning and execution. Shell has Global Framework Agreements (GFA) in place with the two preferred tertiary well control contractors Wild Well Control (Outline Agreement 46

64445) and Haliburton Boots & Coots (Outline Agreement 4610065559). In turn, Shell Australia has local contracts with both providers to allow a rapid call-off.

The scope of services covered by these contracts includes but is not limited to:

- Emergency response services involving all activities necessary to establish control over a blowing well.
- Well control management services involving the integration of the well control contractor into the Source Control Branch for effective and harmonised levels of communication and control.
- Routine engineering services and contingency planning.
- Training of personnel.
- Developing well intervention methods.
- Modelling the reservoir including inflow performance and kill rate requirements.
- Firefighting, including well capping, snubbing, freezing, hot tapping and valve drilling.
- Relief well planning and drilling, pumping services.
- Environmental clean-up services.

Directional drilling and ranging services can be provided under the existing local Shell Australia Well Services Contract. Alternatively, ranging services can also be provided by Haliburton under the Boots and Coot GFA. Similarly, well kill modelling services are available under the above services can also be provided through the existing Well Services Contract with Schlumberger who have provided relief well planning services for Crux in 2022.

Relief Well Drilling Response Time Model

It is estimated a suitable MODU could reach the well location and kill the well within 80 days. A detailed response time model with key milestones in line with APPEA Source Control Guidelines is presented in the table below for MODUs active in Australian Waters.

Non-drilling performance specific durations follow the recommendations within the Australian Offshore Titleholders Source Control Guideline (APPEA 2021). Drilling durations are based on the Crux Development well planning assumptions with additional allowance for ranging and well kit (See Table 9-108). Drilling timings benchmark with industry data and follow Operator historical Trouble Free Time and Non Productive Time offset drilling performance trends.

Table 9-108: Relief Well Drilling and Well Kill Duration

Phase	Task/Milestone	Duration (day(s))
Activation (7 days)	• Event reported. • Begin sourcing of relief well rig. • Concurrently begin activation of source control team and source control specialists.	1

Phase	Task/Milestone	Duration (day(s))
	• Relief well rig confirmed. • Relief well MODU mobilisation to relief well location. • Concurrently, commence preparation of relief well MODU Safety Case Revision. • Concurrently, commence preparation of relief well WOMP.	6
Transit (21 days)	• Relief well MODU contract confirmed. • Finalise preparations for mobilisation to relief well location.	3
	• Mobilise rig to relief well location.	18
Drilling & Well kill (52 days)	• Relief well MODU Safety Case Revision and WOMP approved by NOPSEMA. • Commence preparations for spud. • Commence mobilisation of equipment to relief well MODU.	3
	• Commence relief well drilling operations to intercept and kill the well. • Continue mobilisation of equipment and personnel required to kill the well. • Finalise well kit preparations and conduct well kill.	49

9.15.2.2 Shoreline Clean-up and Protection of Sensitive Resources

Conducting shoreline protection and clean-up involves moving personnel and equipment, which introduces the environmental aspects of ground disturbance and (possibly) local lighting. The objective of shoreline clean-up is to apply clean-up techniques that are appropriate to the shoreline type so as to remove as much oil as possible where there is a net environmental benefit in doing so. Various techniques may be used alone or in combination to clean up oiled shorelines, including shoreline clean-up assessment techniques, natural recovery, absorbents, sediment reworking, manual and mechanical removal, and washing, flooding, and flushing. Considerations for selecting and implementing shoreline clean-up techniques are included in the BROPEP.

Deploying booms to protect sensitive shoreline receptors, typically pre-emptively, introduces the potential for ground disturbance or damage to nearshore habitats such as intertidal reefs, seagrasses and macroalgal communities that are present at offshore islands/shorelines.

Due to the remote locations at which these response activities may be undertaken, and associated logistic and safety considerations, it is very unlikely that nighttime operations would be conducted. If they were required, the associated lighting would involve mobile, low elevation sources with limited potential for light affects beyond the area of activity.

9.15.3 Description and Evaluation of Impacts

Table 9-109 indicates the environmental features, values and sensitivities that have been identified to be potentially affected by the oil spill response strategies in the event of an emergency event during the activities covered by this EP. Features or values and sensitivities which could not be credibly affected by oil spill response strategies are not discussed further.

Table 9-109: Oil Spill Response Strategies Receptor Impact Screening Summary

	Protected Areas			Features															Values and Sensitivities																													
				Physical		Natural				Socioeconomic								Heritage and Cultural			Physical				Natural							Socioeconomic								Heritage and Cultural								
Aspect	**Receptor**	Marine Conservation Reserves	Wetlands of International and National Importance	Commonwealth and National Heritage Places	Marine Regions	Australian Environment	Northwest Shelf Province Bioregion	Northwest Shelf Transition Bioregion	Northwest Transition Bioregion	Timor Province Bioregion	People and Communities	Fishing Industry	Tourism and Recreation	Defence	Shipping	Scientific Research/Restoration	Oil and Gas Industry	Indonesian and Timor-Leste Coastlines	Underwater Cultural Heritage	Traditional Indonesian Fishing	Indigenous Cultural Connections	Air Quality	Water Quality	Sediment Quality	Underwater Noise	BIAs	Critical Habitat	Shoals and Banks	Offshore Reefs and Islands	Coastal Reefs and Islands	KEFs	Threatened, Migratory, Marine and Cetacean Species	Fishing Industry	Tourism and Recreation	Defence	Shipping	Scientific Research/Restoration	Oil and Gas Industry	Indonesian and Timor-Leste Coastlines	Underwater Cultural Heritage	Traditional Indonesian Fishing	Indigenous Cultural Heritage
		×								×													×	×					×			×													

Legend:		
		Potentially affected
	×	Predicted impact

9.15.3.1 Source Control (Relief Well Drilling)

Drilling of a relief well in response to a LOWC at the Crux platform will result in additional/different activity discharges to sea from those described in Section 9.10, notably cuttings and drilling fluids. Associated environmental effects include localised disturbance to seabed sediments and associated benthic communities, and a localised and temporary reduction in water quality. All of the pre-selected relief well drilling locations are in deep (~165 m) water, ~13 km from the nearest known banks or shoals and where the seafloor is expected to comprise predominantly bare unconsolidated substrates. The discharges associated with the drilling of relief wells are not dissimilar to those from drilling of production wells, with the same/similar potential environmental impacts and risks, and the same/similar management controls. Detailed evaluation of these impacts and risks is provided in the Crux Development Drilling EP (Shell 2023) and summarised below.

9.15.3.1.1 Physical Features, Values and Sensitivities

Water and Sediment Quality

Impacts to water quality from the discharge of drilling fluids and cuttings typically occur within close proximity of the discharge point. This is supported by results from the modelling of drill cuttings and fluids discharges for the Crux foundation wells conducted for the OPP, which indicated dilution is expected to occur rapidly due to the currents in the open ocean environment (RPS 2018a). Very fine cuttings form a very small portion of the total amount of cuttings and fluids discharges as they tend to clump together to form larger particles that sink relatively quickly. The combination of low toxicity and rapid dilution of unrecoverable drilling fluids discharged in association with drill cuttings are of little risk of direct toxicity to water-column biota (Neff et al. 2000).

The majority of drill cuttings and residual fluids will be deposited in the area around the discharge location and will form a cuttings pile. The accumulation of cuttings will physically modify the sediments by modifying the particle size distribution. Stochastic modelling results indicate the cuttings pile may reach a thickness of up to 374 mm for a single well (RPS 2018a), which will be largely comprised of coarse cuttings directly under the discharge location. Impacts to sediment will decline with increasing distance from the wells.

The coarser sediments deposited directly under the discharge location are unlikely to be resuspended by currents and will gradually be buried by naturally deposited sediments over time. Finer sediments deposited further away may be reworked by currents and transported via saltation or as suspended sediments.

Based on the assessment, potential impacts to physical features, values and sensitivities from the discharge of drill cuttings and fluids are considered to be Minor, with no long-term effects anticipated.

9.15.3.1.2 Natural Features, Values and Sensitivities

9.15.3.1.2.1 Timor Province Bioregion

Benthic Communities

The discharge of drill cuttings and residual fluids will impact upon benthic communities due to the potential physical and chemical changes to sediments. The deposition of cuttings has the potential to smother sessile benthic organisms, with effects predicted to occur at deposition thicknesses of greater than 6.5 mm (IOGP 2016). Sedimentation is an ongoing natural process, and benthic organisms exhibit adaptations to respond to increased sediment deposition. Natural sedimentation rates in northwest Australia were estimated by Glenn (2004) to range between ~0.17 mm and 2.23 mm per year.

The benthic communities within the Activity Area comprise sparse epibenthic burrowing macrofauna on soft sediment substrates (Fugro 2017a). These are widely represented in the region and are not of high environmental value. Modelling studies (RPS 2018a) indicate these communities will be affected by the discharge of drill cuttings and fluids out to a range of ~326 m from the discharge point (e.g. some reduction in species diversity and abundance). High levels (>10 mm) of burial will occur out to a radius of ~68 m; sessile benthic fauna within this range are expected to be completely smothered.

The relief well drilling locations are not close to any sensitive or high conservation value benthic habitats. The absence of benthic primary producers in this environment and the relatively short duration of the discharge limits the potential for impacts upon benthic communities. Given this, impacts are expected to be Minor, with no long-term effects anticipated.

Pelagic Communities

Adverse effects on pelagic species, including planktonic communities, may occur due to a change in water quality following discharges of drill cuttings and fluids. Impacts to these organisms can be as a product of both physical and chemical alterations of water quality predominantly in the water column.

Studies by Smit et al. (2008) indicated that phytoplankton and filter-feeding zooplankton typically exhibit greater effects from suspended solids from drilling and suggested that these biota are less well-adapted to relatively high concentrations of suspended sediments than benthic biota. Concentrations at which impacts to phytoplankton may result are highly localised and unlikely to occur >25 m from the discharge point (IOGP 2016; Smith et al. 2004). Studies indicate effects of drilling fluids and cuttings on zooplankton at concentrations >100 mg/L are unlikely, based on 96-hr exposure duration experiments. Concentrations >100 mg/L for more than 96 hours during relief well drilling activities would only occur in the immediate vicinity of the discharge location. Minimal impact to plankton (phytoplankton, zooplankton and meroplankton (larvae of invertebrates and fish) is therefore expected from the discharge of drill cuttings.

The localised, temporary decrease in water quality from the discharge of drill cuttings and fluids may temporarily displace pelagic marine fauna from the plume; this short- term, behavioural impact is considered to be negligible. Neff (2010) explains that the lack of toxicity and low bioaccumulation potential of the drilling muds means that the effects of the discharges are highly localised and are not expected to spread through the food web.

Given the open ocean location of the relief well sites and associated environmental conditions (i.e. windy, strong currents, etc.), the content and dispersive nature of drilling muds within the marine environment, and the small proportion of any pelagic species population that may be affected by localised and temporary impacts to water quality, the impacts to pelagic communities from drilling discharges are considered to be Slight.

9.15.3.1.2.2 Threatened, Migratory, Marine and Cetacean Species

There are no aggregation areas for EPBC Act listed species within the areas potentially affected by drilling discharges. The benthic habitats in the vicinity of the relief well locations are unlikely to support substantive foraging or other important lifecycle activities in any species. Many of the threatened, migratory, marine and cetacean species potentially exposed to discharges (e.g. cetaceans, marine turtles) are air-breathing vertebrates which are unlikely to be directly affected as their skin is relatively impermeable. Given the localised and temporary nature of effects to water quality as a result of drilling discharges, and the very low numbers of any threatened, migratory, marine and cetacean species likely to be present coincident with discharge, the impacts to pelagic communities from drilling discharges are considered to be Slight.

9.15.3.2 Shoreline Clean-up and Protection of Sensitive Resources– Disturbance to Ground and Lighting

The oil spill modelling for the worst-case Crux LOWC scenario indicates that the only permanent shoreline that may receive condensate above >100 g/m^2 is at Cartier Island. Given that the shortest period to exposure at these levels is >35 days by which time the toxicity of the condensate would have attenuated through weathering, the probability that clean-up activities would offer the potential for net environmental benefit is likely to be low. However, discussion of the potential effects of response activities is included below for completeness.

9.15.3.2.1 Protected Areas

Cartier Island and surrounding reefs are protected by Cartier Island Marine Park, which provides habitat for a number of EPBC Act listed species. The potential impacts of response activities on these values are discussed in Section 9.15.3.2.2.

9.15.3.2.2 Natural Features, Values and Sensitivities

Offshore Reefs and Islands

Conducting shoreline clean-up activities, including moving personnel and equipment, has the potential to cause damage to terrestrial and intertidal habitats, with subsequent impacts to dune/beach structure, flora (e.g. macroalgae) and fauna (e.g. turtles and birds [including nests]). Invasive or frequent clean-up can also involve physical removal of substrates that could adversely impact habitats and fauna and alter coastal geomorphology and hydrodynamics. The impacts associated with undertaking shoreline clean-up may be more than if the product was left in place and remediated through natural processes (Natural Recovery). Leaving the product

in place is a very common response option if continual human and vessel/vehicle traffic has the potential to generate greater impacts than the product itself. The optimal suite of response strategies will be determined through the SIMA process described in the BROPEP.

Deploying booms to protect shorelines and intertidal environments could potentially cause physical damage to coral reefs/intertidal ecosystems through boom and/or anchor movements. Reviewing shoreline and shallow-water habitats and bathymetry and establishing demarcated areas for access and anchoring will reduce impacts to nearshore environments.

Given the controls in place and the short-term and localised incidental environmental effects from shoreline clean-up activities, there would only be Minor residual impact consequences presented by personnel and equipment undertaking shoreline clean-up activities (Magnitude: −2, Sensitivity: M).

9.15.3.2.2.1 *Threatened, Migratory, Marine and Cetacean Species*

Shoreline clean-up and protect/deflect activities will be managed to minimise impacts on turtles (including hatchlings) and birds (and other fauna) by minimising disturbance to important habitats, such as nesting and feeding sites. Small boats or helicopters would be used to transfer responders to shore, and they would be accommodated on nearby medium-sized vessels or facilities such as Prelude (if available). Assessing appropriate equipment and personnel numbers required to reduce habitat damage, along with establishing access routes/demarcation zones, and operational restrictions on equipment and personnel movements will limit sensitive habitat damage and damage to important fauna areas. Temporary camp areas will be established in consultation with WA DBCA, WA DoT and NT DEPWS.

Although unlikely, shoreline response activities may require use of lighting, which can cause disorientation and/or disruption to nesting and breeding behaviours in seabirds, shorebirds and turtles. The need to conduct night-time operations in sensitive areas will be assessed and operational restrictions established. It is considered unlikely that operations will be conducted at night because of the remote location of potentially impacted shorelines, the use of small teams to conduct response operations to reduce ecological impacts (see Section 12.3 of the BROPEP) and the safety implications associated with dangerous marine fauna (e.g. saltwater crocodiles).

Given the controls in place and the short-term and localised incidental environmental effects from shoreline clean-up activities, there would only be Minor residual impact consequences presented by personnel and equipment undertaking shoreline clean-up activities (Magnitude: −2, Sensitivity: M).

9.15.4 Impact Assessment Summary

Table 9-110 lists the highest residual impact consequence rankings of the relevant environmental receptor groups.

Table 9-110: Oil Spill Response Strategies Evaluation of Residual Impacts

Environmental Receptor	Magnitude	Sensitivity	Residual Impact Consequence
Evaluation – Planned Impacts			
Protected Areas	−2	M	Minor
Physical Values and Sensitivities	−2	M	Minor
Natural Features	−2	M	Minor
Natural Values and Sensitivities	−2	M	Minor
Socioeconomic Features	N/A	N/A	N/A
Socioeconomic Values and Sensitivities	N/A	N/A	N/A
Heritage and Cultural Features	N/A	N/A	N/A
Heritage and Cultural Values and Sensitivities	N/A	N/A	N/A

Potential impacts to socioeconomic, heritage and cultural receptors are not predicted to exceed those presented in Section 9.14 and therefore are not repeated in this section.

9.15.5 ALARP Assessment and Environmental Performance Standards

Table 9-111 presents the ALARP assessment of oil spill response capability. A description of controls, EPSs and measurement criteria for each oil spill response strategy are presented in the BROPEP.

9.15.6 Acceptability of Impacts

Table 9-111: Acceptability of Impacts – Oil Spill Response Strategies

Receptor		Acceptable Level of Impact	Acceptable?	Acceptability Assessment
Category	**Subcategory**			
Protected Areas	Marine conservation reserves	No impacts to the values of marine parks.	Yes	SCAT and shoreline cleanup or protection of sensitive resources activities only activated where net environmental benefit predicted and subject to implementation controls in consultation with relevant agencies to ensure no significant adverse impacts to fauna or habitats that represent marine park values.
Physical features, values and sensitivities	Water quality	No significant impacts to water quality. Impact not expected to result in a substantial change in water quality, which may adversely impact biodiversity, ecological integrity[26], social amenity or human health.	Yes	The discharge of drilling fluids and cuttings has the potential to result in reduced water quality at the discharge location, however discharges will dilute in the open ocean environment. Modelling studies indicate impacts to water and sediment quality are highly localised around the discharge location (being open offshore waters with no significant seabed features), which is consistent with industry monitoring studies. Shell will implement measures to reduce the potential for impacts to water and sediment quality from drilling discharges. Slight impacts that are localised to the vicinity of the relief well drilling location are considered acceptable.
	Sediment quality	No significant impacts to sediment quality. Impact not expected to result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity[26], social amenity or human health may be adversely affected.	Yes	
Natural features, values and sensitivities	Marine bioregions	No significant impacts to benthic habitats and communities. Impacts to non-sensitive benthic communities limited to a maximum of 5% of the Project Area (as defined in the OPP). No significant adverse effect on pelagic communities, populations, habitats or spatial distribution of a species. No substantial adverse effect on a population of a marine species or cetacean including its lifecycle and spatial distribution.	Yes	The benthic habitats and communities within the area of potential affects from relief well drilling discharges are broadly distributed and not considered unique or particularly sensitive. Impact predicted to be highly localised to platform location and to represent <5% of the Project Area (as defined in the OPP). Given the dispersion and dilution predicted following discharge, mobile species unlikely to be exposed to sufficiently reduced water quality for sufficient durations to have significant impacts on mobile species. Localised scale of effects represents a negligible proportion of regional planktonic assemblage distributions which are expected to rapidly recover from any adverse effects. Given the absence of important habitat and ecological assemblages of pelagic species, no significant adverse impact on pelagic communities, populations, habitats or spatial distribution of a species expected. SCAT and shoreline cleanup or protection of sensitive resources activities only activated where net environmental benefit predicted and subject to implementation controls in consultation with relevant agencies to ensure no significant adverse impacts.
	Threatened, migratory, marine and cetacean species	Management of aspects of the activity must align with Conservation Advice, recovery plans and threat abatement plans. No significant impacts to EPBC Act listed threatened, migratory, marine or cetacean species.	Yes	The number of EPBC Act listed species within the localised area temporarily affected by relief well drilling discharges is expected to be low. Many are air breathing vertebrates, which are unlikely to be directly affected as their skin is relatively impermeable. Temporary disturbance to low numbers of individuals will not cause significant impacts. SCAT and shoreline cleanup or protection of sensitive resources activities will only be activated where net environmental benefit predicted and subject to implementation controls in consultation with relevant agencies to ensure no significant adverse impacts.

New and/or unique environmental impacts associated with implementing the possible spill response strategies are considered to be acceptable if they present a net environmental benefit compared to the 'do nothing' option as determined and documented through the SIMA process (as described in the BROPEP).

Assessing these impacts from the spill response strategies discussed above determined a residual ranking of Minor or lower (Table 9-110). The acceptability of these impacts has been considered in the following context.

Principles of ESD

The response option impacts described above are consistent with the principles of ESD because:

- The health, diversity and productivity of the marine environment will be optimised for future generations by minimising the impact of any large-scale spills by implementing the accepted BROPEP and associated response strategies.
- The precautionary principle has been applied, and studies were undertaken where knowledge gaps were identified. This knowledge was applied when evaluating environmental impacts.
- With the prevention and mitigation controls in place, the conservation of biological diversity and ecological integrity will be optimised following a large-scale spill.

Relevant Requirements

Managing the impacts associated with implementing oil spill response strategies is consistent with relevant legislative requirements, including:

- The NOPSEMA-accepted BROPEP (HSE_GEN_016765).

Matters of National Environmental Significance

Threatened and Migratory Species

Alignment with the relevant management plans, recovery plans and Conservation Advice for threatened and migratory fauna will be addressed on a case-by-case basis through the SIMA process when selecting appropriate spill response strategies (see Table 7-16 for the list of potentially applicable plans and advisory documents). These plans and advisory documents will help determine protection priorities once the nature, scale and trajectory of the spill is understood.

Commonwealth Marine Environment

The new and/or unique environmental impacts presented by source control (relief well), SCAT/shoreline cleanup and protection of sensitive resources on the Commonwealth marine environment when assessed in isolation from the spill event itself will not credibly exceed any of the significant impact criteria, as listed in Table 8-1.

External Context

To date, no objections or claims about oil spill response strategies have been raised by relevant persons. Shell's ongoing consultation program will consider statements and claims made by relevant persons when further assessing the risks (see Section 5.13).

Internal Context

Shell also considered the internal context, including Shell's environmental policy and ESHIA requirements. The EPOs and the controls that will be implemented for the activity are consistent with the outcomes from consultation for the petroleum activity and Shell's internal requirements.

Acceptability Summary

The acceptability of the associated impacts have been considered in the context of:

- the established acceptability criteria.
- ESD.
- relevant requirements.
- MNES.
- external context (i.e. stakeholder claims).

- internal context (i.e. Shell requirements).

The potential residual impacts are deemed to be minor, which Shell considers to be acceptable if they meet legislative and Shell requirements. The discussion above demonstrates that these requirements have been met in relation to the new and/or unique impacts associated with implementing the spill response strategies. Shell considers the potential residual impacts to be ALARP and acceptable.

9.15.7 Environmental Performance Outcome

EPO #	EPO	Measurement Criteria
13.1	Select and implement spill response strategies to minimise the overall environmental impacts from a spill and the associated response strategies.	BROPEP implementation records and SIMA records.

10 Implementation Strategy

Section 22 of the OPGGS(E) Regulations requires a strategy to be incorporated into the EP that describes the environmental management system; responsibilities of employees and contractors; monitoring and reporting; oil pollution emergency response and testing; and consultation and compliance to be implemented for the activity.

10.1 Management Systems

The Shell Management System (Management System) provides a structured and documented system for effectively managing impacts and risks in compliance with relevant Shell SEAM Standards (Sections 4.3 and 10.2), and within the boundary of the overarching Shell Performance Framework (Section 4.1) and HSSE and SP Policy and Commitment (Section 4.2). The Management System consists of the key management system elements such as Governance; Legal; Health; Process Safety; Personal Safety; Security; Environment; Projects; Transport; Social Performance and Product Stewardship; Leadership and Commitment; Policy and Objectives; Organisation, Responsibilities and Resources; Learning and Competence; Managing Risk; Planning and Procedures; HSSE Consultation/Communication; Emergency Response; Permit to Work; Management of Change; Incident Investigation and Learning; Performance Monitoring and Reporting; HSSE Assurance; Audit and Assurance; Manage Exceptions; and Management Review.

The Management System will be implemented through all activity phases and will transition in alignment with activity sequencing from well completions (Section 10.1.1) leading into hot commissioning and start-up (Section 10.1.2) into operations (Section 10.1.3 and remainder of Section 10). The transition will be governed by a Project to Asset Transition Map that will be subject to continued development prior to activities commencing.

10.1.1 Well completions

The Project HSSE Management Plan implements the Management System in conjunction with contractor management systems during well completions, supplemented by a detailed Field Management Plan (FMP) (Table 10-2) that plans, coordinates and designates routine and infield communications, field operation protocols (such as safety zones, exclusion zones, barge management, approach and stationing, ROV operations, vessels operations, and vessel holding areas in addition to specific field plan requirements for well perforation and clean-up activities). The FMP also:

- Establishes the plan and interfaces for permitted operations (including management of any well completions and hot commissioning SIMOPS activities), management of change, stop work protocol, security requirements, safety case and environmental management requirements.
- Designates plans and interfaces for contractors working on the Activities and forms a bridging document for the Contractors' HSSE Management Plans which are stipulated under Shell contracts.
- Designates plans and interfaces for marine and aviation operations, including marine vessel assurance, helicopter operations, crane interface, personnel transfer, cargo transfer and bunkering, and infield standby vessel management.
- Designates plans and interfaces for emergency response and adverse weather management which includes (but not is not limited to) dropped object management, subsea equipment damage and hydrocarbon release incident management; search and rescue and medivac; and incident notification, reporting, investigation; weather forecasting and cyclone management.

A FMP for the Prelude FLNG PSZ will also be in place prior to offshore execution. The FMPs will carryover from project activities outside/prior to the scope of this EP (e.g. offshore installation). The FMPs are overseen by the Offshore Coordination Lead who is also accountable for Permit to Work and PIC during well completions whilst the Well Operations Manager is accountable for the well completions activity (Table 10-1).

Contract HSSE Management Plans (Contract HSSE MP) are requirements of all offshore execution contracts and have requirements for Environmental Management Plans (or similar) to incorporate requirements specified by Shell. Shell implements specific processes and activities aimed at ensuring that contracts consistently and effectively manage risks for the contracted activities, governed by the HSSE and SP Contractor Management Strategy Manual (see Section 10.3.1).

During this activity phase, the Shell Wells function owns the governing management system, and all subsequent Management System (Contractor and Shell) will bridge to that (Table 10-2).

Environmental requirements of this EP relevant to well completions activity will be provided to relevant Contractor's in the form of a flow through specification or instruction (or as relevant to the contractual instruments). EPS and related obligations will therefore become a key element of each Contractor's HSSE Management Plan, as relevant to that work scope.

Throughout the well completions activities, the Crux Project Director will be accountable for implementation of this EP. The Well Operations Manager and HSSE Manager (Project) will be responsible for implementation/execution/delivery of environmental performance standards and oversight of relevant Contract HSSE Management Plan's, and hence environmental performance of Contractors relating to this EP and Shell requirements. Contractor roles and responsibilities for environmental management will be outlined in the respective Contract HSSE MP.

10.1.2 Hot commissioning and start-up

The Project HSSE Management Plan will transition to an Operations HSSE Management Plan (or equivalent) during hot commissioning (as this aligns with introduction of hydrocarbons to the topsides and custody transferred from Well Operations Manager to the Readiness and Start-up Manager, Table 10-2) in preparation for start-up and ramp-up phases. Similarly, the FMP active during well completions will be superseded by a revision for hot commissioning and start-up (Table 10-2). If there are any SIMOPS between well completions and hot commissioning activities, these will also be managed by the designated FMP(s) (see Section 10.1). From hot commissioning phase onward, the facilities are under asset custody and the Management System for operations activity phase commences at this point, however the following arrangements will apply during the periods that Contractors are still supporting various activities in this phase (including second stage well clean-up, finalisation of hot commissioning).

- The FMPs will continue to be overseen by the Offshore Coordination Lead, however, accountability for Permit to Work and PIC position will be transitioned to the Operations Lead. The Readiness and Start-up Manager is accountable for the hot commissioning and start-up activities (Table 10-1).
- Environmental requirements of this EP relevant to hot commissioning and start-up activities will be provided to relevant Contractors in the form of a flow through specification or instruction (or as relevant to the contractual instruments). EPS, EPOs, and related obligations will therefore become a key element of each Contractor's HSSE Management Plan, as relevant to that work scope.
- The Crux Project Director will handover accountability for this EP to the Vice President Prelude/Crux, and a range of disciplines will be responsible for implementation of this EP (Table 10-1).
- The Prelude OIM, Commissioning and Start-Up (CSU) Lead, Readiness and Start-up Manager, Offshore Coordination Lead, and Operations Lead each have different accountability tasks and scope ownership during the hot commissioning and start-up activities, hence will be responsible for execution/delivery of environmental performance standards and oversight of relevant Contract HSSE Management Plans for different scope components. These positions therefore play a key oversight role for the environmental performance of Contractors relating to this EP and Shell requirements (Table 10-1). Contractor roles and responsibilities for environmental management will be outlined in the respective Contractor HSSE Management Plan.

Table 10-1: Indicative Transition of Responsibilities

Activity	Crux Project Director	Vice President Prelude/Crux	Prelude OIM	Offshore Coordination Lead (Project PIC)	Operations Lead (Operations PIC)	Well Operations Manager	CSU Lead	Readiness & Start-up Manager	HSSE Manager (Project)	HSSE Manager (Operations)	Engineering & TI Manager	Asset Engineering Manager	Maintenanc, Turnaround, Const. Manager
Well Completions													
Platform HSSE and offshore prioritisation and coordination				A									
Offshore project management						A							
Perforate wells						A							
1st phase cleanup						A							
PTW Management (Well Completions)				A									
HSSE Reporting									A				
Emergency Response Management				A									
Environment Plan Implementation	A					S			S				
Hot Commissioning													
Platform HSSE and offshore prioritisation and coordination					A								
Statement of Fitness (Pipeline Backflow)		A											
Statement of Fitness (P-RFSU)	A												
Backflow gas from Prelude asset			A										
GTG commissioning with pipeline gas (pre-RFSU)							A						
Platform operation, maintenance & preservation (pre system handover to Asset)							A						
Platform operation, maintenance & preservation (post system handover to Asset)					A								
Platform performance/technical integrity		A											
PTW Management (Hot Commissioning & Start-up)					A								
HSSE Reporting										A			
Emergency Response Management					A								
Environment Plan Implementation		A	S		S		S	S		S	S		
Start-up													
Platform HSSE and offshore prioritisation and coordination					A								
Overall Start-Up Planning and Readiness								A					
2nd stage cleanup through operating Asset					A								
Platform performance/technical integrity		A											
Start-up interface on Prelude			A										
Remaining hot commissioning execution (during start-up)							A						
HSSE Reporting										A			
Emergency Response Management					A								
Environment Plan Implementation		A	S		S	S	S	S		S		S	
Operations													
Platform HSSE and offshore prioritisation and coordination					A								
Platform operation, maintenance & preservation					A								
Platform performance/technical integrity		A											
HSSE Reporting										A			
Emergency Response Management					A								
Environment Plan Implementation		A	S		S			S		S		S	S

This is not intended to be a detailed breakdown of offshore execution responsibilities, accountability, supporting, consulting, informed positions (RASCI). A responsibility title may be different from position title. Shell manages these leadership responsibilities and position titles in a Shell Offshore Execution RASCI. The RASCI may change based on the evolution of offshore execution planning. 'A' refers to the Accountable position who owns the activity outcome and ensures the activity is completed successfully. 'S' refers to the Supporting position who provides information or expertise to complete an activity with specific regard to implementation of this EP. Also refer chain of command (Section 10.3.2.1).

Table 10-2: Management System Transitioning

System/Responsibility	Crux Role (Outside Prelude PSZ)			Crux Role (Inside Prelude PSZ)	
	Completions	Hot Commissioning	Start-up	Hot Commissioning	Start-up
Field Management Plan (FMP)	Project	Asset		Prelude	
FMP Focal Point	Wells	CSU	Start-up	CSU	Start-up
Management System	Shell Wells	Shell Australia			
HSSE Management System Bridging Plan	Shell Australia (includes this EP) – all HSSE MPs (Wells and Contractor) shall bridge to this HSSE Management System				
EP Responsibility	Wells	CSU	Start-up	CSU	Start-up

Note: The transition outlined in Table 10-2 will be governed by a Project to Asset Transition Map that will be subject to continued development prior to activities commencing and may be amended during this development process.

10.1.3 Operations

The remainder of this section outlines the key components of the environmental management system for Operations Activities unless otherwise stated. The Management System will be implemented subject to a continuous improvement cycle based on the 'plan, do, check, review' loop, with a focus on the key activities outlined (predominantly relevant to operations activities) under the organisational structure laid out in Table 10-3. There are numerous, specific, ongoing (typically annual) assurance activities against each of the key systems.

The audit and review function of this seeks to ensure that the system is being implemented, the requirements are effective in implementation of the Shell Commitment and Policy on HSSE and SP (Figure 4-3) to achieve EPSs and implement continuous improvement. Examples of elements that demonstrate continuous improvement are highlighted under each section.

Table 10-3: Management System – Key Implementation and Improvement Activities

Management System Element	Implementation and Improvement
Leadership and Commitment *Creating and sustaining a culture that drives Shell's commitment of no harm to people or the environment*	Seek ongoing feedback on how others perceive HSSE and SP leadership (performance reviews, HSE Culture Survey [Shell People Survey], 360 Feedback).
Policy and Objectives *Supporting the implementation of Shell HSSE and SP Commitment and Policy*	Set annual HSSE and SP targets to drive continuous performance. Annually Review and approve HSSE and SP objectives.
Organisation, Responsibilities and Resources *Establishing and maintaining an organisation that enables the compliance with the SEAM Standards*	When there are changes in the Business or organisation, identify the positions that require Competence assurance. HSSE and SP Critical Position Register, Shell People Competency Profiles.
Risk Management *Identifying the HSSE and SP hazards and establishing the controls to reduce the risks to ALARP*	Ongoing review of Hazards and Risks. Regular review of Risk Registers.
Planning and Procedures *To integrate the requirements of the SEAM Standards into business plan and procedures: Emergency and Crisis*	Establish and maintain a programme of testing of Emergency Response plans and procedures at least once a year or more frequently based on the level of risk. Shell Australia Emergency Response Plan (ERP), Records of Emergency Response (ER) drills, exercises, and After-Action Reviews (AARs).

Management System Element	Implementation and Improvement
Response, Spill Preparedness and Response, MOC, PTW	
Implementation, Monitoring and Reporting *Implement the HSSE and SP requirements embedded in plans and procedures and take corrective action when necessary*	Report all Incidents, including near misses, to the Supervisor of the work activity. Learn from Significant Incidents and High Potential Incidents through communication and implementation of required actions.
Assurance *Providing assurance that SEAM Standards are implemented and effective*	Establish, maintain, and execute HSSE and SP Self-Assessments in support of the Business HSSE and SP Assurance Plan, Self-Assessment, Gap Analysis, HSSE and SP Management Review. Management Review (documents demonstrating how Shell Australia reviews the effectiveness, adequacy, and fitness for purpose of the Management System and take action to improve). Review the HSSE and SP Management System and its individual elements at least once a year and document the results.
Management Review *Reviewing the effectiveness, adequacy, and fitness for purpose of the* Management System *and taking actions for improvement*	Assess the Effectiveness and Adequacy of the management system in delivering the policy and Objectives and in driving continual improvement.

10.2 Shell Safety, Environment, and Asset Management (SEAM) Standards

Crux processes and operating procedures are linked to and governed by the Shell SEAM Standards, consisting of five standards, each containing a number of specific requirements. SEAM standards include (Figure 4-4):

- HSSE and SP Asset Management Foundations (Section 10.3).
- Process Safety and Asset Management (Section 10.4).
- Workplace Health, Safety and Security (Section 10.4.13).
- GHG and Energy Management (Section 10.6).
- Transport Safety (Section 10.8.5).

Each of the elements within the SEAM Standards is assigned a process owner who is accountable to ensure effective implementation. These work processes are described in a structured set of documents ranging from manuals, procedures, and work instructions to provide the clarity on why and how each of the process steps are to be executed in a structured and aligned manner.

10.3 HSSE and SP Asset Management Foundations

The Health, Safety, Security, Environment and Social Performance (HSSE and SP) and Asset Management Foundations Standard includes Shell Group Requirements intended to manage the common/foundational elements of risks and controls. Ineffective governance and/or ineffectiveness of managing the HSSE and SP and Asset Management risks may lead to potential incidents affecting people, assets, environment, and/or community.

10.3.1 Contractor HSSE Management

Contractors and their subcontractors carry out numerous activities on behalf of Shell. Effective management of environmental, integral, health, and safety risks in contracts involves Shell setting clear expectations, providing clear documentation and guidelines and managing these risks throughout the contract lifecycle.

Shell implements specific processes and activities aimed at ensuring that contracts consistently and effectively manage HSSE and SP risks for the contracted activities. These processes are detailed in the HSSE and SP Contractor Management Strategy Manual. The contractor management processes implemented for Crux are consistent with these requirements.

Key aspects of contractor HSSE management requirements are:

- Pre-contract award activities:

- Determine the Contract HSSE and SP risk by assessing the risk associated with the contracted activities.
- Determine the contract mode.
- For a high risk HSSE contractor, the contractor is to develop and provide a Contract HSSE Plan.
- Assess whether the contractor has the capability and resources to manage the risks associated with the contracted activities.
- Before awarding the contract, confirm that the contractor meets the requirements. Focus on closing gaps in the draft contract HSSE and SP Plan submitted by the contractor.
- Define the level of company monitoring based on the capability of the contractor, the contract HSSE and SP risk and the contract mode.
- Appointing a competent contract owner and contract holder for each contract.

- Post-contract Award Activities:
  - Require the contractor to demonstrate that their personnel who are responsible for managing the HSSE risks of the contracted activity understand the HSSE requirements of the contract and any associated Contract HSSE Plan related to their role.
  - Require the contractor to demonstrate that all its personnel will receive an induction on the HSSE risks of the contracted activities including the controls to manage those risks specified in the contract and any associated Contract HSSE Plan.
  - Verify that the HSSE requirements of the contract and any associated Contract HSSE Plan are being implemented and are effective at managing the HSSE risk of the contract. Where necessary, implement actions for improvement.
  - Regularly assess the HSSE performance of the contractor, including its management of subcontractors.
  - Business Performance Review process for high-risk strategic contracts – regularly assess the HSSE performance of the contractor, including its management of subcontractors.

10.3.1.1 Contractor Mode Matrix

Contract mode designation is how Shell differentiates between types of contracts. The contract mode specifies which HSSE and SP Management System will be applied to the activity being performed under the contract. The contract mode requirements are summarised in Table 10-4.

Table 10-4: Contractor Mode Matrix

Mode	Governing HSSE and SP Management System	Description	Assurance Process
1	Shell	Typically assigned when contractor staff are working under a Shell HSSE and SP Management System alongside Shell staff. The contractor provides people, processes, and tools for the execution of the contract under the supervision, instructions, and HSSE and SP Management System of Shell. The contractor has a Management System to provide assurance that the personnel for whom it is responsible are qualified and fit for the work and that the processes, tools, materials, and equipment they provide are properly maintained and suitable for the contract.	Shell management level review and site level audits and inspections

Mode	Governing HSSE and SP Management System	Description	Assurance Process
2	Contractor HSSE and SP Management System Bridging document to Management System	Assigned to contractors working under their own HSSE and SP Management System in an area on a Shell owned or contracted facility. Activities are external but have an interface to a Shell facility (e.g. marine vessels under term charter, helicopter transport) are normally managed under Mode 2 contract. The contractor executes all aspects of the contract under its own HSSE and SP Management System, providing the necessary instructions and supervision and verifying the proper functioning of its HSSE and SP Management System. Shell has the right to verify the overall effectiveness of the HSSE and SP Management System controls in place, including the interface with subcontractors and assuring that the Shell and contractor HSSE and SP Management System are compatible.	Shell management level reviews to assess contractor's capability, suitability, and material equivalence of the Contractor HSSE and SP Management System.
3	Contractor HSSE and SP Management System	Work is conducted at the contractor's site and HSSE and SP risks are managed under the contractor's HSSE and SP Management System. Contractor operates within its own HSSE and SP Management System that has no interfaces with the Shell HSSE and SP Management System.	If appropriate, site visit to ensure HSSE and SP of premises.
Multi-Mode	Determined by mode of individual activity with bridging document to Shell HSSE and SP Management System where required	In certain circumstances, contracted services span several activities and/or are delivered at various locations. In these circumstances contracts are identified as multi-mode and work is broken down into smaller, identifiable activities each with a mode and party assigned for management of HSSE and SP risks. Depending upon location, HSSE and SP risks are managed under the contractor's or Shell's HSSE and SP Management System. Interfacing must also reflect the individual activities.	Shell management level reviews to assess contractor's capability, suitability, and compatibility of HSSE and SP Management System

10.3.1.2 Contractor Competency Requirements and Assurance

The contractor is responsible for ensuring that all its personnel have the appropriate level of competence required to carry out the work safely and effectively. The contractor is also responsible for developing and implementing a competence assurance plan. The Shell contract holder is responsible for ensuring that the contractor's competence assurance system is reviewed, is robust and meets Shell's requirements.

In addition to trade competencies and qualification requirements, the minimum competence requirements for contractors working on Shell offshore facilities are:

- Basic Offshore Safety Induction and Emergency Training;
- Facility induction (such as lifesaving rules, emergency response and muster procedures, incident reporting, environmental requirements); and
- Role-specific training such as Permit to Work (PTW) (if required).

In addition to these competence requirements the contractor must have current:

- Fitness to work certification (relevant to the tasks to be performed); and
- Maritime Security Identification Card and Maritime Security Awareness where required.

10.3.2 Organisation, Roles, and Responsibilities

10.3.2.1 Chain of Command

There is a transition of command through the activity phases during the process of handover from Crux project to Crux asset and operations. This is divided into three sectors summarised below.

The Shell Group chain of command for well completions is as follows:

- President, Projects and Technology reports to Chief Executive Officer.
- Executive Vice President Projects/Engineering reports to President, Projects and Technology.
- Crux Project Director reports to Executive Vice President Projects/Engineering.
- Crux Project Manager reports to the Crux Project Director (EP Owner).
- Crux Project PIC reports to the Crux Project Manager.

The Crux Project Director retains accountability for this EP until handover to the Vice President Prelude/Crux for hot commissioning activity. The following Shell Group organisational chain of command structure provides leadership and direction for hot commissioning and start-up activities:

- President, Integrated Gas reports to the Chief Executive Officer.
- Country Chair reports to the President, Integrated Gas.
- Vice President Prelude/Crux reports to the Country Chair.
- Readiness and Start-up Manager reports to the Vice President Prelude/Crux (EP Owner).
- Operations Readiness Manager reports to the Readiness and Start-up Manager.
- Crux Operations PIC reports to the Operations Readiness Manager.

The following Shell Group organisational chain of command structure provides leadership and direction for operations activities:

- President, Integrated Gas reports to the Chief Executive Officer.
- Country Chair reports to the President, Integrated Gas.
- Vice President of Prelude-Crux reports to the Country Chair.
- Operations Manager reports to the Vice President Prelude/Crux (EP Owner).
- Production Manager and Prelude OIM reports to the Operations Manager.
- Crux Operations PIC reports to the Production Manager.

The role of the County Chair and Country Coordination Team retains governance and oversight of the Project execution and Asset chain of command reporting lines throughout all activities. During operations activities, the Vice President Prelude/Crux is ultimately accountable for the Crux facilities and activities (see Table 10-1) and will implement this through an Operations Manager and Maintenance, Turnaround and Construction (MTAC) Manager.

Reporting to the Operations Manager, the Offshore Installation Manager (OIM) position will oversee the Crux and Prelude facilities management (in command of the facilities and responsible for its safe operation). The OIM position is continuously occupied while the facility is in operation. If the designated OIM is incapacitated the role is filled by a competent person delegated by the OIM or Operations Manager. The Prelude-Crux Production Manager oversees the production function with direct reporting from the Crux Operations Lead (Person in Charge, PIC) and Production Lead and subsequent support teams.

The MTAC Manager oversees the planning and execution of minor and major maintenance programs and turnarounds throughout operations.

The Prelude OIM and Crux Operations Lead (PIC) lead offshore teams residing on Prelude FLNG and/or mobilise for Crux manned campaigns. When Crux is manned, the PIC will be in charge and accountable for the facility. When unmanned, the Prelude OIM will be in charge and accountable for the facility. The MTAC Manager has technicians that reside on Prelude FLNG and/or mobilise during maintenance campaigns alongside the required contractors. All other positions are onshore and mobilise as required for inspections and work activities.

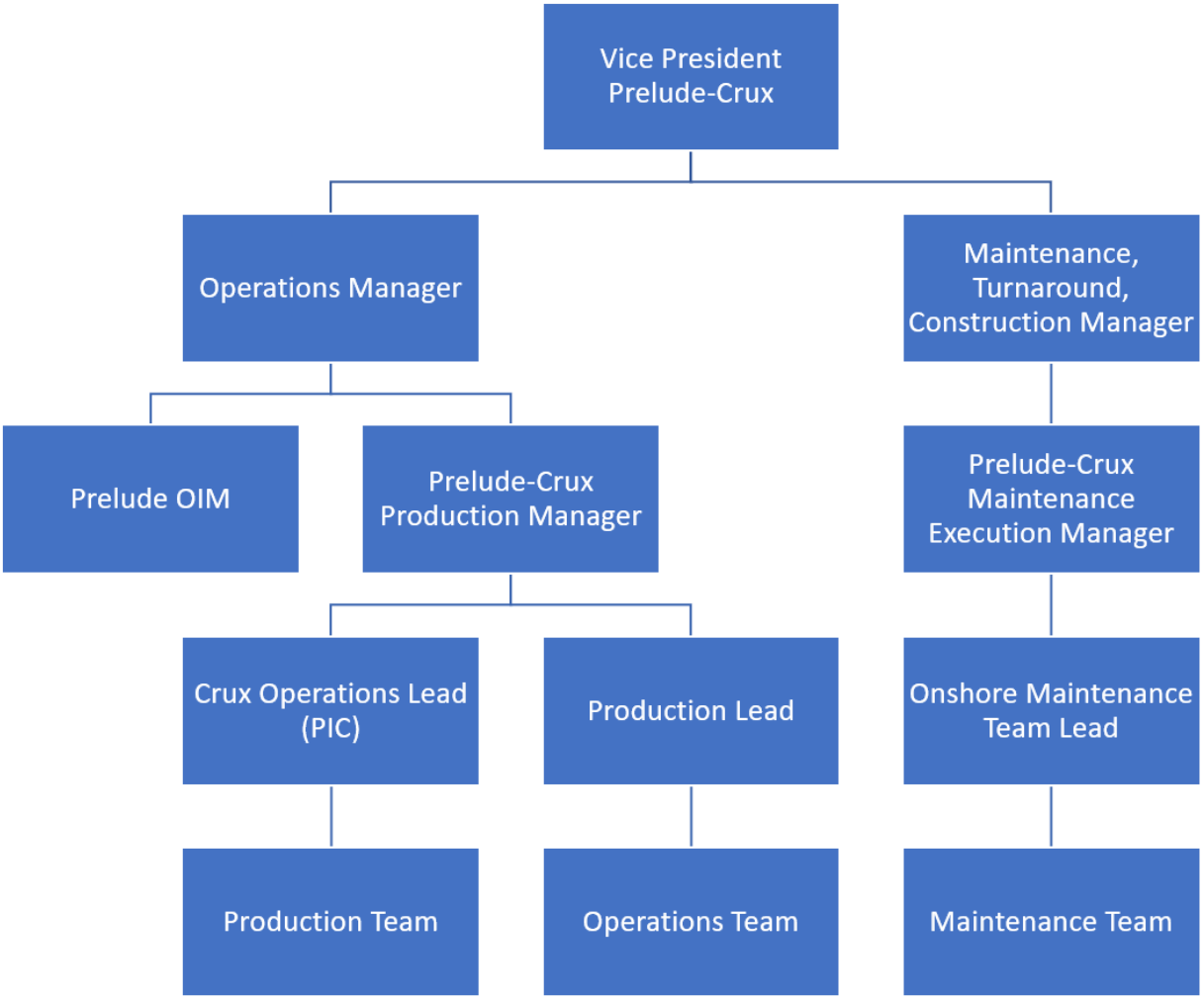


Figure 10-1: Indicative Operations Organisational Structure (simplified to show key roles)

10.3.2.2 Support Teams

The chain of command structure for operations is supported by a diverse team (both onshore and offshore) to deliver on the Operating Plan, including:

- Production, Operations and Maintenance support disciplines.
- Prelude-Crux Environment Adviser reports to Prelude-Crux HSSE Manager (Asset).[104]
- Functional support teams report to the corresponding Functional Vice President.

Variations in the support team for the short-term durations of well completions, hot commissioning and start-up are described in Section 10.1. Functional teams include HSSE, Engineering, Subsea, Wells, Projects, Marine, and Aviation.

- HSSE team provides specific guidance and access to specialist health, safety, security and environment resources including assistance for governance and training, as well as guidance on standards.
- Engineering team support includes PTM surveillance, design, process safety, and technical integrity.
- Subsea team is responsible for the IMR activities on subsea infrastructure including facility structures, flowlines, manifolds, and subsea isolation valves to ensure integrity.
- Wells team ensures the safe planning and execution of well maintenance operations.

[104] Prelude-Crux HSSE Manager responsibilities may be managed by the Safety, Environment, Management Systems & Assurance (SEQ) Manager organisation title. Similarly, other responsibilities listed in this Section may be managed by alternate organisation titles.

- Projects team are responsible for the engineering, construction, and execution of small projects on operational facilities to ensure ongoing integrity and safe operation.
- Marine team are responsible for chartering, mobilising, demobilising, and marine vessel assurance.
- Aviation team provides personnel transport, material transport, emergency evacuation and search and rescue capabilities.

Other services and functions provided by the business unit include, but not limited to:

- Engineering and maintenance standards/guidelines and supporting governance processes.
- Engineering and maintenance strategies, systems, and applications to support and optimise operations.
- Coordination of production engineering and maintenance execution processes and resources.
- IMT support (in the unlikely event of an emergency incident).

Offshore Activities on the platform will be led by the Person in Charge (PIC) throughout the various phases outlined within this EP alongside the Offshore Installation Manager (OIM) with oversight of offshore facilities from Prelude FLNG (for specific details relating to well completions, hot commissioning, and start-up, see Section 10.1).

An overview of accountabilities of key personnel in relation to the extended implementation, management and review of the EP is outlined in Table 10-5. Key roles and responsibilities related to the management and implementation of oil spill response arrangements in the event of an emergency event are outlined within the BROPEP (see Section 10.14.3).

Table 10-5: Key Responsibilities and Accountabilities[105]

Title (Role)	Main Responsibilities/Accountabilities
Crux Project Director *EP Owner – Well Completions*	**Well completions, hot commissioning, and handover to operations** • Accountable and responsible for overall project governance through to handover to the Vice President Prelude/Crux. • Ultimately accountable for EP implementation in well completions activity phase. • Handover to Vice President Prelude/Crux during hot commissioning activity phase.
Crux Project Manager	**Well completions, hot commissioning, and handover to operations during start-up (reporting to the Crux Project Director)** • Responsible for management of the project through well completions to performance testing during start-up. • Accountable for statement of fitness (P-RFSU). • Accountable for platform performance and reliability testing during start-up.
Vice President Prelude/Crux *EP Owner – Hot Commissioning, Start-up, and Operations*	**Hot commissioning, start-up** • Accountable for EP implementation throughout hot commissioning and start-up (after handover from Crux Project Director). • Accountable for the statement of fitness (pipeline backflow). • Accountable for safe, efficient, and environmentally compliant start-up of the facility. • Accountable for incident notification, reporting and investigation in line with regulatory requirements. **Operations** • Accountable for EP implementation. • Accountable for safe, efficient, and environmentally compliant operation of the facility. • Oversight of Operations Manager and MTAC Managers and related functions and duties during operations. • Accountable for incident notification, reporting and investigation in line with regulatory requirements. • Accountable for ensuring all necessary regulatory approvals are in place to operate. • Custodian of communication with all regulatory agencies required to operate the facility. • Accountable for KPIs and environment initiatives. • Accountable for environmental performance to drive continuous improvement. • Accountable for the implementation of stakeholder consultation as per the description in this EP.

[105] All titles and descriptions are based on an evolving offshore execution plan and may change during further design of the organisational roles in execute phase, and therefore some responsibilities may be redefined or reallocated.

Title (Role)	Main Responsibilities/Accountabilities
Crux Readiness and Start-up Manager	**Hot commissioning, start-up** • Accountable for the operational readiness and start-up of the facilities. • Accountable for permit to work system (hot commissioning, after introduction of hydrocarbons). • Accountable for hot commissioning start-up and operation after handover to Vice President Prelude/Crux (i.e. after handover to asset). • Accountable for platform readiness for second stage well clean-up. • Accountable for second stage well clean-up through operating asset. • Support EP implementation.
Prelude OIM	**Hot commissioning, start-up** • Accountable for backflow gas from Prelude FLNG during hot commissioning. • Accountability for facilities interface with Prelude FLNG. **Operations** • Accountable for field management plans. • Support for EP implementation during operations. • Accountable for offshore compliance with regulatory requirements and Shell's policies and standards. • Accountable for Permit to Work governance, process, and permit requirements. <u>Resourcing, Training and Competencies</u> • Provides appropriate offshore resources to comply with EP requirements. • Accountable for the performance and development of production, services and maintenance teams and ensuring capability and competency. <u>Monitoring, Auditing, Non-conformance, and Emergency Response</u> • Accountable for monitoring performance against the EP. • Implements environmental assurance activities and audits, and monitors action tracking and closure. • Ensures incidents are reported and investigated in line with Shell standards and EP requirements. • Responsible for role of Incident Controller during emergencies. • Responsible for ensuring emergency exercises and drills are performed.

Title (Role)	Main Responsibilities/Accountabilities
Offshore Coordination Lead (Project PIC)	**Well completions, hot commissioning and start-up** • Accountable for daily POB management. • Accountable for supply and coordination of platform diesel, water, ablution services. • Accountable for supply of consumables and supplies. • Accountable for the provision and coordination of lifting services, scaffolding, rope access, temporary diesel generators and temporary refuge supplies. • Responsible for Field Management Plan. • Responsible for operation and safety of the ASV. • Responsible for HSSE and emergency response management. • Support for offshore SIMOPS coordination, prioritisation, and coordination. • Support for logistics and supply chain planning and management. • Support for well perforation, first and second stage clean-up field coordination. • Supporting services for statement of fitness (pipeline backflow, P-RFSU, and hot commissioning GTGs).
CSU Manager and CSU Lead	**Hot commissioning, start-up** • Accountable and responsible for Gas Turbine Generator (GTG) commissioning with pipeline backflow gas (pre-RFSU). • Accountable and responsible for platform operation, maintenance and preservation (pre-system handover to Asset). • Accountable and responsible for production chemistry – sampling and monitoring (e.g. fuel gas, TEG, etc) prior to P-RFSU. • Support EP implementation. • Support roles for offshore management and execution during start-up. • Support roles for second stage clean-up and remaining hot commissioning activities. • Support roles for platform performance and reliability testing (performance test runs).
Prelude-Crux Production Manager	**Operations** • Reports directly to the Operations Manager. • Responsible for the overall production from the facility and oversight of the Production and Operations team. • Provides leadership, direction, and oversight to the Crux Operations Lead (PIC). • Support role for EP implementation.

Title (Role)	Main Responsibilities/Accountabilities
Crux Operations Lead (PIC)	**Hot commissioning, start-up, operations** • Accountable for platform HSSE and offshore prioritisation and coordination during hot commissioning and start-up. • Accountable for platform operation, maintenance and preservation (post system handover asset). • Accountable for permit to work system. • Accountable for emergency response management. • Accountable for second stage well clean-up through operating asset. • Support role for EP implementation.
Production Chemist	**Hot commissioning, start-up** • Responsible for production chemistry – sampling and monitoring (e.g. fuel gas, TEG, etc) prior to P-RFSU. **Operations** • Responsible for production chemistry, sampling and monitoring programs.
Wells Operations Manager	**Well Completions** • Accountable for well perforation, first stage and second stage clean-up. • Accountable for management of well completions contract. • Support role for EP implementation.
Engineering and Technical Integrity (TI) Manager	**Start-up** • Responsible for platform performance/reliability testing (performance test run). • Support role for EP implementation.
Asset Engineering Manager	**Operations** • Responsible for platform performance/reliability testing. • Support role for EP implementation.
Maintenance, Turnaround, and Construction (MTAC) Manager	**Operations** • Responsible for planning and coordination of minor and major maintenance, turnarounds, and brownfields construction scopes. • Responsible for the execution of the maintenance work plan to manage asset integrity of the facility and to support the EP. • Support role for EP implementation.
Head of Marine	**Well completions, hot commissioning, start-up and operations** • Accountable for offshore vessel coordination within 500 m zone, marine assurance, and warranty. • Accountable for ASV and W2W vessel mobilisation and readiness, operations, and safety.

Title (Role)	Main Responsibilities/Accountabilities
Crux HSSE Manager (Project)	**Well completions** • Accountable for HSSE reporting. • Support EP implementation. • Responsible for monitoring and reviewing progress against EP, targets and KPIs. • Responsible to ensure compliance with the EP and drive continuous improvement. • Escalate any potential environmental issues and non-compliances to leadership team. **Hot commissioning** • Support EP implementation for remaining project scopes.
Prelude-Crux HSSE Manager (Operations/Asset)	**Hot commissioning, start-up, operations.** • Accountable for HSSE reporting. • Support EP implementation. • Responsible for monitoring and reviewing progress against EP, targets and KPIs. • Responsible to ensure compliance with the EP and drive continuous improvement. • Escalate any potential environmental issues and non-compliances to leadership team.
Offshore HSSE Advisors	**Well completions, hot commissioning, start-up and operations** • Liaises with PIC and Coordinators/Team leads on day-to-day management of environmental risks and issues. • Identifies opportunities for continuous improvement and communicates these to the PIC and Shell Australia Environment Team. • Resourcing, Training and Competencies. • Coach and assist implementing safety and environmental improvement initiatives. • Coach relevant personnel understand the requirements in the EP applicable to their role. Monitoring, Auditing, Non-conformance, and Emergency Response • Assists with the ongoing promotion of environmental performance at the facility including environmental reporting, monitoring, and review. • Assisting with assurance activities and incident reporting and investigation as required.

Title (Role)	Main Responsibilities/Accountabilities
Crux Environment Lead (Project)	**Well completions, hot commissioning, start-up** • Provide subject matter expertise to oversee implementation of the EP. • Ensure responsible personnel have access to the EP and understand the outcomes, performance standards and measurement criteria. • Train responsible personnel regarding environmental responsibilities to implement the EP. • Liaise with applicable regulatory authorities and stakeholders as required. • Develops risk reduction strategies. • Facilitate ALARP and acceptability reviews. • Maintain and update EP on an ongoing basis. • Facilitate and provide coaching for environmental improvement plans. • Participate in resourcing, training and competency plans and programs. • Develop and maintain environmental training and coaching materials for deployment to Shell and contractor organisations. <u>Monitoring, Auditing, Non-conformance, and Emergency Response</u> • Responsible for environmental monitoring and reporting requirements from the EP including environmental performance and compliance reporting. • Monitor progress against environmental improvement plans. • Participate in environmental audits/inspections and compliance checks. • Communicate findings to management and assisting with close out of actions. • Assist the review, investigation and reporting of environmental incidents.
Prelude-Crux Environment Adviser (Operations/Asset)	**Start-up and operations** • Provide subject matter expertise to oversee implementation of the EP. • Ensure responsible personnel have access to the EP and understand the outcomes, performance standards and measurement criteria. • Train responsible personnel regarding environmental responsibilities to implement the EP. • Liaise with applicable regulatory authorities and stakeholders as required. • Develops risk reduction strategies. • Facilitate ALARP and acceptability reviews. • Maintain and update EP on an ongoing basis. • Facilitate and provide coaching for environmental improvement plans. • Participate in resourcing, training and competency plans and programs. • Develop and maintain environmental training and coaching materials for deployment to Shell and contractor organisations.

Title (Role)	Main Responsibilities/Accountabilities
	Monitoring, Auditing, Non-conformance, and Emergency Response • Responsible for environmental monitoring and reporting requirements from the EP including environmental performance and compliance reporting. • Monitor progress against environmental improvement plans. • Participate in environmental audits/inspections and compliance checks. • Communicate findings to management and assisting with close out of actions. • Assist the review, investigation and reporting of environmental incidents.
Vessel Masters	**Well completions, hot commissioning, start-up and operations** • Responsible for acting immediately to rectify any environmental incident on the vessel. • Implementation of the EP on board the vessel. • Ensure effective operation of the vessel, considering relevant environmental aspects. • Communication of vessel environmental management activities on board. • Maintain administration of vessel's environmental management system requirements • Ensure all crew members comply with the EP. • Manage any spills per SOPEP. • Responsible for ensuring cetacean sighting recording is undertaken. • Compliance with marine regulations.
Contract Holders	**Well completions, hot commissioning, start-up and operations** • Ensure implementation of this EP for the contractor scopes of work. • Ensure contractors have adequate environmental capability to execute their scope of work. • Review and assurance of contractor environmental performance.
All personnel	**Well completions, hot commissioning, start-up and operations** • Understand and comply with all Shell standards and procedures that apply to their area of work. • Immediate reporting of any environmental hazards or incident to the supervisor. • Understand the environmental risks and controls applicable to work. • Follow instructions from the PIC or supervisor with respect to environmental protection and measurement criteria outlined in this EP. • Undergo environmental training as required by role and activity. • Carry out assigned activities in accordance with approved procedures and the EP. • Stop any operation or activity that is deemed to present an unacceptable risk to the environment.

It is the responsibility of all Shell employees and contractors to adhere to and implement their key responsibilities throughout the life cycle of a project and to ensure that they are suitably trained and competent in their assigned roles.

10.3.3 Competence and Inductions

10.3.3.1 Competency

All personnel required to work on the activity shall be employed on the basis they are competent to carry out their role. However, there is a subset of the workforce whose roles and duties are critical to the safe running and management of the operations within the activity that they require Competence Assurance. These are people in HSSE Critical Positions (see Figure 10-2) who are directly responsible for the safety of operations.

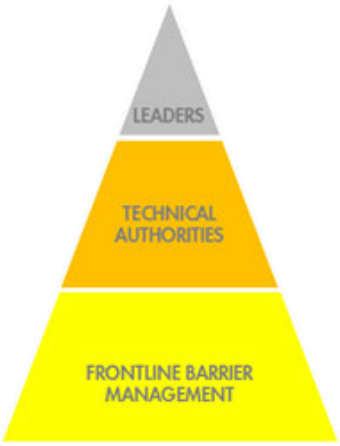


Figure 10-2: HSSE Critical Positions

Being competent within their role is essential for effective management and will form a key element of implementation of the activity whilst ensuring the best environmental outcomes. These positions include the following key roles and responsibilities:

- **HSSE Critical Leader Positions**
  - Senior Management Position at Leadership Team level with Operational, Technical and/or Engineering responsibilities with RAM red or yellow 5A or 5B risks (refer to Figure 10-4).
  - Operational, Technical or Engineering position responsible for defining ALARP for RAM red or yellow 5A or 5B risks for a project, technical department, or asset. Operational, Technical and/or Engineering position accountable for delivering ALARP for RAM red or yellow Risks for a major asset, group of small assets, major project, or group of small projects.
- **Technical Authority Level 1 and Level 2**
  - Technical Authority Level 1 or 2 roles, which involve design, implementation and maintenance of barriers established for managing hazards with RAM red or yellow 5A or 5B risks are deemed HSSE Critical (refer to Figure 10-4).
  - Required to be ‘Skill’ level at relevant technical and operational competencies.
- **Frontline Barrier Management (FLBM)**
  - Responsible for playing a critical role in ensuring that all safety-critical tasks and activities are carried out effectively. They are responsible for implementing and maintaining the effectiveness of all barriers identified (controls and recovery measures) for managing MAE and MEE hazards (as defined in section 10.4.1.1) at the facility, including managing hazards with RAM red or yellow 5A or 5B risks (refer to Figure 10-4). These are mainly the roles played by production and maintenance technicians on the platform.

To supplement these, within Shell, the SEAM Standards require people in HSSE Critical Positions to have their Management System competence assured. HSSE Critical Positions must attain a set proficiency level in three competences: HSSE Lead; HSSE Prepare; and HSSE Apply. People in HSSE Critical Positions are also responsible for the development and maintenance of effective barriers to prevent incidents.

Personnel in HSSE Critical Leader positions are required to demonstrate the required level of competency in Lead, Prepare and Apply HSSE and SP Risk Management, subject to their Proficiency Profile. The HSSE

critical leader positions are required to be skilled on the Lead, Prepare and Apply HSSE and SP Risk Management competency elements. Shell maintains a HSSE Critical Positions Register and HSSE Critical Positions have been identified, and positional competency requirements have been defined according to the HSSE and SP and Asset Management Foundations Standard.

Shell has a defined set of Technical Authorities. Where a Technical Authority is not available within the Asset team, access is available to the Shell Global Technical Authority pool. A list of competencies is maintained globally through the Discipline Authorities Manual (DAM).

The register assigns a HSSE profile to each role and defines required proficiency levels for each profile. After assessment of individual competencies against position requirements, proficiency gaps will be addressed in training and coaching.

Shell personnel and contractors working offshore require mandatory training as defined in the Competency Matrix (or equivalent naming convention). This matrix identifies the required HSSE and SP competence and training requirements for Shell staff who carry out specific activities and duties during the various phases of the project. The training matrix is built around requirements from the Management System and Australian regulatory requirements. Platform visitors may have less stringent training/competency requirements as appropriate to the job tasks they are executing.

In terms of the vessel operators, only prequalified companies with whom Shell have a service agreement are qualified to bid for the activity. A HSSE pre-qualification questionnaire is included in the tender package, which is evaluated by the HSSE department in parallel to the technical and commercial evaluations. Contractors have their own competence requirements in place as described in Section 10.3.1. Training records of all personnel will be maintained, and the training program will be subject to review on a regular basis.

10.3.3.2 EP Induction – Training

All personnel, including contractors and sub-contractors, will be given a HSSE induction prior to the commencement of work on the activity so that they are aware of their obligations and commitments.

The HSSE inductions shall cover:

- Shell Australia HSSE and SP Policy and Commitment including SEAM Standards
- Legislative requirements

Key environmental aspects, impacts and risks associated with the activity including:

- Liquid discharge management
- Drainage management
- Emissions management
- Chemical and hydrocarbon management
- Waste management
- Marine fauna interaction
- Marine benthic impacts
- Reporting of environmental incident(s)
- Emergency response
- Activity EP commitments (EPS, EPOs) and environmental management requirements.

Additionally, on arrival at the facility or any activity vessel (ASV, W2W vessel, etc), personnel (including short-term visitors) will attend an onsite orientation briefing, designed to familiarise them with the general operations and location of key areas. The orientation will explain the site-specific safety, environmental and emergency response aspects. A log with signatures of all personnel to have completed this training will be kept ensuring compliance with Shells competency and induction standards and to ensure requirements are met. The log will be stored in a centralised database and the HSSE Manager is responsible for maintenance, retention, and compliance. Separate EP induction packages will be produced for the well completions, hot commissioning, and start-up phases.

10.3.4 Permit to Work

The Permit to Work (PTW) process will be used to control and approve work on the Crux facility and Activity Area. The process ensures that adequate controls and measures are in place to safeguard people, assets, and environment from work activity hazards. Details of the PTW process is described in the Permit to Work Manual and electronic PTW administration system. Additional information is provided in Section 10.1 for well completions and hot commissioning, including the use of FMPs to plan and coordinate activity.

The objective of the PTW system is to create a safe working environment by controlling any hazards that may arise from a task, from the planning phase, right through to execution and handback. The PTW system will ensure that all activities planned or undertaken on Crux are properly planned, risk assessed, controlled/approved, coordinated, communicated, and safely executed in accordance with Shell's policies, procedures, government regulations, industry standards and to the SEAM Standards. The PTW process ensures that:

- All work is clearly defined and authorised.
- The scope of work to be carried out, the risk level and the category of work (hot, cold, etc) is clearly defined on the permit form.
- Persons authorised to work are trained and competent in their scope.
- An appropriate level of hazard identification and risk assessment is carried out in keeping with ALARP principles for all activities.

Activities requiring a permit will fall within one of the following defined permit types in Permit Vision and will be subject to the Crux Permit to Work requirements:

- Cold Work
- Mechanical
- Instrument and Control
- Radiation
- Excavation
- Working at Height (including work over water/work of the side)
- Electrical
- Lifting and Hoisting
- Drilling/Well services
- Confined Space
- Breaking Containment, and
- Hot Work.

Permits are classified based on the level of risk associated with the specific job for which the permit is to be issued. The permit may specify mandatory controls according to the hazards associated with the task. An equivalent process to the above will apply to all activity phases covered by this EP.

10.3.4.1 Permit to Work Roles and Responsibilities

Persons authorised to plan, prepare, authorise, and carry out work activities are trained and competent in their field. Specific roles and responsibilities are defined to ensure work is controlled according to the PTW process. The permit risk level of authorisation required, with High-Risk permits requiring the OIM to authorise the permit.

Table 10-6: Key Role and Responsibilities within the Permit to Work Process

Role	Responsibilities
PIC	Accountable for the safe and effective use of the PTW system on the Crux Facility.

Role	Responsibilities
Permit Requester	The person who applies for a PTW to do the work, identifies the hazards and proposes the controls.
Permit Verifier	The person responsible for reviewing the permit draft and ensuring that it is complete and correct, and potential hazards have been identified, and the defined controls are sufficient for the work scope.
Permit Authoriser	The person responsible for authorising the permit. The person able to fill this role is dependent on the risk associated with the permit.
Permit Issuer	The person responsible for ensuring that all preparations are complete and for issuing the PTW for the work to proceed.
Permit Holder	The person responsible for carrying out the work in accordance with the conditions of the PTW.
Area Authority	The person in charge of a specific area – they are responsible for permits and the management of conflicting work in their area.
Responsible Person Electrical	The person who approves PTW involving electrical works. The focal point for the safe day to day control and operation of electrical systems.
Isolation Verifier	The person who verifies the content of the Isolation Confirmation Certificate.
Isolation Authoriser	The person who authorises execution of the planned isolation.

The Permit to work system has eight key steps which must be followed, these are:

- Define work scope.
- Identify hazards and agree controls.
- Authorise work plan.
- Verify controls in the field.
- Issue permit.
- Pre-job discussion.
- Execute and supervise.
- Verify job complete and hand back.

Following the above steps ensures that all work carried out is fully risk assessed for the project and environment and aligns to ALARP.

Shell has implemented an electronic PTW system (e-PTW) called Permit Vision. There is high-level redundancy built into the tool; however, the facility is equipped with a paper-based back-up system. The electronic PTW system allows for continuous monitoring of implementation and performance to aid further development and improvement of the PTW process with a view to safeguarding environment, asset and people.

10.3.5 Management of Change

It is a Shell requirement for assets to perform effective Management of Change (MOC). An MOC process will be implemented through all activity phases, initially in well completions via the Project MOC process that will transition into an Operations MOC process based on the activity sequencing from well completions leading up to hot commissioning and start-up. The formal process of MOC aims to ensure that all effects from an applied change are identified and their impact to the asset considered holistically. The importance of MOC is highlighted by the appointment of an individual who is accountable for the MOC process, governance, and its effective implementation. The Shell Management of Change Manual (Operations), or equivalent Crux Management of Change Procedure (Project), will implement the process which is designed to provide assurance that new risks are not knowingly incurred when changes are introduced, or the prevailing risk profile is not adversely changed without appropriate mitigation.

The change scopes may entail permanent, temporary, or emergency change and are included within the MOC Manual, these include:

- Process changes (hardware, process control, process conditions, design/safeguarding/operating limits such as operating to technical maximum capacity (tech max)).
- Procedural changes that affect HSSE critical content.
- Organisational changes (Shell and Contractor) impacting HSSE critical roles.

The Management of Change Manual is supported by specific procedures, templates, and checklists and monitored through the electronic MOC system. The process is built around seven simple steps forming an overarching governance framework (Figure 10-3).

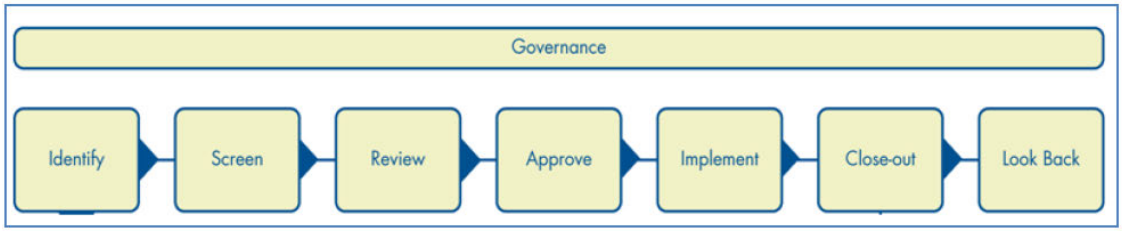


Figure 10-3: Shell Australia Management of Change Steps

Key elements of the MOC process are:

- Change is recognised and the MOC process is applied for all changes that fall within its scope.
- Hazard Identification (HAZID) and risk assessment is done on every change to identify the impact of the change and to ensure that appropriate additional controls are implemented to reduce the risk to ALARP.
- Changes are reviewed by the appropriate personnel as defined in the Change Approval Authorisation Matrix. Reviewers must be satisfied that sufficient information is presented, good design practices have been followed and that the final design is operable, maintainable, and reliable.
- Changes are approved as defined in the Change Approval Authorisation Matrix. Approval of the change means that the MOC Approver is satisfied that the scope and impacts of the change are understood, the hazards are identified and mitigated (where appropriate), that the overall benefit of implementation the change outweighs the risk(s) and that all changes are authorised prior to implementation.

The following scenarios may also trigger the review of the management of a particular environmental impact or risk to ensure that ongoing management of impacts and risks are at ALARP and Acceptable levels:

- Changes in regulatory requirements/standards.
- Information which may suggest an increase in environmental risks or impacts to those outlined in the EP.
- Prominent new scientific studies which may ‘negatively’ change the understanding of environmental risks and impacts.
- Objections or claims raised which require changes in EP content following the process outlined in Section 5.13.

The screening process for all new changes requires assessment of the HSSE and SP aspects. This may result in a change being flagged to comply with sections 38 and 39 of the OPGGS(E) Regulations. If a change is considered significant as determined by the MOC process, then a revised or new EP will be submitted to NOPSEMA for acceptance. Minor EP revisions will not be submitted to NOPSEMA for formal assessment unless they trigger an EP revision against the OPGGS(E) Regulations.

The Shell MOC process complies with the SEAM Standards.

The MOC process for the Crux Project, up until initial start-up, is described in the Crux Management of Change Procedure (2200-010-FA-6180-00001). The overall objectives of the MOC Process are:

- Fully assess significant impacts of proposed project-level changes before decisions are made
- Prevent changes that would threaten the achievement of project objectives
- Ensure all potentially affected disciplines/parties are considered in the change assessment
- Permit changes that add value to the project with full consideration of impacts and risks

- Fully assess the risks associated with implementing, or not, the change.

Potential changes covered by this procedure includes:

- HSSE Change: changes that may impact HSSE requirements, including commitments within regulatory documents, such as Environmental Plans
- Scope Change: changes to the technical scope of the project, including mandatory requirements, specifications and procedures
- Organisational Change: changes to critical roles in the project, including Critical HSSE Leadership roles.

The MOC procedure is supported by specific procedures, templates and checklists.

- Identify – identify the need for change, initiate a MOC request with a proposed solution and gain endorsement by project management
- Screen – the screening identifies and considers the HSSE and project risks to confirm whether the MOC requires further development. This includes considered alternatives, HSSE considerations if any, required resources, cost and schedule consequences as far as is reasonable possible with the available data
- Develop – the change is detailed to a sufficient level to be risk-assessed by impacted parties. HSSE hazard screening may take place to confirm the need for a subsequent risk assessment. Where possible, actions to mitigate the risks will be identified and requirements to verify the effectiveness and inclusion of the mitigating actions will be detailed
- Approve – the proposed change(s) and the associated risks is reviewed by an MOC Panel to determine whether the change should be accepted or rejected
- Implement – following acceptance from the MOC panel, the change is implemented by impacted parties
- Close-out – verify once the change has been implemented that all outstanding issues have been addressed, that all work is closed out and all open action items are completed.

The "develop" step for changes includes an assessment of HSSE and SP aspects as per the Crux Management of Change Procedure.

The following will also trigger the review of the management of a particular environmental impact or risk to ensure that ongoing management of impacts and risks are at ALARP and Acceptable levels:

- Changes in regulatory requirements/standards.
- Information which may suggest an increase in environmental risks or impacts to those outlined in the EP.
- Prominent new scientific studies which may 'negatively' change the understanding of environmental risks and impacts.
- Objections or claims raised which require changes in EP content following the process outlined in Section 5.

The screening process for all new changes requires assessing the HSSE and SP aspects as per the Crux Management of Change Procedure require assessment of HSSE and SP aspects. This may result in a change being flagged as possibly needing a change to the EP which require compliance with Sections 38 and 39 of the OPGGS(E) Regulations. If a change is considered significant determined by the MOC process, then a revised or new EP may be submitted to NOPSEMA for acceptance. Minor EP revisions will not be submitted to NOPSEMA for formal assessment.

10.3.6 Managing HSSE and SP Risk

The purpose of Managing HSSE and SP risk is to establish a process to identify HSSE and SP Hazards and to reduce the risks to ALARP. The Hazards and Effects Management Process (HEMP) establishing a process to manage HSSE &SP Risks to As Low as Reasonably Practicable (ALARP) in assets. It is complemented by additional SEAM Standards, such as the Management of Risks to As Low as Reasonably Practicable (ALARP), Process Safety & Asset Management SEAM Standard (section 10.4), which are themselves complemented

by practices, such as the HSSE Critical Equipment (section 10.4.1.1) and HSSE Critical Human Barrier requirements (section 10.3.3.1). The HEMP process allows the business to be explicit in how it manages and assures the effectiveness of the barriers in place to address Risk, especially Risks in the Red or yellow 5A or 5B areas of the RAM. Refer to Figure 10-4 for the RAM.

Severity	Consequence				Increasing Likelihood				
					A	B	C	D	E
	People	Assets	Community	Environment	Never heard of in industry	Heard of in the industry	Has happened in the Organization or more than once per year in the industry	Has happened at the M location or more than once per year in the Organization	Has happened more than once per year at the Location
0	No injury or health effect	No damage	No effect	No effect					
1	Slight injury or health effect	Slight damage	Slight effect	Slight effect					
2	Minor injury or health effect	Minor damage	Minor effect	Minor effect					
3	Major injury or health effect	Moderate damage	Moderate effect	Moderate effect					
4	PTD or up to 3 fatalities	Major damage	Major effect	Major effect					
5	More than 3 fatalities	Massive damage	Massive effect	Massive effect					

Figure 10-4: Shell Risk Assessment Matrix (RAM)

10.3.7 Chemical Change Process

Shell has adopted the Shell Chemical Change Process and Shell Global Product Stewardship Guidelines to assess chemicals than may pose environmental impacts via planned discharges. All chemical applications are required to be screened in accordance with Shell Global Product Stewardship Guidelines (Figure 10-5).

Where chemicals may be discharged to the marine environment, Shell's preference is to select those chemicals that are deemed environmentally acceptable (PLONOR, Gold, Silver, D and E) with no substitution warning under the Offshore Chemical Notification Scheme (OCNS). Chemicals that fall within these bands require no further assessment and are deemed ALARP and acceptable.

For chemicals outside of the OCNS, Shell follows a three-step process and hierarchy of controls to support decision making:

- **First:** Try to eliminate use of product – If unable to eliminate use of product proceed to step 2
- **Second:** Try to substitute with a product of lower risk
- **Third:** Ensure that risks can be managed.

Chemicals that do not have an OCNS ranking or fall outside of the preferential banding (PLONOR, Gold, Silver, D and E with no substitution warning) are required to be assessed further incorporating, seeking a suitable alternative chemical of lower environmental impact. If no alternative is technically or feasibly suitable, the chemical is required to be assessed via Shell Global Product Stewardship guidelines and ALARP

demonstration with risk reduction control measures (Figure 10-6). In addition, Shell complies with the Industrial Chemicals Environmental Management (Register) Act 2021 and associated legislative instruments, including the Industrial Chemicals Environmental Management (Register) Instrument 2022, which establish the Industrial Chemicals Environmental Management Standard (IChEMS). Under this framework, chemicals are scheduled according to their environmental risk, with Schedules 6 and 7 representing the highest concern. Chemicals that are prohibited or require specific risk management measures under these instruments are either excluded from use or managed in strict accordance with regulatory requirements. Approval will be provided by the Shell Production Chemist/Product Stewardship focal point. Chemicals that are not deemed ALARP will not be approved, and an alternative product shall be requested.

To ensure that chemicals which may pose a risk to the marine environment are managed appropriately on an ongoing basis, annual compliance checks will be made by Shell and chemical vendors of Shell's Chemical Treatment Program Guide and Chemical Risk Assessment Register. To accompany routine compliance checks, the impact of chemicals in key discharge streams will be assessed on an ongoing basis as indicated in Section 10.7.1.

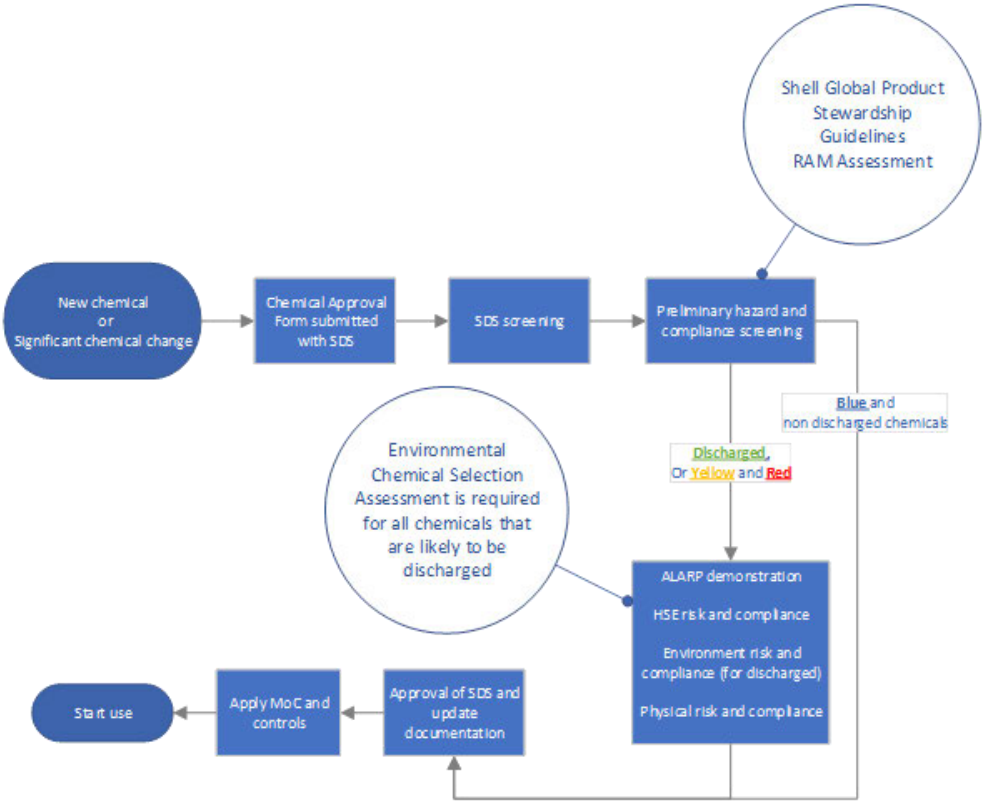


Figure 10-5: Chemical Approval Process

HQ = Hazard Quotient

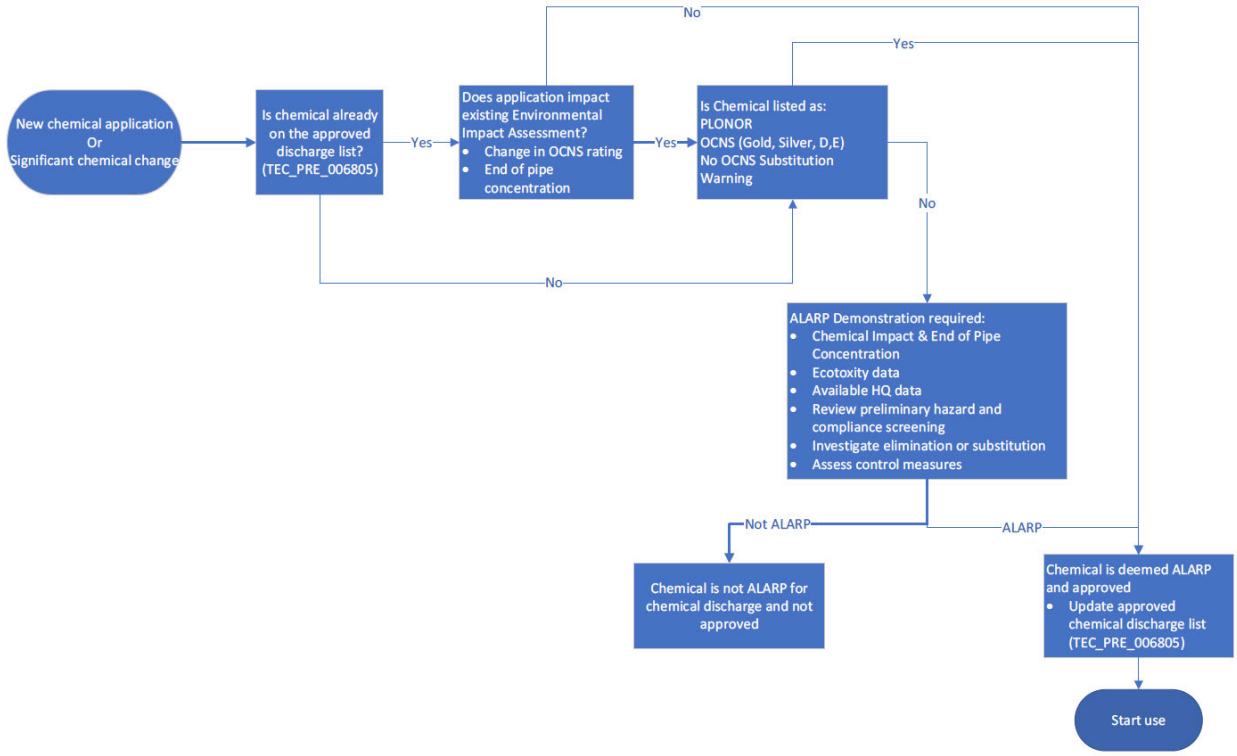


Figure 10-6: Environmental Chemical Impact Assessment

10.3.8 Manage Information, Data and Systems

This objective is to create an accountable role in the Asset which can look across operational work processes to ensure consistency in information and data management practices; support data centric culture development through best practice sharing and Assurance activities. The process evaluates maintenance and production practices to ensure there is an integrated approach to critical information management and data required to fulfil the business outcome and manage asset risks.

10.4 Process Safety and Asset Management

The Process Safety and Asset Management SEAM Standard encompasses a range of standard practices, a selection of these critical to Crux environmental management in the context of process safety and asset management are summarised in this section. Implementation of these standards ensures that Crux is positioned to operate in a safe and environmentally responsible manner and realise the benefits of a proven maintenance execution process that is of a global standard.

10.4.1 Asset Integrity and Process Safety Management

Shell uses the Asset Integrity and Process Safety Management (AIPSM model), as shown in Figure 10-7, to describe the key focus areas of process hazard analysis and process safety management which is also critical for EP implementation. The key focus areas include:

- **Design integrity** – to design and build assets with so that risks are ALARP.
- **Technical integrity** – apply barrier to manage identified MAEs and MEEs. Ensure these barriers (SCEs and ECEs) are maintained to keep them effective.
- **Operating Integrity** – processes ensure that the facility is being operated within its design envelope.
- **Leadership integrity** – leadership is the key enabler to ensure that we have assets that are safe to operate. Each leader plays an important role in safeguarding against process safety and environmental incidents and must demonstrate visible and felt leadership in the field.

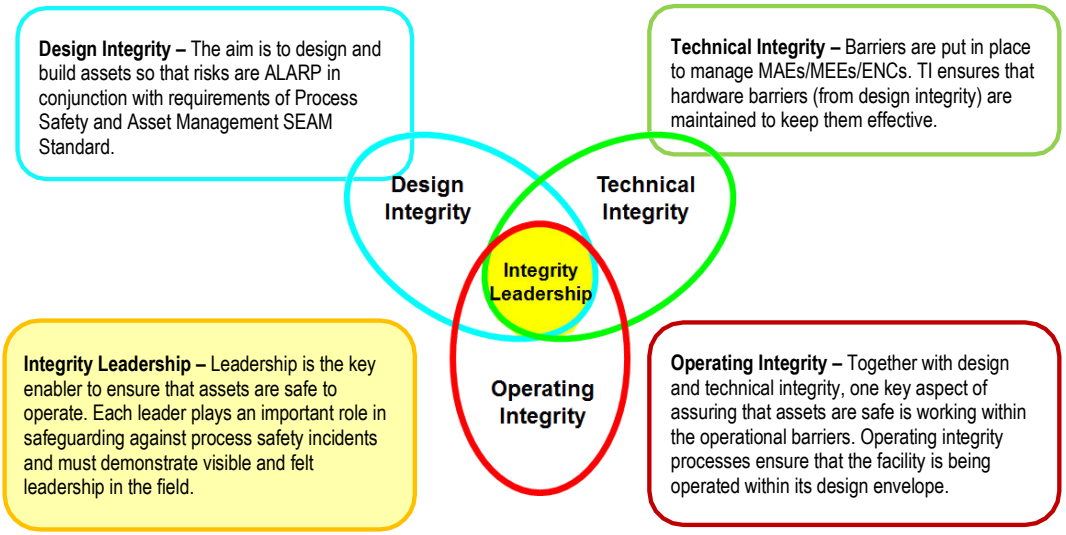


Figure 10-7: Shell AIPSM Focus Area

10.4.1.1 Environment Critical Equipment Management

To apply AIPSM to environmental management, environmental risks and impacts are identified in process hazard analysis or risk reviews such as HAZID, Environmental Impact Identification (ENVID) or Hazard and Operability (HAZOP) workshops. These workshop are conducted with the assistance of a multi-disciplinary team to ensure a systematic and methodological approach to identifying potential environmental impacts and risks which are then recorded in project registers. Once the risks and impacts are identified, mitigation is considered, in line with the hierarchy of controls, and with the aim to ensuring risks and impacts are both acceptable and minimised to ALARP. A subset of the hazards is subjected to additional review to enable subsequent preparation of technical integrity performance standards. These subsets are defined as:

- Major Environmental Event (MEE) – those hazards which are assessed using the Shell Risk Assessment matrix (RAM) to be Red or Yellow 5A/B to the Environment. MEEs relating to loss of containment may often align to an equivalent MAE (hence defined below as the subsequent critical elements are managed accordingly).
- Environmental Non-Compliance (ENC) – those hazards defined as an environmental legal non-compliance that is categorised/risk ranked as Severe (with impact ranked at 4 or 5) or Critical with regards to Shell's Environmental Legal Risk Ranking matrix.
- Major Accident Event (MAE) – those hazards which are assessed using the Shell Risk Assessment matrix (RAM) to be Red or Yellow 5A/B to People. In addition, under the OPGGS (Safety) Regulations, an MAE is an event connected with a facility, including a natural event, which has the potential to cause multiple fatalities of persons at or nearby the facility. Therefore, for the Crux Project, an MAE has been defined as a hazard with the potential to cause multiple fatalities or is risk assessed as RAM Red for People.

Using process hazard analysis tools such as bow tie assessment, a multi-disciplinary team will identify Environmental (or Safety) Critical Elements (ECE or SCE) for each of the MEEs, ENCs and MAEs. Any MEEs that are equivalent to an MAE will be subsequently managed by the SCE process. An ECE is defined as an item of equipment or structure whose failure could lead to the release of a major environmental hazard or whose purpose is to prevent or limit the consequences of a major environmental hazard (RAM Red or Yellow 5A/5B Environmental risks); or environmental regulatory non-compliance as part of implementing the controls to manage environmental hazards to ALARP and Acceptable levels.

Design Performance Standards were developed for each of the ECEs during the design phase for Crux facilities. Subsequently, Operate Performance Standards were developed for each of the ECEs detailed in the Operation Environmental Critical Elements and Performance Standards Manual. A Performance Standard will typically consist of an ECE goal, functional criteria, minimum assurance task, assurance measure and assurance value and will subsequently form part of the CMMS. The following ECE groups have Operations Performance Standards:

- Oil in Water Discharge Detection (Produced water)
- Emissions Monitoring Flare and Vent
- Emissions Monitoring Product Throughput
- Emissions Monitoring Gas Turbine Generator (GTG)
- Flare Tip Ignition System.

Table 10-7 lists the key tools that are to be used on the Crux facilities to manage ECE (and SCE) hardware barriers, both integral to the operation of Crux facilities. Performance testing during star-up ad ramp-up phases will also enable the further testing and development of these performance standards. Assurance checks are also undertaken throughout the design and fabrication stages to assure the functionality of environmental critical elements. If a critical element failed to meet the criteria specified in the ECE Performance Standard during a preventive maintenance activity or an operations check and the ECE cannot be remediated immediately, or failed during service or on demand such that it cannot perform its environmentally critical function it may be classified as an ECE impairment. If an ECE is damaged but its ability to meet the required ECE performance standard is not impacted (e.g. damage to a critical analyser but it continues to perform valid measurements), then is not considered to be an ECE impairment. If an ECE impairment arises:

- Once an impaired ECE has been identified, a corrective maintenance work notification must be created in CMMS for the repair of the ECE. The repair of the ECE will be managed through the corrective maintenance process/Perform Maintenance Execution (PME) process (Section 10.4.8).
- The ECE impairment and its corrective maintenance work order will be visible through the Facility Status Report (FSR) tool (see Table 10-7).

Table 10-7: Technical Integrity Management Tools

Tool	Name	Function
CMMS	Computerised Maintenance Management System	Contains Crux Asset Register with ECEs. Maintenance work planning, scheduling, and execution management. Documentation of completion of maintenance work. Business Warehouse function for maintenance KPI reporting and analysis. Quality module for analysis of maintenance work. Integrated with other business systems for purchasing, materials management, finance, and logistics.
AMS	Asset Management System	A set of processes which are part of SEAM standards needed to organise asset management capabilities, ensuring that activities are performed consistently and systematically. Includes mandatory elements (through Standards and Manuals) and non-mandatory elements (through Recommended Practices) and used in conjunction with other SEAM Standards. The Vice President Prelude/Crux is accountable for ensuring adherence to the AMS. The AMS standard provides all the tools and processes which help an asset get to at least the minimum requirements comprising four major sections: 1. Leadership, Commitment and Accountability. 2. Requirements Processes and Guides. 3. Organisational Capability. 4. Learning Loops.
IMSA	Integrity Management System Application	Integrity management software for pipelines (both onshore and offshore) and underwater assets (apart from wells).
FSR	Facility Status Report	Status of preventive maintenance and corrective maintenance work orders and deviations
MRP	Maintenance Reference Plan	A long-term planning reference detailing the maintenance and integrity related to activities required to sustainably safeguard an asset.

Tool	Name	Function
eWIMS	Wells Integrity Management System	Electronic online system for the management of wells specific integrity tasks. Interfaces with CMMS for scheduling and status of tasks (as CM or PM work orders)

10.4.2 Process Safety Requirements

Process safety requirements are integral to the environmental hierarchy of controls and ALARP demonstration, as they relate to loss of containment of hydrocarbons and hazardous materials. Shell applies Design and Engineering Management (DEM) when designing or constructing new assets or making any modification to an existing asset. The DEM applies to assets/projects that have RAM red or yellow 5A or 5B process safety risks and set mandatory design and construction requirements and include consideration of industry standards, industry learnings from major process safety incidents and regulatory expectations in geographies in which Shell operates. In addition to the DEMs, another key component of this SEAM Standard is the Statement of Fitness (SOF) requirement which provides sufficient assurance to operations that the new asset, or modification to the existing Asset, is handed over in compliance with the applicable process safety requirements. A SOF is a cross-functional review to confirm integrity and ensure that controls are in place and effective (process safety risks managed to ALARP) to begin or continue operation of a process or equipment. SOF assurance tasks are fundamental to the transitioning from well completions, through to hot commissioning and start-up (see Section 10.3.1.1 and accountabilities are listed in Table 10-1). Assets are also required to verify, assure, and validate technical integrity in design and construction (including brownfield projects or modifications). Process Safety Information is maintained to manage process safety risks, and this typically includes (but is not limited to) design basis; process engineering flow schemes; piping and instrumentation diagrams; cause and effect diagrams; alarm documentation, plot plans, layouts, area classification drawings; specifications, datasheets; operating procedures and training records.

10.4.3 Process Safety Basic Requirements – Design Engineering Management 2

Design Engineering Management 2 (DEM2) contains a set of Process Safety Basic Requirements (PSBR). The intent of the PSBR is to prevent a re-occurrence of known major Process Safety incidents by focussing on their main causes and key barriers. Examples include:

- ESD valves on platform risers (Piper Alpha 1988);
- Avoid liquid release relief to atmosphere (BP Texas City 2005); and
- Low Temperature Embrittlement (Longford 1998).

The PSBRs contain both design and operational requirements. Application of DEM2 requirements is mandatory. Any Shell Group project or asset must demonstrate alignment to these PSBRs or otherwise follow a rigorous derogation process requiring the signature of the Shell Group Chief Executive Officer. There have been no DEM2 derogations required for Crux (both design and operational).

10.4.4 Application of Technical Standards – Design Engineering Management 1

The Shell Group Design and Engineering Publications (DEPs) form the basis of all detailed design and are applied over and above the regulatory minimum. These documents are owned and managed by Shell Projects and Technology, the Shell Group technical service organisation, and are under continual review as experience and knowledge grows through operation around the world. The documents therefore embody the most up to date knowledge within Shell Group on a wide variety of design and engineering tasks. Where applicable the DEP have been aligned with internationally recognised Industry Standards.

A subset of DEPs contains process safety related design requirements. These DEPs form what is known as the Design Engineering Management 1 (DEM1). Compliance with the 'SHALL' requirements is mandatory for all new projects and equipment. A deviation process that includes a demonstration that ALARP will be achieved is required to be followed if an alternative solution is to be used. The ALARP demonstration is assessed by relevant Subject Matter Experts, including personnel external to the facility. Accepted deviations are filed on a central Shell Group register.

10.4.5 Ensure Safe Production

The Ensure Safe Production work process provides a structured framework by which an asset can operate cost-effectively within safe and optimal limits without compromising its integrity or reliability while maximising production, reducing deferment, and minimising HSSE impacts and risks to ALARP and acceptable levels.

Ensure Safe Production process scope consists of these five areas further outlined in Figure 10-8 below:

- **Ensure Plan Delivery** by establishing routines and activities to maximise value and deliver Production Plan through analysis, optimisation and resolution of issues that threatens delivery of the plan.
- **Situational Awareness** by shift team gaining full understanding of the facility during shift and crew handover through standardising communications and planning across operations shifts. It is important that teams understand what is needed to operate safely, reliably, and optimally.
- **Manage Limits and Alarm** by ensuring that facilities are operated within approved operating limits, a healthy alarm system is maintained and there is reliable operator response to alarms. Process conditions leading to alarms are managed to stabilise operations, minimise control room distractions and promote effective response to abnormal situations. Effective alarm and target management leads to improved business outcomes.
- **Proactive Monitoring** through early detection of threats or opportunities by carrying out structured monitoring of process and equipment which enables facility team to ‘find small, fix small’ leading to sustained optimal operations and minimised process safety and reliability risks.
- **Managing Abnormal Situation** through recognising and responding to any deviation in the production process in a structured way and bringing the situation back to normal in a controlled way. Through stabilise, slowdown and shutdown process safety, reliability risks, limit exceedances or other developing process threats that may impact overall integrity of the facility can be minimised or eliminated.

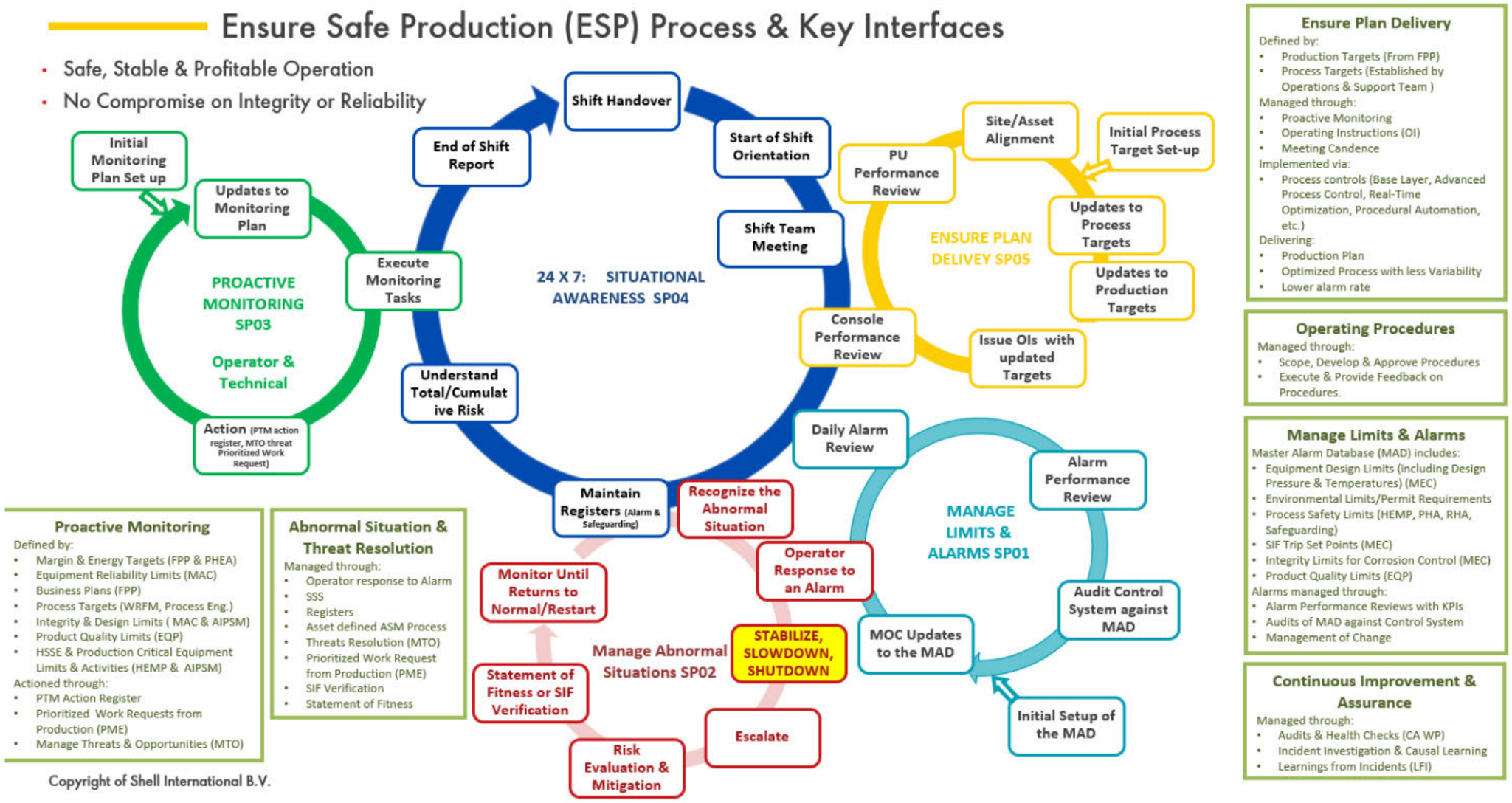


Figure 10-8: Ensure Safe Production Process Overview and Key Interfaces with Other Processes

10.4.5.1 Proactive Technical Monitoring

A Proactive Technical Monitoring (PTM) process will be developed to ensure early detection of threats through structured proactive monitoring of process and equipment, which will enable the ability to 'find small, fix small' leading to sustained optimal operations and minimised risks. PTM includes monitoring for identification of short-term threats, as well as monitoring longer-term or cumulative threats and will be applied for the management of produced water discharges and oil in water limits, and other applications as required such as flare monitoring and fuel gas consumption.

Figure 10-9 shows how the proactive technical monitoring integrates across other key SEAM standards work processes which are key to good environmental management. Perform Well Reservoir Facility Management (WRFM) is further detailed in section 10.4.11.

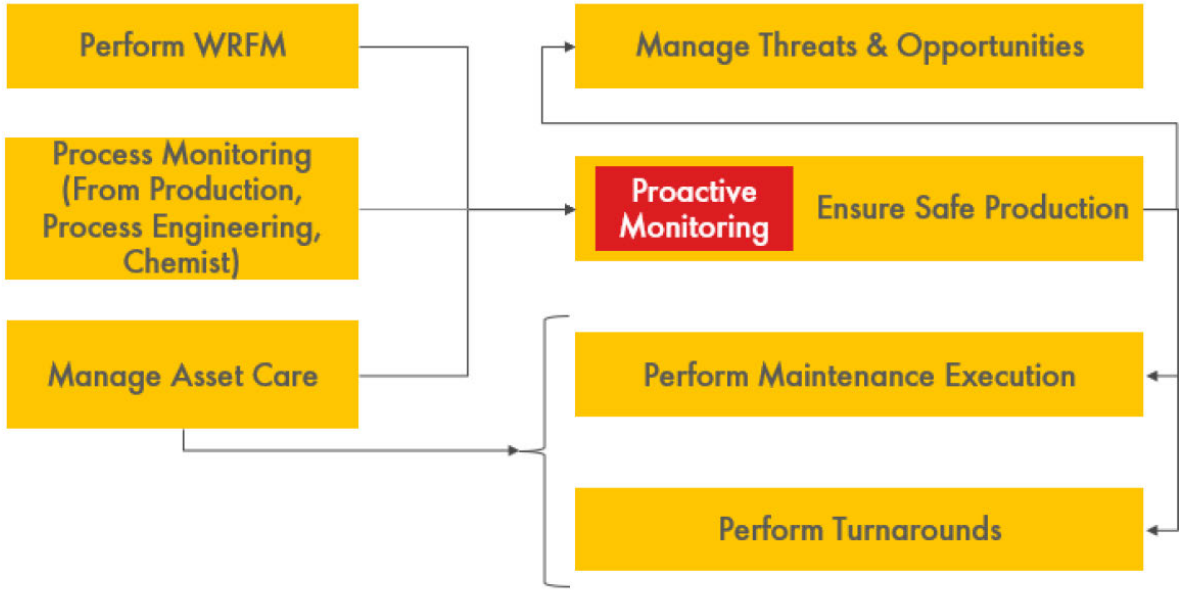


Figure 10-9: Integration of Proactive Monitoring across the SEAM Standards Work Processes

The key process activities of Proactive Monitoring shown in Figure 10-10 and are:

- Create and deploy monitoring plans aligned with Equipment Care Strategies;
  - Gather data.
  - Define the care strategies for equipment and process.
  - Determine monitoring approach.
  - Complete additional set-up for Exception Based Surveillance.
  - Finalise and deploy monitoring plans.
- Execute monitoring;
- Respond to exceptions;
  - Analyse (vet out false positives and false negatives).
  - Diagnose (deeper technical analysis to come with a recommendation).
  - Action recommendations.
- Update the monitoring plan (continuous improvement cycle).

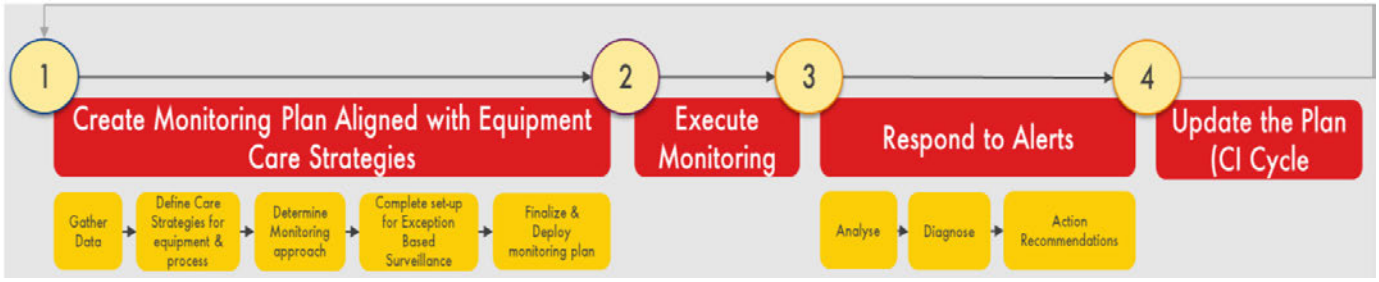


Figure 10-10: PTM Work Process – Key Steps

Executing PTM during production is summarised in Figure 10-11.

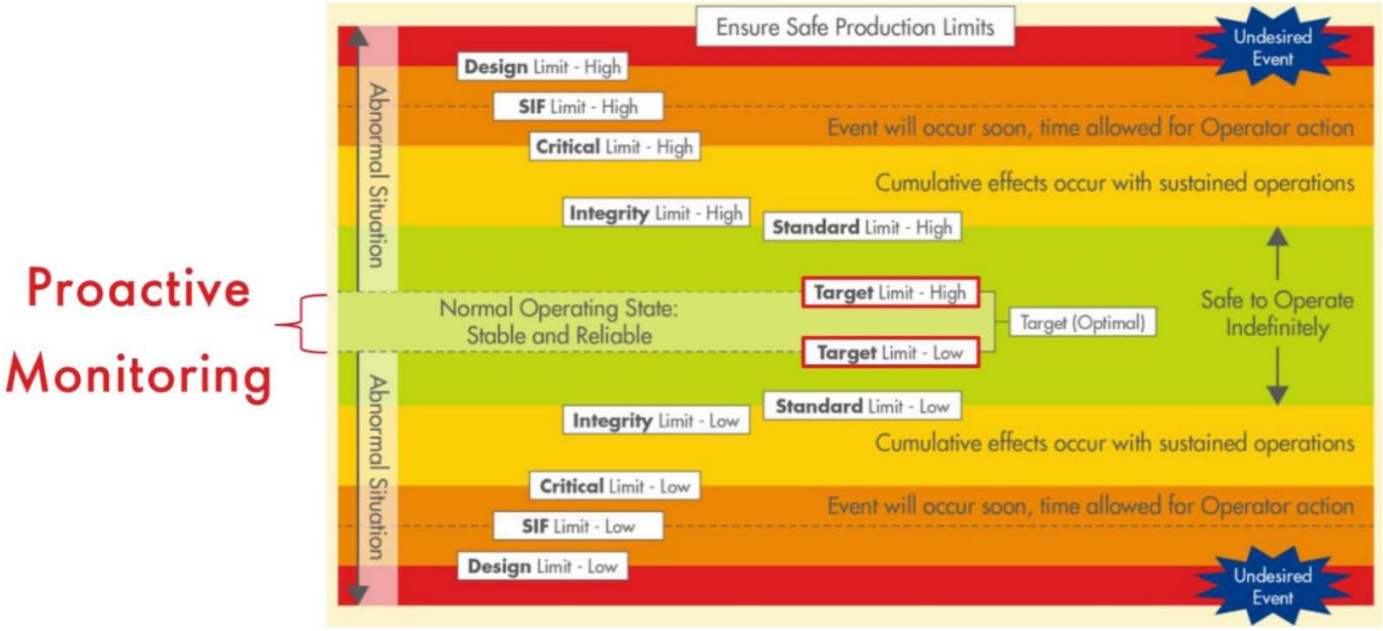


Figure 10-11: Scope of PTM and Interface with Abnormal Situation Management Process

The PTM process will be developed and applied on key process systems and equipment, including the produced water system. This will also involve a short cycle continuous improvement to the monitoring plan for the produced water system, implemented within the start-up ramp-up period prior to NNM phase 1. This is intended to provide Shell confidence that in the event of impairment of ECEs, such as the oil in water analysers, that assurance of still continuing to meet defined EPSs can continue to be maintained.

Key parameters to be monitored (absolute value) and analysed (e.g. rate of change, multivariate analysis, relative percentage difference) to provide assurance against oil in water analyser impairment for example, will include the Produced Water Degasser inlet flows, interface level and condensate carryover compartment level, all readable from dedicated instrumentation. All data from PTM will be stored, including engineer notes against alerts, in the exception based surveillance system. Responsibility for final decision making around implementing react visits during unmanned periods will sit with the Operations Manager, within the managing abnormal situations process outlined in Section 10.4.5.2.

10.4.5.2 Managing Abnormal Situations

Managing Abnormal situations involves recognising and responding to any deviation in the production process in a structured way and bringing the situation back to normal in a controlled way. The operator is mandated and expected to Stabilise, Slowdown or Shutdown the installation to ensure the safety of staff and the safe operation of the installation. Figure 10-12 shows the range of production limits the abnormal situations process covers.

As an example, to illustrate the application of this philosophy, this may involve initiating react visits where there is inadequate observed process stability related to an EPS parameter, or alternatively, after exhausting all

controls to try and stabilise a process upset, the operator may initiate either slowdown or shutdown of production.

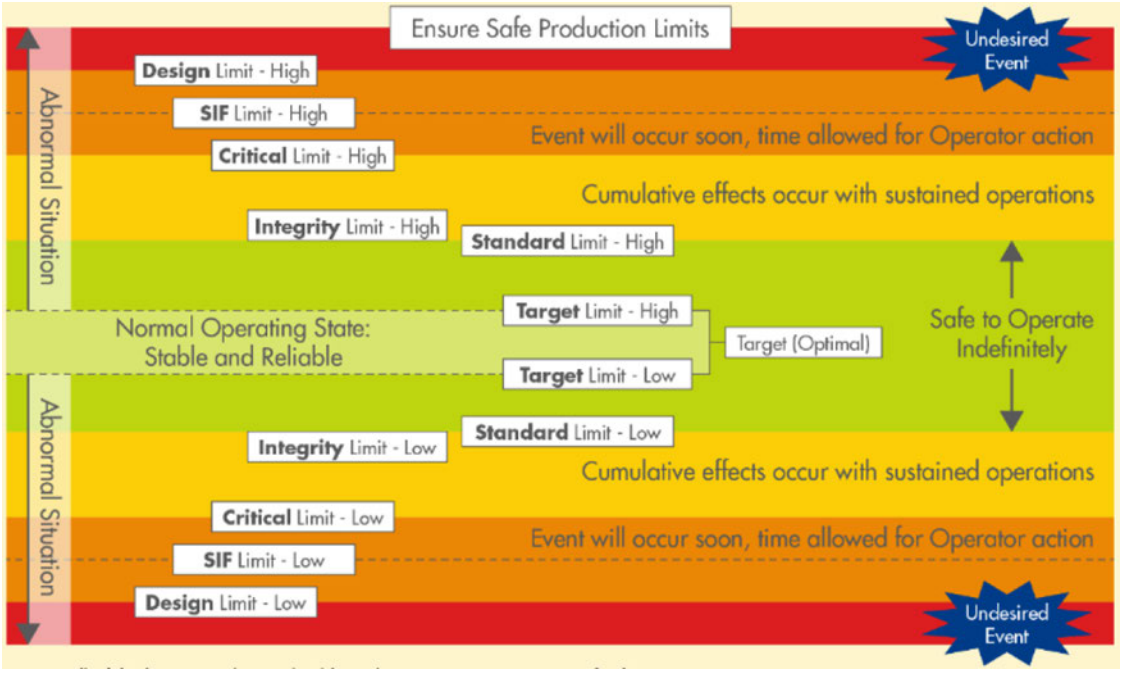


Figure 10-12: Ensure Safe Production Limits

10.4.5.3 Situational Awareness

Situational awareness activities objective is to handover the responsibilities from the outgoing shift team or crew to the incoming shift team or crew, verify the handover, and familiarise them with the current condition of the Asset. The situational awareness of the team/crew is increased by evaluating information obtained from Shift Handover and the Start of Shift Orientation (SoSO) in the Shift Team Meeting to determine the current Shift Plan. Each team member documents events as they occur during the current shift in the End of Shift Report.

The SoSO is a time bounded, usually at the start of each shift, initial familiarisation of the Asset generally performed between shift handover and shift team meeting (except for geographically dispersed locations which perform the SoSO after the shift team meeting.) The SoSO is meant to confirm the status of the Asset matches what was heard during the shift handover and prepares the individual to contribute to the shift team meeting. Whilst Crux is unmanned, SoSO will occur remotely, through the use of CCTV and other remote forms of situational awareness.

10.4.6 Design and Operating Envelopes

The Crux Facility has been designed and built to ensure that the risks associated with process safety events have been managed to ALARP. This is part of the ‘design integrity’ focus areas of AIPSM.

Design limits define the boundary of the design envelope for each piece of equipment and if exceeded could potentially lead to a loss of containment. These limits (such as pressure, temperature, and level) have been set using industry and company standards and assured via various process safety reviews (such as HAZOP and desktop). Design limits should never be violated as this puts the mechanical integrity of the system at risk which could result in a critical failure of equipment and an increased risk to environment.

The safeguarding envelope sits between the operating and design limits. Where appropriate, automated safeguarding (trips or mechanical devices) have been implemented to prevent the design envelope being breached.

The operating envelope identifies the integrity, capacity, and performance constraints of a system. The operating envelope by default is within the boundary of the design envelope. The operating envelope should not be violated – it is Operations responsibility to operate within the limits and boundaries of the operating

window. Figure 10-12 provides an overview of the relationship between design and operational envelopes. Failure to operate responsibly within the design limits risks a loss of containment and potential environmental and safety risk increase.

Systems onboard the Crux Facility take live plant data and pre-defined envelopes (Design, Safeguarding, Envelopes and Operating Windows) to determine how a particular piece of equipment or process is operating. Alerts are directed to the relevant engineer and indicate which envelope the equipment is operating in and how it has been operating (and if there are faults). This allows for quick identification of where issues may lie and can be used to predict future exceedances. These alerts are reviewed by engineers frequently, and findings or required actions are fed back to the Operations team.

Changes to design and operating envelope limits must go through the MOC process.

10.4.7 Manage Asset Care

Implementation of the Manage Asset Care standard ensures that Crux is in a position for the facility to operate in a safe and environmentally responsible manner and realise the benefits of a proven maintenance execution process that is of a global standard. The standards cover excellence in maintenance execution which transcribes to 'the right job, by the right person at the right time'; i.e. jobs and processes that are approved, scoped, performed with the right competency and attitude, scheduled to be performed at a time that reflects the needs and risk of the business and that asset. The manage asset care standards are designed to ensure the safe and reliable operation of assets, minimising risks, and maximising performance.

Crux records Corrective Maintenance within the Computerised Maintenance Management System (CMMS). An Asset Register (Section 10.4.7.1) is developed and maintained within the within the CMMS for maintainable equipment, allowing for auditable recording of preventative and corrective maintenance on equipment within the scope of work process on an as needs basis. Equipment care strategies are developed, which includes:

- Preventative Maintenance Library (PML) which defines planned tasks for the care of asset equipment using a risk-based approach to set optimal tasks that deliver business results.
- Maintenance Plan within CMMS that will gather data and analysis information and undergo reliability reviews to cover preventative and corrective maintenance.

Effective manage asset care execution contributes to the longevity, reliability and environmental safety and performance of Shell's assets.

10.4.7.1 Asset Register

The Asset maintains up to date information to make risk-based business decisions in an Asset Register. The Asset Register meets the minimum data standards requirements outlined by Manage Information, Data and Systems SEAM process (refer HSSE and SP and Asset Management Foundations Practices, Section 10.3.8). The asset register will support future maintenance activities and satisfy the decommissioning and removal obligations and make allowance for changes in asset management requirements and planning throughout field life for both temporary and permanent equipment in conjunction with the evolution of the Crux project and activity sequences.

10.4.8 Perform Maintenance Execution

Perform Maintenance Execution (PME) SEAM processes ensure corrective and preventative maintenance tasks are identified, planned, scheduled and completed using work orders in the CMMS. All corrective maintenance requests entered in the CMMS are prioritised by a risk-based methodology, and preventative maintenance tasks are prioritised by relevant discipline engineers using the Manage Asset Care Process (Section 10.4.7). Continuous improvement in the PME process is managed through performance metrics tracked on a weekly, monthly, and quarterly basis. Additionally, feedback loops are utilised in the Close Work and Improve Performance phase of the PME Process, to initiate, implement and drive process improvements. Throughout the process, there is ongoing collaboration with other disciplines to ensure seamless interfaces and allows optimisation of process outputs.

A Corrective Maintenance (CM) notification is raised automatically in the CMMS to address failed assurance tasks. CM Notifications are raised whenever a failure or impending failure is identified. All CM notifications are prioritised for execution using the Corrective Management Prioritisation Tool (CMPT). The CMPT assessment is done initially by Offshore maintenance and Production Operations Team Leads, and then validated by the

Operations Maintenance Coordinator, in collaboration with relevant Technical Authorities (as and when required). The CMPT considers consequences to People, Asset, Environment and Reputation and the likelihood of those consequences occurring. During the review of newly identified corrective work and when considering the risk, this is done with the mindset of managing risk to ALARP and any mitigation is considered to this standard. Once the priority is set and the notification is approved the Latest Allowable Finish Date (LAFD) for the corrective intervention is locked. Timely completion of maintenance, in advance of the (LAFD) enables completion of the intervention prior to the realisation of consequences occurring.

Once the notification is approved a CM work order with the defined Latest Allowable Finish Date (LAFD) can be created, planned, scheduled, and executed. Maintenance schedules are developed based on the capacity to liquidate work, with the expectation that work teams are 100% loaded for the week. The schedule is built incorporating (in this order) carry-over work from the previous week, PM work and CM work, with an emphasis on bringing in HSSE critical work, then based on priority and LAFD dates. The schedule is built in collaboration with Operations to ensure that equipment can be made available and is ready for maintenance when required.

10.4.9 Perform Hydrocarbon and Energy Accounting

Crux facilities are designed and will be operated to sustain accurate accounting for material balance, production allocation, energy consumption and GHG emissions. This accounting framework will support the continuous improvement process for optimising energy efficiency and GHG emissions improvement detailed in section 10.6.

10.4.10 Perform Turnarounds

Crux will develop a long-term turnaround strategy in accordance with this SEAM process to enable safe, effective, and consistent implementation of turnarounds to maximise equipment safety, reliability, and availability and form the basis for continuous improvement cycle.

10.4.11 Wells, Reservoir, Facility Management

A Wells, Reservoir, Facility Management (WRFM) Plan will be revised annually and integrated with the Field Management Plan, addressing matters such as reservoir management strategy, data acquisition and surveillance plan, and well test requirements. The WRFM Plan will also be an important input into monitoring, surveillance and planning for formation water breakthrough, associated well strategies and GHGEM continuous improvement detailed in Section 10.6.

10.4.12 Manage Decommissioning and Restoration

Decommissioning involves the timely, safe, and environmentally responsible removal of, or otherwise satisfactorily dealing with Crux Project infrastructure. This process is aligned to the key principles for decommissioning, as outlined in the Offshore Petroleum Decommissioning Guideline (DISER 2022) and the Decommissioning Compliance Strategy 2024–2029 (NOPSEMA 2023a), which include:

- Decommissioning is the responsibility of titleholders.
- Early planning for decommissioning to occur as part of the design and concept selection.
- Removal of all property is the ‘base case’ and is consistent with Australia’s international obligations, primarily under the United Nations Convention on the Law of the Sea and the 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972, (the London Protocol). Other decommissioning options may be considered but must comply with the OPGGS Act and its regulations, including the principles of ESD.
- Decommissioning must be completed before the end of title to ensure that all decommissioning activities are conducted under the OPGGS Act and regulations framework.

The Crux Project decommissioning planning commenced in the project development phase and will continue throughout the life of operations, including IMR activities, consideration of late-life asset management, cessation of production, removal of property, plug and abandonment of wells, and finally, title relinquishment. A Crux asset decommissioning plan, incorporating a Subsurface Isolation Strategy to complete safe and efficient decommissioning of wells, will address the facility life cycle and enables sufficient planning for future requirements with SEAM Standards and local regulations.

The manage asset care works process (see Section 10.4.7) outlines how the asset register will support future IMR activities and satisfy the decommissioning and removal obligations. Table 10-8 outlines the decommissioning considerations for each of the key property (infrastructure, structures, and equipment) within the Crux production and infrastructure licences. These considerations include infrastructure specifications (composition, weight, and dimensions), monitoring and maintenance requirements and decommissioning considerations.

Temporary structures, equipment and infrastructure that are no longer in use will be removed (see Section 6.11.5). This approach enables compliance with section 270, section 572(2) and section 572(3) of the OPGGS Act, which require titleholders to remove property when it is neither used, nor to be used, in connection with the operations or other arrangements that are satisfactory to NOPSEMA in relation to the property.

As described in Section 7.2.1 environmental baseline studies have been completed to establish pre-impact environmental conditions throughout the Crux Project Area. Appendix I of the installation and cold commissioning environment plan commits to completing further environmental baseline studies, which will provided additional basis to inform the impact assessments throughout the Crux Project operations and decommissioning phases. These environmental baseline studies will enable the eventual title relinquishment process as per Section 270 of the OPGGS Act.

Subsection 572(2) of the OPGGS Act provides that while property remains in the title area and is used in connection with the operations authorised by this EP, it must be maintained in good condition and repair. The Crux philosophy for IMR is to inspect and maintain the installed property portfolio such that its mechanical condition remains fit for the purposes specified in its original design requirements. These include but are not limited to integrity, availability, service life, and abandonment requirements. Section 6.11.3 describes the IMR activities.

Shell's commitment to decommissioning planning and execution is described within Section 5.6.6 of the Crux OPP. Shell refers to this description as information previously given under section 56(1) of the OPGGS(E) Regulations. The decommissioning design provisions for all property installed above the mudline are intended to provide a number of technically feasible decommissioning and removal options (see Table 10-8). Sections 572(7) and 270(3) of the OPGGS Act provide for alternative decommissioning options to full removal (such as leave in-situ) where it can be demonstrated that the activity can comply with all other legislative requirements and that the potential risks and impacts are reduced to ALARP and acceptable level.

The future Crux decommissioning EP (to be developed) will meet the requirements of the OPGGS Act and OPGGS(E) Regulations, and any additional relevant legislation, policies (such as NOPSEMA's Policy: Section 572 Maintenance and removal of property [NOPSEMA 2022d]) and guidelines (such as the Offshore Petroleum Decommissioning Guideline [DISER 2022]) in force at the time. Decommissioning options will be assessed before the end of project life as per relevant legislative requirements. These decommissioning options will be evaluated to demonstrate that environmental impacts and risks are acceptable and ALARP during the Crux Decommissioning EP process.

It is widely acknowledged that various factors that may affect titleholders' consideration of the most suitable decommissioning option, including site-specific environmental and safety risks, type of infrastructure, costs, and available technology/technical feasibility. An ALARP and acceptability assessment of the decommissioning options proposed for the project will provide transparency in decision making where environmental benefits and impacts are clearly presented in the context of a broader framework of decision criteria. The decommissioning and removal of any property from within the title area at the end-of-life will be undertaken pursuant to a future NOPSEMA–accepted Crux decommissioning EP, subject to ensuring that such activities do not cause unacceptable environmental impacts.

After the successful completion of decommissioning activities, Shell will apply to surrender the Crux production and infrastructure licences. Once satisfied that Shell has complied with all requirements for the surrender of these licences, the Designated Authority can consent to the surrender of the licences. It is anticipated that decommissioning and surrender of the licences, from approval of the Decommissioning EP through to the Designated Authority's consent to the surrender of the licences, will take about 12 months.

While the majority of decommissioning will be undertaken at the end of the project's operating life, Shell will look for opportunities throughout the activity to periodically remove any disused infrastructure, where feasible. Before the end of the Crux Project's lifespan, various decommissioning options will be assessed in consultation with relevant parties and evaluated for their environmental impacts and risks. Unless otherwise agreed upon

through an accepted EP, the Crux infrastructure will be removed in a manner that ensures environmental impacts and risks are minimised and are ALARP.

Table 10-8: Indicative Asset Specifications, Monitoring, Maintenance and Decommissioning Considerations

Asset	Description	Indicative Specifications			Temporary, Long–term or Permanent	Indicative Monitoring and Maintenance	Decommissioning Considerations		Removed under this EP?
		Approximate Dimensions	Weight (~t)	Typical Materials			Recoverable?	Possible Recovery Methods	
Export pipeline	Crux export pipeline located between the Crux- and Prelude-end PLETs.	Length ~155 km 26″ Outside Diameter (OD) × 22.2/19.1 mm Wall Thickness (WT)	Steel: 48,000 Concrete: 53,000	Carbon steel (CS) pipe, 40-50 mm thick concrete weight coating and asphalt enamel coating. Sacrificial anodes spaced along the pipeline.	Long–term (20 years design life).	Maintenance undertaken in accordance with manage asset care. Risk based inspections to monitor and maintain system integrity and operability. Check general condition, free spans, scour, marine growth, cathodic protection readings, coating damage, mechanical damage, field joint damage, leaks and other anomalies.	Yes	Inventory flushed to remove hydrocarbons and contaminants. Water jetting of sediment, if required. Disconnect and recover: • Via reversed installation method to pipelay vessel. Pipeline cut into shorter lengths on vessel before transported to shore for disposal. • Alternative option is to cut pipeline on seabed to manageable section lengths before lifting via crane to vessel and transport to shore for disposal.	No
Fibre-optic jumper	Fibre-optic jumper connection between Crux-end PLET and Fibre-Optic Cable Termination (FOCT).	Length ~170 m	0.17	Various.	Long–term (20 years design life).	Maintenance undertaken in accordance with manage asset care. Risk based inspections to monitor and maintain system integrity and operability.	Yes	Recover onto a vessel via crane after disconnection from Cable Termination Assembly (CTA) and PLET.	No
Static umbilical including UTH	Umbilical located within J-Tube of Crux topsides. Contains fibre-optic, hydraulic and electrical lines for SSIV control and fibre-optic connection from shore to Crux topsides. Subsea connection from the Crux-end PLET to the Crux-end UTH. Crux-end Electrical Flying Leads (EFL)/Steel Flying Leads (SFL) connect the UTH to Crux PLET SSIV.	Length ~360 m Width 114.8 mm OD	15	Super duplex alloy, various.	Long–term (20 years design life).	Maintenance undertaken in accordance with manage asset care. Risk based inspections to monitor and maintain system integrity and operability of the umbilical length on seabed, cobra head and J-tube including J-tube cover. Check general condition, damage, marine growth and other anomalies.	Yes	Installation method reversed, disconnect and cap umbilical ends. Recover by lifting via vessel crane.	No
Crux-end PLET	Crux-end PLET comprising 26″ SSIV.	Length ~12 m Width ~7.3 m Height ~6.2 m	80	Steel.	Long–term (20 years design life).	Maintenance undertaken in accordance with manage asset care. Risk based inspections to monitor and maintain system integrity and operability. Check general condition, marine growth, cathodic protection reading, coating damage, leaks and other anomalies.	Yes	Structure internally flushed to remove hydrocarbons and other contaminants. • PLET disconnected or cut from EFLs, SFLs, Fibre-optic jumper, pipeline and subsea tie-in spool before lifting via crane to vessel and transport to shore for disposal.	No
Crux-end PLET foundation	Structure supports the Crux-end PLET and provides for export pipeline movement. Contains multi-quick connect (MQC) panel for static umbilical interface.	Length ~20 m Width ~13.2 m Height ~2.85 m (top of MQC panel)	70	Steel.	Long–term (20 years design life).	Risk based inspections to monitor and maintain system integrity and operability. Check for general condition, settlement, inclination, scouring, cathodic protection reading and other anomalies.	Yes	Recover onto a vessel via crane.	No
Prelude-end PLET	Prelude-end PLET comprising 18″ SSIV.	Length ~12 m Width ~7.3 m Height ~6.2 m	78	Steel.	Long–term (20 years design life).	Maintenance undertaken in accordance with manage asset care.	Yes	Structure internally flushed to remove hydrocarbons and other contaminants. • PLET disconnected or cut from ELFs, SFLs, pipeline and flexible	No

Asset	Description	Indicative Specifications			Temporary, Long–term or Permanent	Indicative Monitoring and Maintenance	Decommissioning Considerations		Removed under this EP?
		Approximate Dimensions	Weight (~t)	Typical Materials			Recoverable?	Possible Recovery Methods	
						Risk based inspections to monitor and maintain system integrity and operability. Check general condition, marine growth, cathodic protection reading, coating damage, leaks and other anomalies.		riser before lifting via crane to vessel and transport to shore for disposal.	
Prelude-end PLET foundation	Structure to support Prelude-end PLET and provides for export pipeline movement. Contains MQC panel for dynamic umbilical interface.	Length ~20 m Width ~13.5 m Height ~2.85 m (top of MQC panel)	72	Steel.	Long–term (20 years design life).	Risk based inspections to monitor and maintain system integrity and operability. Check for general condition, settlement, inclination, scouring, cathodic protection reading and other anomalies.	Yes	Recover onto a vessel via crane.	No
Subsea tie-in spool	Subsea spool connecting the rigid riser to Crux-end PLET.	Length ~50 m 26″ OD 2 × ~23 m	55	CRA clad carbon steel with a three-layer polypropylene coating.	Long–term (20 years design life).	Maintenance undertaken in accordance with manage asset care. Risk based inspections to monitor and maintain system integrity and operability. Check for general condition, coating and field joint coating damage, settlement, scouring and other anomalies.	Yes	Inventory flushed removing hydrocarbons and other contaminants. Disconnect from the rigid riser and Crux-end PLET. Spool may need to be cut into shorter lengths to assist recovering. Recover onto a vessel via crane.	No
Rigid riser	Pre-installed riser located within Crux topsides.	Length ~200 m (linear) 26″ OD, 25.4 mm thickness +3 mm clad.	120	CRA clad carbon steel with a three-layer polypropylene coating.	Long–term (20 years design life).	Maintenance undertaken in accordance with manage asset care. Risk based inspections to monitor and maintain system integrity and operability including air, splash zone and submerged sections of the riser and the riser guides/clamps. Check for general condition, coating, field joint damage and other anomalies.	Yes	Inventory flushed to remove hydrocarbons and contaminants. Riser in the air section is to be cut and removed with topsides. Riser in the submerged sections to be recovered with the substructure.	No
EFLs	Subsea cables between static or dynamic umbilicals for power and signals to and from SSIV actuator instrumentations.	~20 m	0.1	Various.	Long–term (20 years design life).	Maintenance undertaken in accordance with manage asset care. Periodic power and communication signal testing on the Prelude and Crux topsides.	Yes	Recover with ROV intervention onto a vessel.	No
SFL	Subsea hydraulic tubes between static or dynamic umbilicals for hydraulic pressure supply to SSIV actuator to operate SSIV.	~25 m	0.067	Various.	Long–term (20 years design life).	Maintenance undertaken in accordance with a planned maintenance schedule. Periodic testing of the hydraulic supply pressure on the Crux and Prelude Topsides.	Yes	Recover with ROV intervention onto a vessel.	No
Flexible riser	16″ ID Flexible pipe connecting Prelude-end PLET to the Prelude FLNG. 19 Buoyancy units will be fitted to the flexible.	Length ~970 m, 528.84 mm OD Buoyancy units: Width ~1.8 m Length ~1.6 m	Flexible: 320 Buoyancy: 1.4 ea.	Flexible – Duplex alloy, carbon steel, various. Buoyancy – syntactic foam with a polyurethane shell.	Long–term (20 years design life).	Maintenance undertaken in accordance with manage asset care. Risk based inspections to monitor and maintain system integrity and operability.	Yes	Inventory flushed to remove hydrocarbons and contaminants. Disconnect from Prelude-end PLET/spool and Prelude FLNG. Recover onto a vessel.	No

Asset	Description	Indicative Specifications			Temporary, Long–term or Permanent	Indicative Monitoring and Maintenance	Decommissioning Considerations		Removed under this EP?
		Approximate Dimensions	Weight (~t)	Typical Materials			Recoverable?	Possible Recovery Methods	
						Check general condition, damage, marine growth, and other anomalies. Periodic testing of the annulus vent flowrate via vent gas monitoring system. Polymer coupon on the Prelude Topsides.		Buoyancy units on the flexible riser to be recovered onto a vessel.	
Dynamic umbilical, including Umbilical Termination Head (UTH)	Umbilical for SSIV controls with hydraulic tubes and electrical cables for between Prelude-end PLET foundation and Prelude FLNG. 21 buoyancy units will be fitted to the umbilical, if required. 1 UTH.	Umbilical: Length ~1,100 m, Width 138.7 mm OD Buoyancy units: Width ~0.5 m Length ~0.5 m UTH: ~1.35 × 1.2 × 1.1 m	Umbilical: 65 Buoyancy: 0.1 ea.	Umbilical – Superduplex, various. Buoyancy – syntactic foam with a polyurethane shell.	Long–term (20 years design life).	Maintenance undertaken in accordance with manage asset care. Periodic hydraulic supply pressure testing on Prelude Topsides. Risk based inspections to monitor and maintain system integrity and operability. Check general condition, damage, marine growth, and other anomalies.	Yes	Disconnect from Prelude-end PLET, and Prelude FLNG. Buoyancy units on the flexible riser to be recovered onto a vessel.	No
Scour protection, span rectification, foundations	Mattresses, skirts, mudmats and grout bags may use scour protection, span rectification, foundations (e.g. spool) may use.	Typically ~6 m × ~3 m × ~0.3 m to ~1 m × ~1 m × ~1 m	3–5 ea.	Concrete mattresses are usually concrete blocks with polypropylene ropes. Grout bags are typically made of flexible material, such as woven polypropylene, and are filled with granular material like sand, which is stabilised with a binder (e.g. cement) or with rock without a binding material.	Long–term (20 years design life).	Risk based inspections only.	Yes	Recover onto a vessel via crane, with ROV support. Use of ROV basket to assist if required.	No
Insert piles	12 (plus two contingency) insert piles.	Length ~64 m (per section) Width ~2.9 m OD with a 70 mm WT	313	Steel. Inert grout (cement and additives).	Permanent	N/A	No	Removing this equipment is considered not technically feasible due to its weight, size, depth below the mudline, and associated safety and risk considerations.	No
Primary piles	16 primary piles.	Length ~147 m Width ~3.5 m OD with a 60 mm WT	812	Steel. Inert grout (cement and additives).	Permanent	N/A	No	Removing this equipment is considered not technically feasible due to its weight, size, depth below the mudline, and associated safety and risk considerations.	No
Substructure	One fixed steel lattice-type jacket with pre-installed 26″ rigid riser.	Height ~190 m	28,000	Steel.	Long–term (>20 years design life).	Maintenance undertaken in accordance with manage asset care. Risk based inspections to monitor and maintain the integrity.	Yes	Substructure is decommissioned by cut-off at the mudline to enable recovery or toppling in-situ. Alternatives that will be evaluated include complete or partial removal for onshore recycling or disposal.	No
Topsides	See Section 6.7 for a high-level description.	Length ~106 m (excluding helideck overhang) Width ~45 m Height ~32 m (Main deck)	11,700	Steel/Various.	Long–term (>20 years design life).	Maintenance undertaken in accordance with manage asset care. Risk based monitoring, inspections and testing to monitor and maintain system integrity and operability.	Yes	Inventory flushed to remove hydrocarbons and contaminants. Disconnect from structure. Removal of topsides processing and utilities equipment for onshore recycling or disposal. Alternatives will also be evaluated.	No

Asset	Description	Indicative Specifications			Temporary, Long–term or Permanent	Indicative Monitoring and Maintenance	Decommissioning Considerations		Removed under this EP?
		Approximate Dimensions	Weight (~t)	Typical Materials			Recoverable?	Possible Recovery Methods	
Well-tie-back and upper completions	5 × upper completions tubing, inner tie-back string with a lower sleeve latching into the production casing hanger wellhead profile and outer tie-back string/riser connected to the 18¾″ high pressure wellhead housing.	5 × 7″ upper completions production tubing. 5 ×10¾″ inner tie-back string. 5 × 22″ outer tie-back string/riser.	0.1	Various.	Long–term (>22 years design life) / Permanent	Maintenance undertaken in accordance with manage asset care. Risk based inspections and testing to monitor and maintain system integrity and operability.	Yes	Inventory flushed to remove hydrocarbons and contaminants. Equipment is decommissioned by cut-off at mudline. All equipment below the mudline will be left in-situ. Equipment above the mudline will be evaluated for recovery or left in-situ.	No
Ancillary permanent equipment and structures	See Section 6.5.1.	Various.	Various	Various.	Long-term	Periodic visual inspection, if required.	Yes	These will be deployed and recovered to a vessel for removal from the Activity Area. Where required, inventory will be flushed to remove hydrocarbons and contaminants and disconnected. Recovery could occur to a vessel (e.g. buoyancy units), Prelude FLNG (e.g. EFL/SFL, spool) or Crux topsides (clamps).	No
Temporary equipment	See Table 6-1.	Various.	Various	Various.	Temporary	Periodic visual inspection, if required.	Yes	These will be deployed and recovered to a vessel for removal from the Activity Area.	Yes, unless required for future EPs.

10.4.13 Manage Threats and Opportunities

The purpose of the Manage Threats and Opportunities (MTO) process is to set a structured framework by which an Asset can identify, prioritise, and take action to mitigate threats and realise opportunities to meet Strategic Asset Management Plan and operating plan delivery. Figure 10-13 shows an overview of the MTO process. The MTO process is a key tool used in supporting environment management on operating assets. For example, MTO is key in supporting prioritisation of most GHGEM abatement projects (refer Section 0) and supporting the stable management of ECEs (Refer Section 10.4.1.1).

Figure 10-13: Manage Threats and Opportunity (MTO) Process

10.5 Workplace Health, Safety and Security

10.5.1 Safety Leadership

SEAM standards cover Safety Leadership within Shell which is considered essential for good safety performance and environmental outcomes. This is best illustrated in the AIPSM model (see Section 10.4.1 and Figure 10-7 for more detail) that shows leadership as being the link that underpins process safety management. Shell believes that visible leadership at all levels creates the safety culture we need to achieve Goal Zero (Figure 10-14). Goal Zero is the Shell vision for causing 'no harm and no leaks'. This vision underpins Shell's approach to HSSE management across all projects and the organisation and is the basis for HSSE planning and goal setting globally.

Leaders are expected to set the tone and make a difference through their actions, by setting clear expectations and through visible personal commitment and collective care. Within Shell, it is believed that a strong safety culture implemented by Leadership will result in a positive, robust safety and environment outcome.

Figure 10-14: Shell Goal Zero

Shell implements the IOGP Life Saving Rules that are fundamental to Shell's journey to Goal Zero. Compliance with the Life Saving Rules is mandatory. All Shell employees and contractors are introduced to the Life Saving Rules during their induction and make a commitment to comply with these rules. In case of a Life Saving Rule violation, an investigation is conducted in line with the established process. If a violation is confirmed, disciplinary action is applied through the consequence management process. Performance against the rules and the effectiveness of the rules in achieving Goal Zero is monitored centrally. Based on the reviews there may be modifications to the detail of the Life Saving Rules. These modifications will be adopted and rolled out by Shell Australia under the MOC process.

Safety Leadership Training forms a critical part of Shell's strategy and is embedded at multiple levels of the Shell Front Line Barrier Management (FLBM) competency framework. The level of competency and the degree of demonstration required is role dependent, with supervisors receiving more specific training. Similarly, appointment as a HSSE Critical Leader require the leader to demonstrate the understanding and effective application of Safety Leadership behaviours. Leadership, with a strong focus on safety is critical to guiding teams and projects to achieving outcomes that benefit the business, people, and the environment.

10.5.2 Control of Work

Control of work requirements apply to the following activities to ensure safe performance and environmental outcomes:

- Energy Systems;
- Lifting and Hoisting; and
- Any other potentially hazardous activity.

10.5.2.1 Lifting and Hoisting

Lifting is a tightly controlled activity on Crux. All lifting and hoisting activities must comply with the requirements of the Lifting and Hoisting Standard. The standard outlines the minimum practices in relation to the safe use of lifting and hoisting equipment and lifting operations on the Crux Facility. The requirements in the Crux standard are consistent with the SEAM Workplace Health, Safety, and Security Standard.

All lifting equipment is maintained, tested, and inspected in line with the relevant Crux Maintenance Strategy and certified as safe to use. Non-compliant equipment is tagged out of service and is not to be used.

All lifts are approved in line with the requirements of the Crux Lifting and Hoisting Standard which aims to reduce risk to persons, equipment, and environment to ALARP. Lifting operations are categorised into one of three types of lifts:

- Routine Lifts;
- Non-routine Lifts;
- Non-routine Complex Lifts.

The degree of detail and level of review and approval for the lift increases with the risk of the lift. Routine lifts are covered via approved procedures and do not require additional approval. Non-routine lifts are not covered by existing procedures and require specific plans to be developed and approved. The conduct of non-routine lifts is managed through the PTW system (see Section 10.3.4).

All personnel involved in any lifting operation are required to attend a Toolbox Talk so that all personnel understand the plan and to ensure reduced risks around persons and environment (dropped objects, etc).

Crux has been designed to avoid the need for routine lifting over live hydrocarbon equipment. However, if a situation arises where there are no suitable alternatives, the risk management process outlined in the Crux Lifting and Hoisting Standard will be followed. In the event the process is followed over live hydrocarbon systems the following considerations will be included:

- The lift is considered as a non-routine complex lift and thus requires a specific lift plan to be developed and approved;
- The alternatives to lifting over live equipment must be considered and documented;
- The lift will be planned in consultation with the designated onsite lifting focal point which will document the lift plan as well as alternatives considered to lifting over live hydrocarbon equipment;
- The risk assessment (incorporated in the lift plan) shall identify appropriate mitigations and controls to reduce the risk associated with the lift (including object dropped to environment protection measures);
- The review and approval levels for the lift plan are determined by the level of risk associated with the lift; and
- Conduct of the lifting activity is managed through the PTW system.

A similar process is used if sensitive (non-hydrocarbon) equipment is identified as part of planning a lift to demonstrate that the risk of impact has been minimised.

10.6 GHG and Energy Management System

Shell Group's GHG targets and ambitions are set out in Energy Transition Strategy (ETS) 2024 (ETS24). The Shell SEAM standard requirements for Greenhouse Gas and Energy Management (GHGEM) define the minimum expectations for each business to set out. The adopted GHG and Energy Management System (GHGEMS) is compatible and complementary with ISO-50001 international standard for Energy Management Systems, and the SEAM Standard Practice GHGEM. The implementation of the GHGEMS for Crux commences from no more than 6 months post completion of second stage well clean-up, as the whole GHGEMS is intended to apply to facilities once they reach operations.

During the well completions, hot commissioning, and early start-up phases of this EP, GHGEM will be managed through a separate execute phase Greenhouse Gas and Energy Management Plan (execute phase GHGEMP), as detailed in EPS 10.3, 10.4, 10.5, 10.6 and 10.7. This is considered appropriate for these activities and GHG emissions sources being well understood and managed to ALARP through meeting EPSs within this EP as detailed as in Section 9.12.

Figure 10-15 summarises Shell Group guidance on SEAM standard requirements, Shell Group targets and ambitions are operationalised at an asset level.

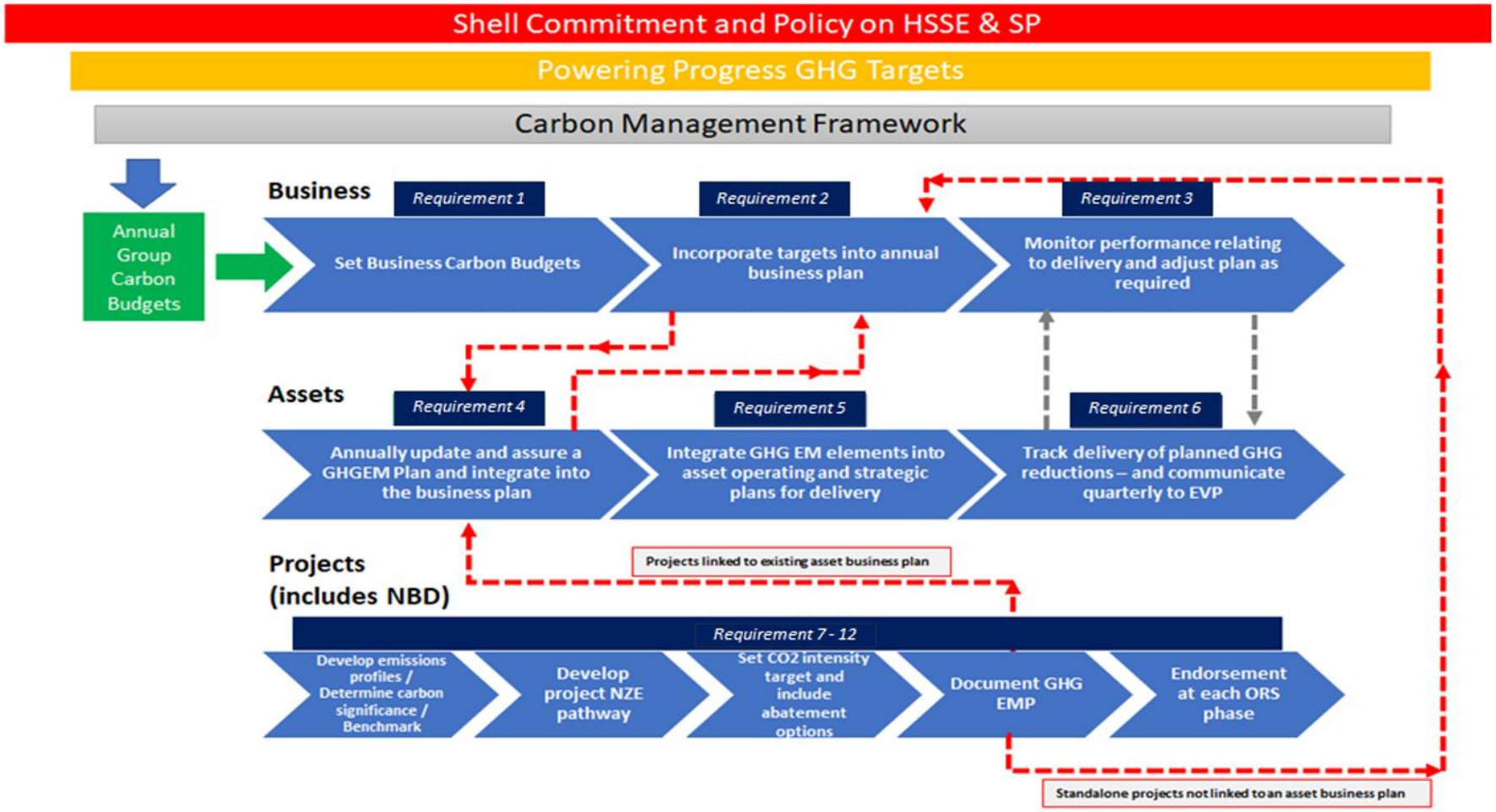


Figure 10-15: The End-to-End GHGEM Process and Interactions Between Group[106], Business[107], Assets[108] and Projects [109]

[106] Shell Group: Shell plc and its subsidiaries globally.
[107] Shell Business (or Group Business): A distinct operational unit within Shell plc, such as Upstream, Integrated Gas, Downstream, or Projects & Technology.
[108] Asset: An operational facility (e.g. refinery, platform).
[109] Project: A defined initiative to develop or upgrade infrastructure, managed through planning to execution.

The purpose of the GHGEMS requirements for Shell Group Businesses (Requirements 1-3), such as Integrated Gas and Upstream, is to demonstrate that Shell has governance in place which ensures Shell Group's targets and ambitions are translated into tangible goals, plans and actions at Assets and Projects.

10.6.1 Role of gas in the energy transition

Shell Group reports on its business activities (including updates concerning gas-related projects) and progress against its business targets, including climate-related targets, on an annual basis in its Annual Report. It also publishes an annual LNG Outlook. Shell Group publishes its Energy Transition Strategy (ETS) every three years—most recently ETS24, with updates currently expected in 2027 and 2030.

Shell Group will continue to assess the role of gas in the energy transition on a triennial (3-yearly) basis (EPS 10.14), including in providing energy security (e.g. through review of relevant literature and studies from credible sources, participating in or commissioning studies, assessing relative carbon intensity of energy generation in customer nations, compared to LNG, using data published or available from business partners in the value chain). If required, Shell Group will apply additional adaptive management measures if the assessment concludes that gas is not contributing to the global energy transition (directly or indirectly).

Following the Shell Global triennial review as outlined in EPS 10.14, at the asset level, Shell will incorporate the outcomes of these reviews into the relevant subsequent annual business and asset GHG goal-setting processes and document in the GHGEMP. This ensures that Scope 3 emissions are managed in alignment with evolving regulatory and market contexts, including updates driven by the Emissions Trading Scheme, LNG market outlooks, and other relevant policy or industry developments. This integration supports continuous improvement and adaptive management, ensuring emissions performance remains consistent with Shell Group's broader decarbonisation objectives.

10.6.2 Operating Plan

The purpose of the Operating Plan (OP) as part of the Forecast and Plan Production SEAM standard requirement, is to operationalise Shell Group's strategy into a credible and affordable plan, enabling the alignment of the organisation on strategic and operational objectives including carbon management and the allocation of resources. The OP process will provide insights that drive decision quality, encourages realism, offers optionality and flexibility and allowing for appropriate capital allocation and continue to ensure that the operational, financial and carbon metrics are fully integrated. The OP is generally based on mid-case outcomes and probabilities; however Shell will also assess outcomes with lower and high probabilities. Actual production performance may be higher or lower than forecast in an OP. Key GHG outputs from the OP process include goals such as GHG intensity, total emissions, and risked abatement. The goals are approved by senior management. Goals also support achieving Shell Group's climate ambitions and reinforce its priorities and desired behaviours at Shell Group level. These may be different from the plan to set direction and apply stretch. GHG emissions forecasts are an integral part of the OP process derived from development concepts, production inputs and assumptions, production forecasts and hydrocarbon maturation, well reservoir and facility management, decommissioning and restoration, cost, commercial, economic, financial inputs and assumptions, along with associated risks and opportunities. Relevant technical authorities and management level signoffs occur from discipline lines through the delivery of the process.

10.6.3 Carbon Management Framework

The Carbon Management Framework sets the nature of decarbonisation efforts across Shell Group. It does this by prescribing Carbon Budgets for each business aligned to our external decarbonisation commitments to achieve Net Zero Emissions. These forward-looking budgets reduce over time, dictating the level of Scope 1, 2, and 3 emissions each business can emit annually in future years. The focus is on achieving Shell Group's external Net Zero Emission (NZE) targets while maximising value. Shell Group Businesses action the Carbon Budgets in Operating Plan through Tone Letters or Guidance, which translate these Business-level budgets into level of ambition for Assets and Projects across that Business to reduce emissions. Businesses are required to deliver plans within the Carbon Budgets and use Marginal Abatement Cost Curves to ensure maximise value within a carbon constraint. These curves are also used at Group-level to optimise plans across Businesses.

As mentioned above, GHGEM Planning is purposefully integrated with Operating Plan to drive desired performance across Businesses. Each Business follows a five-step process to do this:

1. Analyses data from the last Operating Plan cycle, information from abatement planning and emissions reporting tools to set goals for Scope 1 & 2 emissions. Flaring and methane information is also considered to ensure reduction trajectory aligned to related external commitments.

2. Communicates its goals to its projects, Assets and ventures via the Business Carbon Budgets and operating plan tone letter or similar.
3. Compiles, validates, and endorses preliminary Operating Plan GHG data submitted from the Assets and projects.
4. Where necessary, applies Management Adjustments to the endorsed GHG data. These adjustments may reflect leadership confidence in production forecasts, views on in-plan / out-of-plan status of projects, and adjustments necessary to optimise carbon / value optimisation across their portfolio. The assets and projects incorporate the Management Adjustments into their Operating Plans.
5. Monitors GHG emissions and the delivery of planned emissions reductions, surfacing risks and opportunities and act to maintain a trajectory consistent with goals where reasonably practicable.

The purpose of the GHGEM Requirements for Shell Group Assets, such as Crux, is that we have a clear and credible plan each year for the delivery of the Asset part of the Business's Carbon Budgets and to ensure the plans provided have all the essential elements to reasonably confirm agreed GHG reductions can be delivered and compared to that of other Assets within the broader Business and Shell Group.

The Requirements align with the continuous improvement model, meaning that each iteration of the annual cycle should enable a decarbonisation trajectory to meet external commitments (Figure 10-16: Asset GHG Requirements Aligned with the Continuous Improvement Model).

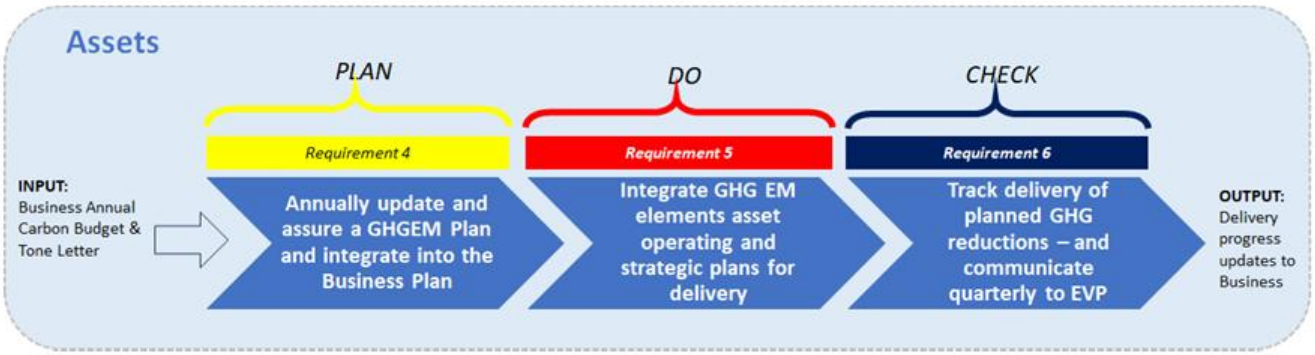
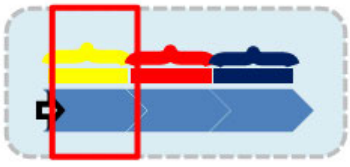


Figure 10-16: Asset GHG Requirements Aligned with the Continuous Improvement Model

10.6.4 Annually Updating and Assuring a GHGEMP integrated into the Operating Plan

Aligning with the 'PLAN' stage of the continuous improvement model for Assets, the annual update and assurance of the GHGEMP and its integration into the Operating Plan, can be fulfilled in six main steps (Figure 10-17).



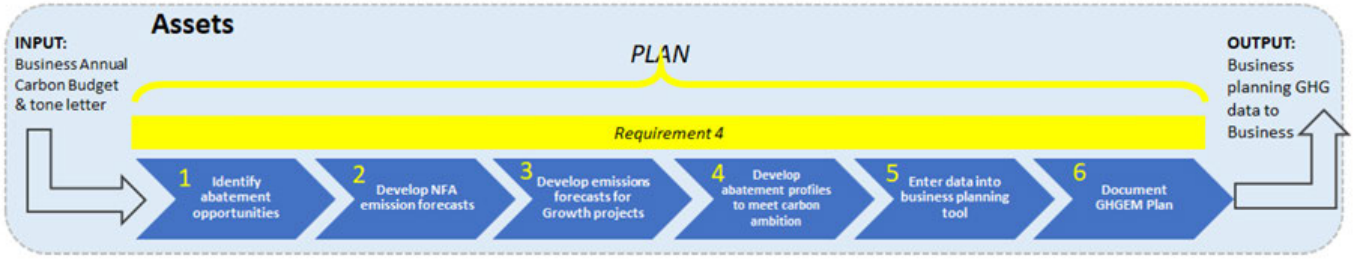


Figure 10-17: Guidance Steps to Fulfil Requirement 4

The plan is to fill the abatement opportunity funnel with a broad selection of abatement opportunities in advance of the Operating Plan cycle. This is done at any point in the year and repeated each year (refer WRFM Workshop, Section 10.4.11). The points below give guidance on how to identify and rank abatement ideas.

Step 1 Key Points: Generate ideas for energy savings and GHG reduction through BAT reviews, interviews and/or multidisciplinary workshops.

This process involves an annual GHG abatement workshop which is held to help identify risks and opportunities to minimise or reduce GHG emissions through abatement or efficiency gains. The GHG abatement opportunities may be either operational improvements or capital projects. The annual abatement workshop will commence in the year starting no more than 6 months post completion of second stage well clean-up.

The workshop participants will be comprised of a multidisciplinary team, which typically includes operators and engineers from various disciplines and functional groups. Outputs will include a list and description of identified abatement opportunities, high level technical feasibility screening of the opportunities, the estimated cost of such opportunities and abatement volume estimates. Ideas of GHG abatement opportunities can also be raised by the workforce through the Manage Threats and Opportunities (MTO) process (see Section 10.4.13).

An assessment process will ensure technically feasible abatement opportunities are then further screened and assessed through MTO. Where assessment has been completed, relevant capital projects are assessed in accordance with relevant internal processes. Those capital projects that are subsequently screened to be in-plan are then put into the proceeding OP cycle so that budgets and resources can be assigned according to the priority given so projects can continue to be pursued using the relevant internal processes. Out of plan projects are generally reviewed on an annual basis unless they are deemed not technical feasible or practical or are clearly well beyond being economically viable to consider being in plan for the foreseeable future.

Step 2: Develop ‘No Further Activity’ (NFA) Emission Forecasts & CO2 Costs for Existing Assets NFA emissions for Assets are based on historical emissions data, and adjusted (as required) for implemented projects, future production profiles and planned production outages.

Step 3: Develop Emission Forecasts/ Costs for Growth / Hydrocarbon Projects. This step is for growth projects, either integrated into an existing Production Unit (e.g., tiebacks/backfills), or new, standalone but within an Asset.

Step 4: Forecast Abatement Profiles / Costs to Meet Carbon Ambition. The Asset sets its carbon ambition by comparing the production emissions forecast with the abatement emissions forecast, and then deciding which abatement projects to include in plan. This choice will depend upon the ranking criteria.

Step 5: Enter Data into Business Planning Tool Once the data is entered into the Operating Planning Tool, the data is available for the Business to review and endorse.

Step 6: Document GHGEMP

The GHGEMP is the key document Prelude and Crux in describing how the asset will continually manage GHGEM to ALARP and acceptable levels throughout the operation of the facility. The GHGEMP will detail:

- GHG emissions and energy use measurement, calculation and assumptions.
- GHG and energy benchmarking.
- GHG abatement opportunities and projects.
- Methane Management.
- GHG and production forecasts.
- GHGEM goals.

10.6.5 Integrating GHGEM Elements of the Operating Plan into Asset Plans for Delivery

Aligning with the ‘DO’ stage of the continuous improvement model for Assets, integration of GHGEM elements of the Operating Plan into Asset plans for delivery, can be fulfilled in four main steps (Figure 10-18).

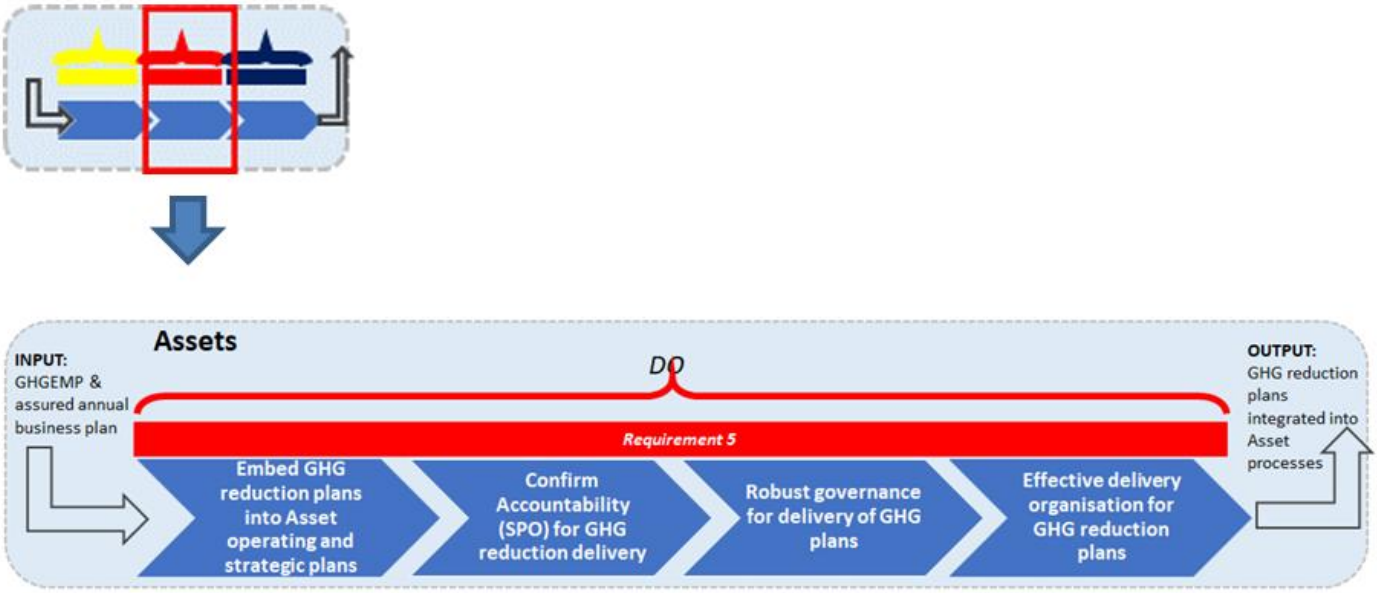


Figure 10-18: Guidance Steps to Fulfil Requirement 5

Step 1: Embed GHGEMP into the Strategic Asset Management Plan (SAMP) and/or Asset Improvement Plan (AIP)

The SAMP is developed ahead of the Operating Planning cycle and then updated after submission of the Operating Plan to include any changes arising from the Operating Plan endorsement. For the SAMP development, consider how GHG emission reductions and energy management can be value levers and sources of competitive advantage for the Asset / production units.

Incorporate GHGEM reduction goals and plans from the Operating Plan into the SAMP so that top-down commitments on carbon are reflected in the bottom-up aspirations and realities of the Asset / production units. Update the SAMP and/or Asset Improvement Plan (AIP) to include tactics on delivery of GHG & EM initiatives / projects to close the Gap to Potential for the GHG & EM value levers.

Step 2: Confirm Accountability for GHG Reduction Delivery for the Asset Requirement 5

Fulfilling the Shell GHGEM Requirements is mandatory for Shell operated assets and the Asset will have a Site Process Owner (SPO) for the GHGEM process as specified in Requirement 5. The SPO is accountable for ensuring the Asset develops and delivers decarbonisation plans to meet external commitments on carbon, flaring and methane, as determined by the Business. Accountability extends to each of the following points:

- GHG emissions identification, quantification, and reporting;
- GHG emissions forecasting for NFA and growth;
- GHG emissions reductions identification and development;
- Development and documentation of the GHGEMP and translation into the annual Operating Plan (with assurance accountabilities / responsibilities);
- Establishment of governance and delivery processes to underpin delivery of the GHGEMP and endorsed SAMP and/or AIP and Operating Plan;
- Clear and transparent decisions on decarbonisation choices, regrets, and priority versus other business drivers;
- Monitoring and reporting of GHGEMP and endorsed Operating Plan delivery progress and communication of delays to EVP; and
- The SPO will appoint Site Process Focal Point(s) (SPFP), responsible for GHG emissions and reductions identification, quantification, and forecasting.

Step 3: Establish Effective Governance for Delivery of GHG Reduction Plans Requirement 5

Table 10-9 details the key roles and responsibilities for governance of the GHGEM at Crux at the time of writing this EP.

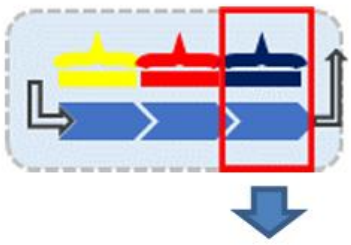
Table 10-9: GHGEMP Governance, Accountability and Assurance

Role	Responsibility
Vice President Prelude/Crux	• GHG (total emissions, intensity, and abatement) goals will be set and tracked on a monthly basis (quarterly for abatement) to ensure GHG emissions are ALARP on an ongoing basis. • Ensuring resources needed for the GHGEM are available. • Ensuring GHGEM achieves its intended outcome(s). • Directing and supporting persons to contribute to the effectiveness of the GHGEM processes. • Supporting other relevant management roles to demonstrate their leadership as it applies to their areas of responsibility.
GHGEM Site Process Owner (SPO)	• Preparing and implementing GHGEMP on behalf of Vice President Prelude/Crux. • Ensuring the GHGEM scope and boundaries are established in GHGEMS. • A surveillance program is in place for the power generation units to ensure that they are operating within the design operating envelope. • Ensuring the integration of the GHGEM requirements into asset processes. • Ensuring action plans are approved and implemented. • Communicating the importance of effective energy management and of conforming to the GHGEM requirements. • Promoting continual improvement of energy performance and the GHGEM. • Ensuring the formation of an GHGEM management team (fuel and flare forum). • Ensuring that processes are established and implemented to identify and address changes affecting the GHGEM.
GHGEM Site Process Focal Point (SPFP)	• Assurance on GHG sources, production, emission actuals, emission forecast and abatement data.
Reservoir Engineering TA2	• Assurance on reservoir related forecasts.
Environment TA2	• Assurance on GHGEMP.

Step 4: Resource an Effective Delivery Organisation for GHG Reduction Projects Requirement 5. The delivery organisation for GHG reductions may either be the Asset team (for smaller initiatives) or a project team (for initiatives that require design development and more involved execution). Once the GHG reduction projects are integrated into the Asset plans, their delivery should be underpinned by availability of named and competent resources with clear accountability, as well as progress visualisation on resources required and how the GHG reduction project/ initiative will be delivered.

10.6.6 Tracking Delivery of Planned GHG Reductions

Aligning with the ‘CHECK’ stage of the continuous improvement model for Assets, tracking delivery of planned GHG reductions can be fulfilled in three main steps (Figure 10-19).



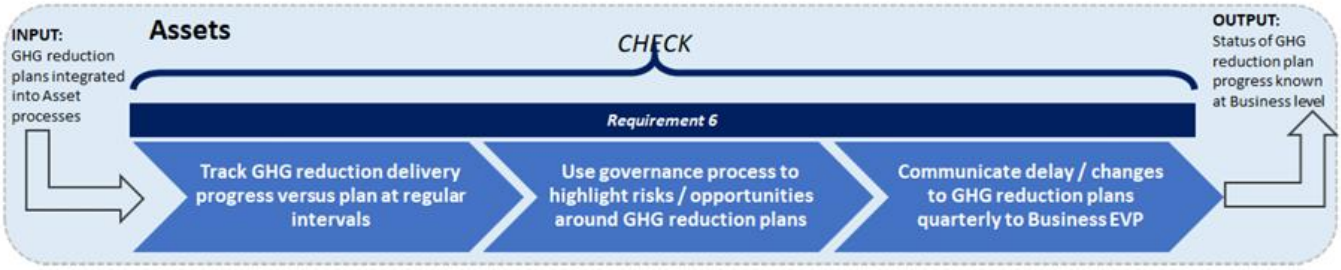


Figure 10-19: Guidance Steps to Fulfil Requirement 6

Step 1: Track GHG Reduction Delivery Progress vs. Plan at Regular Intervals.

Step 2: Use Governance Process to Highlight Emerging Risks / Opportunities around GHG Reduction Plans.

Step 3: Communicate Delay / Changes to GHG Reduction Plans Quarterly to Senior Executive with Single Point Accountability of the Business.

Steps 1-3 above are implemented for Prelude and Crux through the monthly Fuel and Flare Forum. This is a multi-disciplinary team that brings together expertise from relevant functions in the asset to consistently manage the risks and work on the ongoing GHGEM dilemmas as they arise. This will:

- Enable better cross facility understanding and discussion of the fuel and flare balance.
- Drive continuous improvement to reduce GHG emissions.
- Prioritise improvement opportunities.
- Keep log of opportunities (potential and delivered).
- Collaboratively discuss dilemmas.

The inclusion of the Crux asset into the Fuel and Flare Forum will commence no later than 6 months post completion of second stage well clean-up.

Supporting this also, Prelude and Crux will use a selection of the measures of process effectiveness, tailored for Prelude and Crux, outlined below from Shell Group guidance to determine the GHGEMS process effectiveness.

Table 10-10: Guidance on Measures of GHGEM Process Effectiveness

PI Category	PI Description	Leading / Lagging	Reference to Standard	Industry Best in Class	Reason for Metric
Asset GHG Goals	Set Scope 1 & 2 emissions goals for Asset ahead of Operating Planning cycle (and agree with Business).	Leading	GHGEM	Annually	The Asset has a clear GHG reduction plan which aligns with the Business's broader GHG reduction goal.

Top 10 Good and Bad Actors	Periodic reporting of the top 10 energy good and bad actors.	Lagging	Perform Hydrocarbon and Energy Accounting Standard.		Impacts GHG intensity performance, absolute emissions and utility cost.
Abatement Options Delivery	Tracking of delivery of abatement options (and GHG volume reductions) in line with plan.	Leading	GHGEM		Impacts delivery of Business Carbon Budgets.

Fuel and flare goals for first stage well clean-up, hot commissioning and start-up activities (execute phase) are subject to detailed engineering and plans and procedures that will be finalised prior to work commencing (Section 10.6.8 and 10.6.9) and reviewed throughout the activity periods. As plans and procedures develop, any changes will be managed in accordance with update processes and MOC processes accordingly (Section 10.3.5).

10.6.7 Methane and Fugitive Emissions Management

Shell will produce a Fugitive Emissions Management Procedure for Crux within 6 months of start-up that outlines the management process for fugitive emissions (including methane) via a Leak Detection and Repair (LDAR) program in accordance with Shell Recommended LDAR Practice. LDAR is a mechanism designed to detect, report, and remediate leaks in equipment to mitigate risks associated with process safety, health, and environment and maintain compliance with regulations. The procedure will detail:

- Compliance requirements.
- LDAR survey standards performance criteria (e.g., equipment, scope, representativeness, metrics, measurement).
- LDAR survey process.
- Roles and responsibilities.

Shell is a signatory to the United Nations Environment Programme's Oil and Gas Methane Partnership 2.0 (OGMP) initiative, the only comprehensive, measurement-based reporting framework for methane emissions in the oil and gas industry.

Under OGMP, assets are required to progress from the Level 3 standard, which relies on generic emission factors (EFs), to Level 4 (bottom up) source level measurement-based emission factors and Level 5 (top down) site level emission rates, with reconciliation conducted between source level and site level data. The Level 4 surveys are conducted for material emission sources and fugitive leaks of the Crux topsides by an optical gas imaging camera and quantified using a Hi-Flow sampler. Level 5 surveys are conducted off the site by use of suitable technology for site level emissions monitoring, such as RPAS (drones) with sniffer sensor.

As part of this OGMP commitment, Crux will undertake annual OGMP Level 4 and Level 5 surveys in order to achieve the OGMP Gold Standard of reporting and incorporate the data into Shell's emissions reporting.

10.6.8 Emissions Goal Setting (Execute Phase)

Emissions goals are developed for fuel use and flaring throughout first stage well clean-up, hot commissioning, second stage well clean-up and SURU (refer EPS 10.5). Progress against the goals will be monitored in monthly GHG performance reviews. If exceedances are foreseen, based on daily tracking or changes to the strategy, measures will be proactively implemented to minimise the risk of exceedance. The goals are aligned to the estimates risk assessed in Section 9.12 and Appendix H, hence deemed to be ALARP and acceptable, but are subject to the final design for this activity. Goals are based on planned activities and expected flaring rates are set to drive positive environmental decision making to remain below them.

10.6.9 Emissions Limit Setting (Execute Phase)

Emissions limits (set in EPS 10.3 and 10.4) will be higher values than goals in order to drive the right behaviours in terms of aiming to reduce GHG emissions to ALARP through the first stage well clean-up (10.6.9.1) and hot commissioning, second stage clean-up and SURU phases (10.6.9.2).

10.6.9.1 First Stage Well Cleanup

A limit will be developed for flaring during perforation/first stage well cleanup based on the final clean-up strategy and well objectives, prioritising the reduction of flaring to ALARP. Progress against the limit will be monitored. If exceedances are foreseen, based on daily tracking or changes to the strategy, measures will be proactively implemented to minimise the risk of exceedance. The limits will be aligned to the estimates risk assessed in Section 9.12 and Appendix H.2, hence deemed to be ALARP and acceptable, but are subject to the final design for this activity.

10.6.9.2 Hot Commissioning, Second Stage Clean-up and SURU

A limit has been set for flaring during hot commissioning, second stage cleanup and SURU phases as specified in EPS 10.3 (0.224 $MtCO_2$-e) and aligned with the forecasts provided in Section 9.12 and Appendix H.3. Progress against the limits will be monitored monthly. If exceedances are foreseen, based on daily tracking or changes to the strategy, measures will be proactively implemented to minimise the risk of exceedance. The limits are aligned to the estimate risk assessed in Section 9.12 and H.3, hence deemed to be ALARP and acceptable.

10.7 Environmental Performance Monitoring

Monitoring and review form a part of normal operations, the production, safety, and environmental performance of Crux will be analysed on a continuous basis. Structured meetings will be incorporated into the standard working day to provide opportunities for teams to discuss the performance and implement plans to address issues as they arise. Critical elements of environmental performance are achieved by the quantitative monitoring of emissions and discharges with various tools and systems to assess whether the EPOs and EPSs in the EP are being met. Parameters that are monitored and recorded during the activity are detailed in relevant parts of Sections 9 and are summarised in Table 10-11. Where online analysers are the primary monitoring equipment/methodology and where not specified, the intent is always that if the online analyser is not available, proactive technical monitoring, engineering calculation estimation or manual sampling will be used as a contingency. A key part of environmental monitoring is formed through Key Performance Indicators (KPIs) which have been identified as providing an indicator of both production and process performance.

Table 10-11: Emissions and Discharges Monitoring for the Activity

Source	Parameter to be Monitored	Monitoring Frequency	Monitoring Equipment/Methodology	Records
Crux Facility				
GTG emissions	Fuel gas consumed	Online	Flow meters Engineering calculations	PI Database NPI and NGER Records
Diesel fuel used on the platform	Sulphur content	Every delivery	Delivery certificates/records Laboratory sampling	Delivery certificates NPI and NGER Records
	Diesel consumed	Quarterly	Delivery certificates/records and/or storage tank volumes Engineering calculations	Delivery certificates NPI and NGER Records
Flare emissions	Gas flared Composition	Online	Flow meters / analysers Engineering calculations	PI Database NPI and NGER Records
Flare emissions (first stage well clean-up)	Hydrocarbons flared	Online (temporary)	Temporary flow meter Engineering calculations	Records
Produced water discharge (start-up and operations)	Flow	Online	Flow meter Engineering calculations Proactive Technical Monitoring	PI Database Records
	Dispersed oil in water concentration (24-hour average)	Online	Analyser Laboratory Proactive Technical Monitoring	PI Database Records
	See Section 10.7.1 for further details on PW related monitoring.			
Produced water discharge (first stage well clean-up)	Flow	Batch (temporary)	Temporary flow meter Engineering calculations	Records
	Oil in water concentration (batch and average)	Batch (temporary)	Analyser/laboratory	Records
Fugitive emissions	VOCs/CH_4	Annual per LDAR and OGMP	Engineering calculations	NPI and NGER Records
Waste generation	Hazardous waste Non-hazardous waste	Quarterly	Waste records/manifests	Monthly waste reports

Source	Parameter to be Monitored	Monitoring Frequency	Monitoring Equipment/Methodology	Records
Vessel Operations				
Emissions	Fuel sulfur content	As required (every delivery)	Record-based tracking	Bunker receipts (or equivalent)
	Fuel volume used	Quarterly		
	Incineration volumes	As required	Record-based tracking	A copy of the completed garbage record book or official recording system that captures incinerate waste records
Bilge water	Oil content volume; as per IOPP certificate	Each discharge (infrequent)	Maintenance management system Record-based tracking	Maintenance records of oily water separator Oil record book or equivalent report
Ballast water	Volume and location discharged	Each discharge	Record-based tracking	Ballast water records
Sewage	Volume and location discharged	As per ISPP certificate	Maintenance management system Record-based tracking	Maintenance records of sewage treatment system Daily vessel reports
Waste generation	Hazardous waste volume Non-hazardous waste volume	As required (every delivery)	Record-based tracking	Garbage record book, as required for vessel class Monthly waste reports
GHG emissions	Volume GHG emissions emitted through fuel types combusted for stationary or mobile combustion	Quarterly	Record-based tracking	Records of fuel combusted and PMR reporting forms including relevant GHG conversion factors
Accidental release of solid objects	Type/volume and location	As required	Sphera or similar incident reporting system	Incident reports Monthly environmental incident reports
Accidental releases of hydrocarbons or chemicals	Type, volume and concentrations of release Incidents reported in accordance with Shell and regulatory requirements	As required	Sphera or similar incident reporting system	NOPSEMA recordable or reportable incidents (refer to Section 10.11.4)

10.7.1 Produced Water Adaptive Management Framework

The Crux Produced Water Adaptive Management Framework (AMF) is a comprehensive plan designed to manage the environmental impacts associated with produced water (PW) discharges from the Crux platform. The detailed AMF is provided in Appendix I.

The AMF aligns with the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018 and 2023) and the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations, ensuring that measures are updated based on new information and changing conditions. The AMF is also equivalent to the process described within Risk Based Assessment of Offshore Produced Water Discharges (IOGP 2020).

The AMF outlines a systematic approach to adaptive management, involving the setting of Environmental Performance Outcomes (EPOs), implementation of Environmental Performance Standards (EPS) [110], management measures, and continuous monitoring and feedback. Key components of the AMF include defining community values and management goals (EPO's), determining relevant indicators, establishing water and sediment quality guideline values (EPO's), and assessing the achievement of these objectives through periodic monitoring and evaluation. The AMF incorporates Direct Toxicity Assessment (DTA) and chemical characterisation as primary methods for evaluating the potential environmental effects of PW discharges. This approach allows for a detailed understanding of the toxicity of complex mixtures of contaminants, facilitating more effective and responsive management actions. Additionally, the AMF includes provisions for mercury monitoring and adaptive management, ensuring compliance with the Crux Installation and Cold Commissioning Environment Plan.

By adopting this robust adaptive management approach, Shell aims to manage residual uncertainties associated with PW discharges, maintain environmental changes within acceptable limits, and continuously improve environmental performance. The AMF is an integral part of the broader Crux Completions, Commissioning, Start-up, and Operations Environment Plan, supporting Shell's commitment to sustainable and responsible environmental stewardship. The AMF also meets the Shell requirements for a Water Stewardship Management Plan under the SEAM Standards which aligns to the International Water Stewardship Standard principles (AWS 2019).

The AMF, consistent with the approach defined in the Australian and New Zealand Governments (ANZG) Guidelines for Fresh and Marine Water Quality (2018), is a continuous cycle of improvement. It involves setting environmental performance objectives (EPOs), developing and implementing management measures and measuring results. The results from monitoring are then fed back into new EPOs, management measures, and actions, which will be detailed in subsequent EP 5 yearly revisions submitted to NOPSEMA. This approach ensures that management measures are updated appropriately based on new information and changing conditions, allowing for more effective and responsive management of the PW discharge.

Refer Appendix I for a detailed description of the AMF implementation.

10.7.2 Ad Hoc Liquid Discharge Monitoring and Management

The following section describes the process that will apply to non-routine ad hoc discharges during the activities that aren't already implicitly described and assessed in the EP. The process ensures the nature, extent and potential effect of these discharges are adequately understood and assessed to determine potential changes to water quality or other environmental values and sensitivities to ensure impacts and risks associated with such discharges are always managed to ALARP and acceptable levels. Figure 10-20 illustrates the ALARP/Acceptability Assessment that will be implemented that will be undertaken alongside the Management of Change Process to enable a decision for the acceptability of discharge (or alternative options).

[110] Environmental Performance Standards (EPSs) and associated Measurement Criteria (MC) that include references to specific sections of the EP are provided solely for the convenience of the reader. These references are intended to facilitate ease of understanding and navigation. It is important to note that these references are not part of the EPS or MC itself, and the referenced information does not form part of the EPS or MC itself.

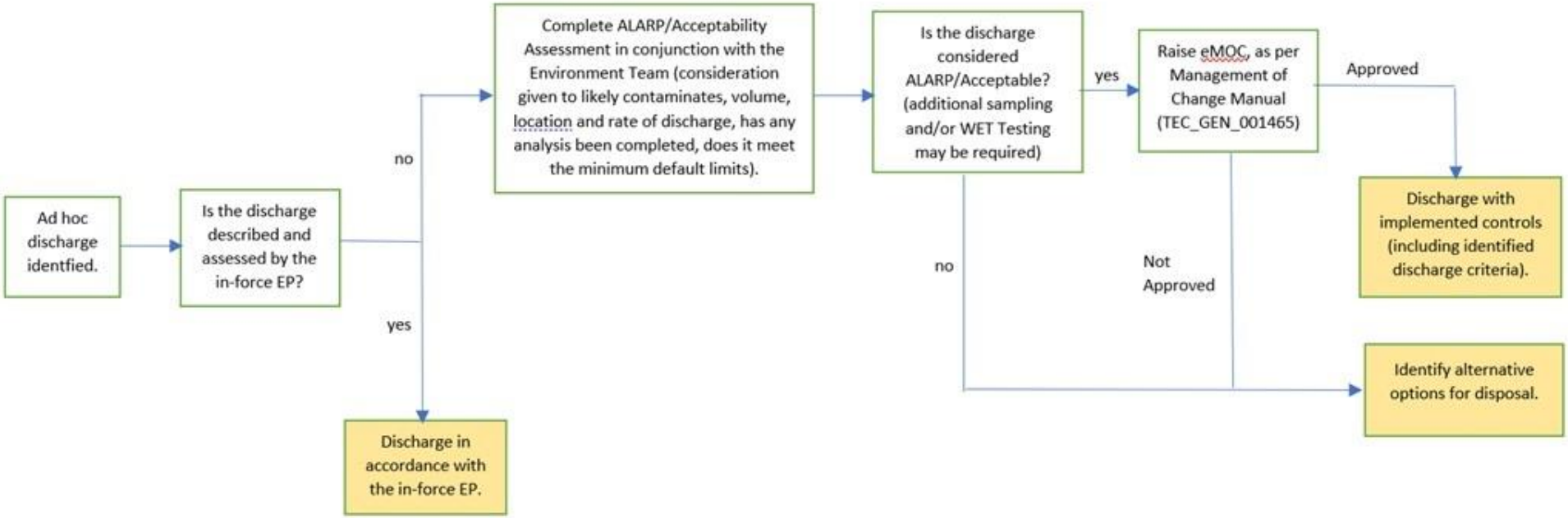


Figure 10-20: Conceptual Ad Hoc Discharges Management Framework

10.8 Management System Assurance

The Management System provides a structured and documented system for managing HSSE Assurance which will be reflected initially by the Project HSSE Management Plan that will transition into an Operations HSSE Management System based on the activity sequencing from well completions leading up to start-up and operations. In this process, both Shell and Contract HSSE Plans make provisions for monitoring, audits, and review as relevant to the scope of work.

The Asset is tasked with:

- Operationalising the Shell HSSE and SP Commitment and Policy (Section 4.2) through their objectives, targets and plans;
- Ensuring that controls are communicated to employees and contractors; and
- Development of annual assurance plans that objectively confirm whether controls are designed and operating effectively, as well as to confirm the overall effectiveness of risk management.

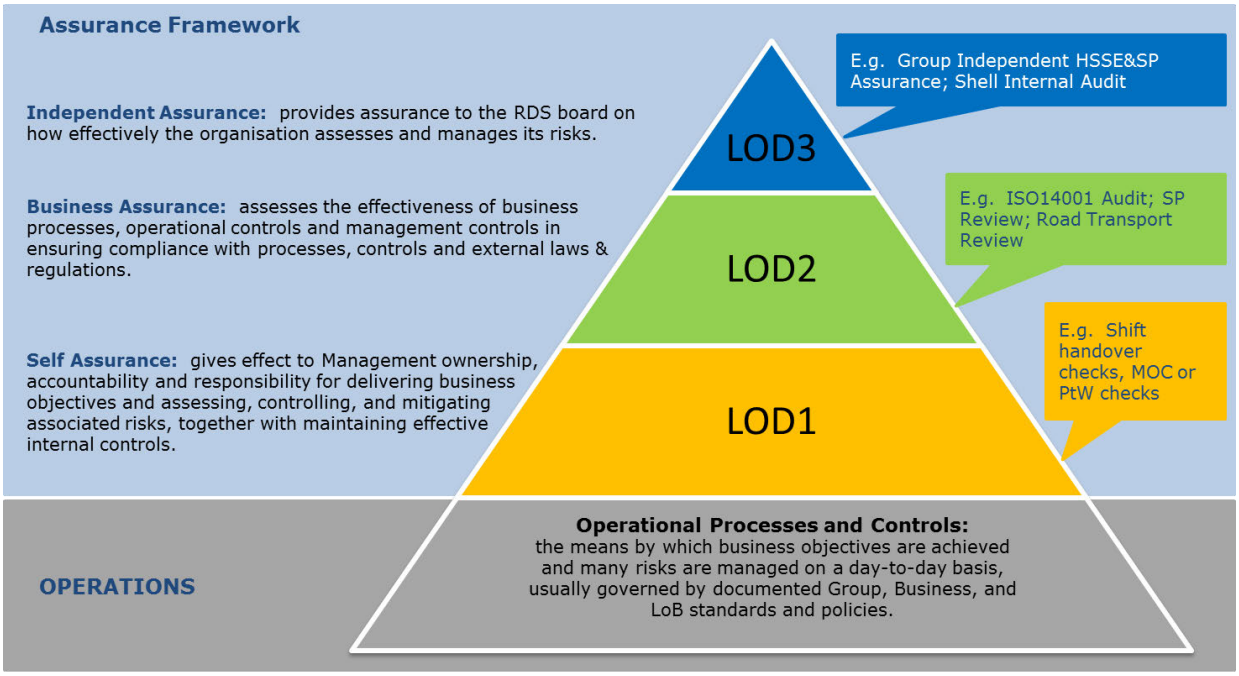


Figure 10-21: Shell Group Tiered Assurance Framework

Compliance with the LOD1 program is monitored by the relevant Process Owner. Results of the program are reviewed regularly by the Process Owner to address any compliance gaps and identify opportunities for continuous improvement.

LOD2 and LOD3 assurance activities are monitored by the business as part of an overall assurance plan. Findings from the assurance activities are analysed and actions implemented to address any identified gaps and opportunities for improvement. The completion of actions is tracked via a centralised action tracking system.

Contractors are also audited as part of the overall assurance program, either through their HSSE Management System for Mode 2 and 3 contracts, or through the Shell assurance processes directly as Mode 1 contracts.

10.8.1 Audits and Assurance

At the Country level (Australian Operations) Shell has a HSSE Audit and Assurance Procedure and HSSE Assurance Plan that establishes the annual assurance program for the Management System, and this is documented in the Management System. Results from all HSSE LOD 2 or LOD 3 audits are reported to the Shell Australia Business Assurance Committee (BAC) and relevant Country Leadership Team (CLT) meetings. Leadership monitors the status of close-out of actions from audits and other assurance activities. The CLT

monthly meeting takes the findings of audits into consideration as part of their annual review of effectiveness of the Management System.

At the asset level, the Vice President Prelude/Crux and HSSE Manager (Asset) are responsible for the design and delivery of the audit and assurance programs in accordance with the Shell Australia HSSE Audit and Assurance Procedure, and this includes:

- Defining key risks, barriers and controls within the activity scope.
- Implementation and monitoring of the audit program.
- Defining and monitoring the follow-up of actions from asset audits and self-assessments until they are implemented and closed out.

The annual assurance program will contain an environmental performance assurance schedule specific to this EP to:

- Verify environmental risks and potential impacts are being managed in accordance with the EPOs and EPSs detailed in this EP.
- Monitor, review, and evaluate the effectiveness of the controls, including associated EPOs and EPSs detailed in this EP, in reducing impacts and risks to ALARP and acceptable levels on an ongoing basis.
- Verify effectiveness of the EP Implementation Strategy.

10.8.2 Annual inspections

An annual inspection/review of the platform topsides will be undertaken every calendar year sponsored by the HSSE Manager via either an offshore inspection or desktop review. Selected risk areas/activities are inspected to review environmental performance against the EPOs and EPSs and verify that control measures are effective in reducing the environmental risks and impacts of the activity to an ALARP and acceptable level. The inspection/review also includes review of conformance with selected aspects of the EP implementation strategy. All risk sources/activities applicable to the offshore facility will be reviewed over a three-year rolling period. Records of findings and records of close-out of any corrective or improvement actions are maintained and tracked in an action tracking system.

10.8.3 Regular (Daily) inspections

Regular, typically at shift handover, operator assurance is conducted as part of SoSO rounds as described in Section 10.4.5.3. Any specific environmental issues identified during the SoSO are raised in Team meetings and resolved as part of continually reducing the risks to ALARP and Acceptable levels.

10.8.4 Tracking

Audit and assurance findings relevant to continuous improvement of environmental performance are tracked through an Action Tracking Register. This Register is used to track compliance with EP commitments, including any findings and corrective actions. Non-conformances identified will be reported and/or tracked in accordance with Section 10.11.2.

10.8.5 Transport Safety

SEAM Standards have requirements relating to maritime and aviation safety which also have direct implications on environmental management in the field (cargo transport vessels, vessels, field operations, etc). These standards require that the asset obtains endorsement of procedures for managing maritime and aviation safety risks from defined and competent subject matter experts in the organisation. This will ensure that:

- Crux procedures embed organisational, and industry wide learnings aimed at managing maritime and aviation risks to ALARP.
- Appointed SMEs (who understand maritime and/or aviation risks) have the necessary authority and competence to review, apply and endorse maritime and/or aviation procedures.
- Procedures for maritime and/or aviation risk management are not developed without the endorsement of appropriate expertise.

These Standards are applied to manage marine and aviation safety in accordance with the Shell Group Requirements and where, for aviation, specifically ‘Shell Group Requirements Aircraft Operations (SGRAO)’.

Shell Maritime Safety establishes practices and specifications for the vetting and management of marine vessels in the supply chain that provides guidance on ALARP controls and evaluation methods. These standards are applied to marine vessels used in the fulfillment of Activities (such as support/supply vessels, W2W, ASV and IMR vessels within the Activity Area).

Numerous assurance steps are required to assure positive vetting. These involve marine and aviation SMEs, Country Security Manager(s), Marine Warranty Surveyor (MWS), and the project workstreams responsible for the activity (see Section 10.8.5). Equivalent processes also apply for aviation services.

10.8.5.1 Marine Assurance

Shell Maritime SEAM standards establish practices and specifications for the vetting and management of marine vessels in the supply chain that provides guidance on ALARP controls and evaluation methods. These standards are applied to marine vessels used in the fulfillment of Activities (such as support/supply vessels, W2W, ASV and IMR vessels within the Activity Area).

The Marine Vessel Assurance process ensures that the vessel's physical controls are robust, including:

- Navigation equipment and aids.
- Communications equipment.
- Dynamic Positioning (DP) systems.
- Lifting equipment.
- Emergency shut-down, alarm and lighting systems.

Oil Companies International Marine Forum (OCIMF) Offshore Vessel Inspection Database (OVID) is the basis for all vessel vetting. Additionally, vessels are screened for class and port state control infractions. The following assurance and compliance activities are undertaken for the positive vetting of vessels undertaking Crux activities, where applicable to the class or risk profile.

10.8.5.1.1 Marine Warranty Survey

All vessels and activities will be assessed by the MWS on behalf of Shell's underwriter. Where required by the MWS, a marine vessel inspection/suitability survey is carried out in accordance with Construction All Risk insurance rules. The MWS issues a vessel suitability report with all significant actions and findings closed.

10.8.5.1.2 Pre-Mobilisation Inspection Report

The pre-mobilisation inspection is done to ensure compliance with HSSE, marine and technical requirements and readiness before the vessel commences work. The vessel (inclusive of equipment, processes, and procedures) is thoroughly inspected; inspection report items must be closed before mobilisation.

10.8.5.1.3 Shell Aircraft International Approval

Shell Aircraft International (SAI) approval is required for all helidecks used for personnel transport. Helicopters and their refuelling equipment must also be approved by SAI.

10.8.5.1.4 Group Maritime Assurance System Clearance

Group Maritime Assurance System (GMAS) clearance from the Shell Marine SME must be obtained before commencing marine operations on the Crux Project and before the contracted marine vessel enters the Activity Area. GMAS clearance ensures that marine vessel assurance has been completed satisfactorily.

10.8.5.1.5 Biofouling Risk Assessment for Vessel Movements

Shell will manage vessel compliance with biosecurity requirements as part of the Shell marine vessel assurance process and the vetting procedure. A biofouling risk assessment will be conducted for all project vessels before mobilising to the Activity Area. The IMS risk assessment process is commensurate to the risk and will depend on the location of the port of origin for each vessel as follows:

- vessels entering Australian territorial seas [12 nm limit] from international locations
- vessels entering the Activity Area directly from international locations

- vessels (as appropriate for size, type and class) entering the Activity Area from Australian domestic locations.

Biofouling management for project vessels entering Australian territorial seas [12 nm limit] from international locations, prior to entering the Activity Area, will apply the Australian Biofouling Management Requirements (DAFF 2023) which implements the requirements of the Biosecurity Act 2015 (Cth) and the IMO 2011 Guidelines for the Control and Management of Ships' biofouling to Minimize the Transfer of Invasive Aquatic Species. All vessel operators that intend to enter Australian territorial waters (outside of the Activity Area) must provide biofouling management information (refer to EPS 6.2) through the mandatory pre-arrival report 12–96 hours prior to arrival via the DAFF reporting systems (Maritime and Aircraft Reporting System [MARS] and Vessel Compliance Scheme[111]). The MARS Biosecurity Document is required to demonstrate a low–risk status prior to entering the Activity Area.

Biofouling management for project vessels entering the Activity Area directly from international locations or locally sourced project vessels from Australian domestic locations (as appropriate for size, type and class) will implement the following requirements derived from the Australian National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee 2009):

- Conduct a biofouling risk assessment using an industry recognised IMS inspector or using the industry recognised risk assessment tool.
- Undertake IMS risk reduction measures as guided by an industry recognised IMS inspector if a vessel is not considered low–risk.
- Only vessels classified as low risk will be permitted entry into the Activity Area.

10.8.5.1.6 Vessel Risk Status

Vessels must achieve a low–risk status to demonstrate to Shell that the IMS risk has been reduced to ALARP. The risk assessment categorises the vessel's risk status as:

- low–risk: low–risk of introducing IMS of concern; no additional management is required.
- uncertain–risk: the risk of introducing IMS is not apparent; a precautionary approach is adopted, and additional management options is required to achieve a low–risk status.
- high–risk: high–risk of introducing IMS; risk reduction measures are required prior to mobilisation.

10.8.5.1.7 Potential Risk Reduction Measures to Achieve Low-Risk Status

As described in Section 10.8.5.1.6, if the vessel is classified as a low-risk status, no additional management is required. For vessels classified as uncertain– or high–risk, the vessel operator is to undertake risk reduction measures either guided by an IMS inspector or identified to achieve a low–risk status and reduced to ALARP. Risk reduction measures may include but are not limited to:

- inspection (desktop, in-water or dry dock) by an industry recognised IMS inspector using the industry recognised risk assessment tool to understand and verify the actual biofouling risk.
- in-water cleaning.
- dry dock cleaning.
- internal seawater systems treatment.
- reject the vessel.

10.9 Non-Conformance Management

Shell classifies non-conformances with EPOs and EPSs in this EP as environmental incidents. Shell employees and contractors are required to report all environmental incidents, and these are managed by Shell's internal event recording, investigation and learning requirements. An internal computerised database called Sphera is used to record, track and report these incidents. Details of the event, immediate action taken to control the situation, investigation outcomes and corrective actions to prevent reoccurrence are all recorded. Corrective actions are monitored using Sphera and closed out in a timely manner.

[111] The Maritime and Aircraft Reporting System (MARS) and the Vessel Compliance Scheme (VCS) - DAFF

10.10 Review

10.10.1 Management Review

The HSSE Manager (Asset) regularly sponsors the monitoring and review of environmental performance and effectiveness of managing environmental risks and performance through team discussions, reporting and meetings. Several forms of management reviews exist to provide additional insight and overview of management system performance. These consist of, but are not limited to, the following:

- Steering Committees
  - Steering Committees exist to provide oversight over specific processes, projects, or business activities. Steering Committees will be formed and modified over time as required to meet the needs of the business. Each of the committees has a Terms of Reference defining the scope and objectives of operation. Examples of such steering committees are the AIPSM Steering Committee and the Goal Zero Meeting.
- Annual Review Processes
  - A formal review of the EP will be completed on an annual basis, which will include review of the risk ranking of environmental impacts, effectiveness of controls, relevant records required as evidence of compliance, compliance issues and progress of any actions required to address any compliance issues. Areas of concern and improvement at a management system level which output into an HSSE Improvement Plan.

An output summary of the annual reviews is used as input in the Country HSSE Management Review along with other Shell assets.

Due to the limited duration (<5 years) and dynamic nature of projects, a management review is not implemented until NNM Phase 1 is achieved. Prior to this, other assurance and continuous improvement processes outlined in this EP are seen as appropriate to meet the objectives of the management review.

10.10.2 Knowledge Management

To manage the information and knowledge that underpins this EP (and other Shell EPs), Shell will implement an Environmental Knowledge Management Process. The process involves the periodic review of EP knowledge against updated information (available to Shell or made publicly available) to identify any gaps or inconsistencies. The source of new information may include (but is not limited to):

- Outcomes of Shell monitoring, surveys, or other studies as relevant to the EP content.
- Published studies and/or literature relevant to the EP content.
- Legislation databases and government guidelines, policies etc.
- Technical details, operational changes or other information on the project and facilities as relevant to the EP content.
- Outcomes of stakeholder consultation as relevant to the EP content.

If new information is available, Shell will consider the new information in accordance with the internal Management of Change processes.

Learning and knowledge sharing also occurs via different methods including event investigations, HSSE bulletins, ongoing communication with contractors, cross asset learnings, engineering and technical authorities discipline communications and sharing, and review of impacts, risks, and controls across the life of the EP.

10.10.3 Continuous Improvement

As illustrated in the sections above, the Management System processes and the system itself are subject to a continuous improvement loop where findings from monitoring, assurance, and review activities are fed back to improve effectiveness. Another important driver for improvement is the review, analysis and learning from incidents.

Continuous improvement will be driven by:

- Improvements driven by the review of business-level HSSE key performance indicators.
- Actions arising from Shell's SEAM standards and updates to these standards as they occur.

- Corrective actions from HSE audits and inspections, incident investigations and on-site learnings, including after-action reviews.
- Opportunities for improvement and changes that are identified during operations and through both pre-activity and post-activity reviews and Management of Change documents.
- Actions taken to address any objections or claims, and issues raised during the ongoing consultation process (Section 5.13).

10.11 Reporting

Shell will implement various reporting measures to meet EPOs and EPSs committed in this EP.

10.11.1 Routine Reporting (Internal)

10.11.1.1 Shift/Progress Reports

The following daily reports will contain environmental performance information in accordance with the Universal Tag Locator (UTL) notification schedule, as relevant:

- Daily reports for relevant contract activities provide performance information about health, safety, and environment, and current and planned work activities. This will include well completions and major maintenance scope contractors.
- End of Shift Reports – includes facility performance information on production and a log of any HSSE events during operations.

UTL Daily Instructions will be provided in either of these report formats, as required, to provide guidance and instruction to panel operators from support teams such as surveillance engineers (Section 10.3.2.2). This may include, for example, guidance or instructions based on PTM surveillance data or observations, or relating to Crux Produced Water OIW Off-Specification Playbook (Section 10.7.1).

The following daily reports will contain environmental performance information, as relevant:

- Daily Progress Report(s) – during some activities (such as subsea IMR), daily reports are issued by the site representative. The reports provide performance information on HSE events, diesel use, together with equipment information, current and planned work activities.

Meetings between key personnel are used to transfer information, discuss incidents, agree plans for future activities and develop plans and accountabilities for resolving issues.

10.11.1.2 HSSE Meetings

Regular dedicated HSSE meetings are held with the offshore and office-based management and advisers to address targeted incidents and initiatives. Minutes of these meetings are produced and distributed as appropriate.

10.11.2 Routine Reporting (External)

10.11.2.1 Environmental Performance Report

Shell will deliver to NOPSEMA an annual environmental performance report for compliance with this EPs EPOs and EPSs on an annual financial year basis (1 July–30 June) submitted by 31 December of each year.

10.11.2.2 Start and End Notifications

In accordance with section 54 of the OPGGS(E) Regulations, Shell will notify NOPSEMA of the commencement of the Petroleum Activities at least ten days before the activity commences.

10.11.2.3 Environmental Performance Reporting

In accordance with applicable environmental legislation for the activity, Shell is required to report information on environmental performance to various regulators. Regulatory reporting requirements are summarised in Table 10-12.

Table 10-12: Routine External Reporting

Reporting Requirement	Description	Recipient	Frequency
Monthly Recordable Incident Reports	Details of recordable incidents that have occurred during the Petroleum Activities for previous month (if any). Complete NOPSEMA Recordable Environmental Incident Monthly Report form (N-03000-FM0928)[112]. Section 50 OPGGS(E) Regulations.	NOPSEMA	Monthly, by 15th of each month
Annual Environment Plan Performance Report for financial year	Compliance with EPOs, controls, and standards outlined in this EP, in accordance with the OPGGS(E) Regulations. Report to include: • summary of activities undertaken throughout the reporting period • sufficient information to determine compliance with EPOs and standards. • Further, where AMF triggers are initiated provide a detail on what triggers have been initiated and supporting monitoring and other information in order to determine ongoing compliance with relevant EPOs and EPSs. Sections 51(1) and 22(7) OPGGS(E) Regulations.	NOPSEMA	Annual, by 31 December each year.
National Pollutant Inventory (NPI) Report	Summary of the emissions to land, air, and water including those from the facility. Reporting period 1 July to 30 June each year.	DCCEEW	Annual, by 30 September each year
National Greenhouse and Energy Reporting (NGER)	Summary of energy use and GHG emissions including those from the facility. Reporting period is 1 July to 30 June each year.	Clean Energy Regulator (CER)	Annual, by 31 October each year

10.11.3 Non-Routine Notifications (External)

In accordance with applicable environmental legislation for the activity, Shell is required to notify governments, regulators, and agencies regarding information on environmental performance or activity to various regulators. Non-routine external notification requirements are summarised in Table 10-13, where applicable to activities.

Table 10-13: Non-Routine External Notifications

Reporting Requirement	Description	Recipient	Frequency
Pre activity (where relevant)			
Notify NOPSEMA that the activity has started.	Complete NOPSEMA start or end of activity form (N-04750-FM1405). Section 54(1) OPGGS(E) Regulations.	NOPSEMA	Notification at least 10 days before the activity commences and no later than 10 days after the activity ends.
Notify the department of the responsible WA or NT Minister of the	Notify activity commencement date, where relevant. Section 55 OPGGS(E) Regulations.	Minister's Department	Before the activity commences.

[112] https://www.nopsema.gov.au/document-hub/forms-and-templates

Reporting Requirement	Description	Recipient	Frequency
proposed commencement date.			
DAFF Biosecurity requirements.	Submit pre-arrival report and ballast water report using Maritime Arrivals Reporting System (MARS). Online forms[113] for vessels arriving from international waters where applicable to meet DAFF's biosecurity reporting obligations pursuant to the *Biosecurity Act 2015* (Cth) and the Biosecurity (Exposed Conveyances – Exceptions from Biosecurity Control) Determination 2016, undertake a vessel biosecurity risk and be assessed as 'low' by DAFF before interacting with domestic vessels and aircraft.	DAFF	Within 12–96 hours before vessel arrives into Australian waters.
AMSA including Joint Rescue Coordination Centre (JRCC) Notification.	Notify activity commencement date and duration.	AMSA (RCC)	Within 24–48 hours before vessel activities commence.
AHO Notification.	Notify activity commencement date and duration.	AHO	At least 4 weeks before the activity commences.
During activity			
AMSA including JRCC notification.	Activity updates, particularly changes to previously communicated operations.	AMSA (RCC)	As soon as possible.
AHO notification.	Activity updates, particularly changes to previously communicated operations.	AHO	As soon as possible.
End of Activity (where relevant)			
Notify NOPSEMA that the activity is completed.	Complete NOPSEMA's start or end of activity form (N-04750-FM1405). Section 54(2) OPGGS(E) Regulations.	NOPSEMA	Within 10 days after activity completion.
AMSA including JRCC notification.	Notify activity has been completed.	AMSA (RCC)	Within 10 days after completion.
AHO notification.	Notify activity has been completed.	AHO	Within 10 days after completion.
End of operations of an EP notification.	Complete NOPSEMA's Regulation 46 – End of operation of environment plan form (N-04750-FM1408). Section 46 OPGGS(E) Regulations.	NOPSEMA	After completing all obligations under this EP.
Environmental Performance Report – End of Activity.	Report to include: • summary of activities undertaken throughout the final reporting period. • sufficient information to determine compliance with EPOs and standards. Sections 51(1) and 22(7) OPGGS(E) Regulations.	NOPSEMA	To be submitted following the 'end of activity' notification being submitted.

10.11.4 Incident Reporting

The Shell Australia HSSE Event Investigate and Learn Procedure, which is applicable to all activities outlined in this EP, has been established to describe the process of reporting, classification, investigation, follow-up and close out of all HSSE and SP incidents on the Crux facility. Follow-up includes analysis, recommendations, implementation, and communication of learnings and continuous improvement of this process, this HSSE

[113] https://www.agriculture.gov.au/biosecurity-trade/aircraft-vessels-military/vessels/mars

process is referenced within the HSSE Management Manual and is supported by Shells internal use of Sphera (discussed in Section 10.9).

The procedure is used to ensure that all incidents (including near misses, unsafe acts and conditions) are reported, investigated and analysed in a consistent manner. Investigations focus on the identification of causes using casual (or positive) reasoning techniques. Investigation depth and breadth are proportional to the actual and potential consequences of the incident. There is a focus on identifying and implementing corrective actions that will eliminate causes and prevent recurrence of similar type of incidents.

The notification and reporting of incidents to NOPSEMA (and other regulatory bodies) is done in accordance with the relevant notified bodies regulations. For all NOPSEMA notifications for reportable incidents see Section 10.11.4.1.

10.11.4.1 Recordable Incidents

A 'recordable incident' is defined by the OPGGS(E) Regulations as a 'breach of an environmental performance outcome (EPO) or environmental performance standard (EPS), in the EP that applies to the activity, that is not a reportable incident'. Shell has processes in place that ensure it will notify NOPSEMA of all Recordable Incidents, according to the requirements of section 50 of the OPGGS(E) Regulations and reported as detailed in Table 10-12. The report will include:

- A record of all Recordable Incidents that occurred during each calendar month that the activity (EP) is in force.
- All material facts and circumstances concerning the Recordable Incidents that the operator knows or is able, by reasonable search or enquiry, to find out.
- Any action taken to avoid or mitigate any adverse environment impacts of the Recordable Incidents.
- The corrective action that has been taken, or proposed to be taken, to stop, control or remedy and to avoid a repeat of the Recordable Incident.
- The action that has been taken, or is proposed to be taken, to prevent a similar incident occurring in future.

10.11.4.2 Reportable Incidents

A 'reportable incident' is defined by the OPGGS(E) Regulations as 'an incident relating to the activity that has caused, or has the potential to cause, moderate to significant environmental damage'. Under Section 47 of the OPGGS(E) Regulations, NOPSEMA is to be notified in the event of a reportable incident within two hours after the occurrence of the environmental incident (see Table 10-14). Under Section 48 of the OPGGS(E) Regulations, Shell will provide a written report within three days of the reportable incident (see Table 10-14).

The Shell Environmental Risk Matrix (Section 9.1) uses magnitude criteria 0 to −5 to define environmental consequences (positive impact [+1], no impact [0], slight effect [−1], minor effect [−2], moderate effect [−3], major effect [−4] and massive effect [−5]) (refer Table 9-3). All environmental events/incidents with an actual or potential magnitude ≥−3 (i.e. moderate effect, major effect and massive effect) are considered reportable incidents.

Based on the risk assessment (Section 9), the following events/incidents are classified as having an actual consequence magnitude ≥−3 (i.e. moderate effect, major effect and massive effect) and are therefore considered to be examples (not an exhaustive list) of reportable incidents.

- Confirmed introduced marine pest species in Australian waters attributable to the activities (Table 9-43).
- The translocation and establishment of pests or diseases to Australian waters associated with the activities (Table 9-86).
- Emergency event (hydrocarbon release) (Table 9-98).

The potential for an event/incident to have an environmental consequence magnitude ≥−3 is assessed as part of the Environmental Risk Assessment which is conducted in Sphera for each event/incident. The assessment is conducted using the Shell Environmental Risk Matrix and considers the 'worst case credible' consequence that could develop from the event/incident under the prevailing conditions. Any event/incident that is assessed as having the potential to result in a consequence magnitude ≥−3, will also be considered a reportable environmental incident.

The reportable incident report will contain all material facts and circumstances concerning the reportable incident, actions taken to avoid and/or mitigate any adverse impacts and corrective action taken, including learnings. This report will be submitted to NOPSEMA as soon as practicable after the oral notification. Table 10-14 outlines the reporting requirements for reportable incidents. Table 10-15 lists other externally notifiable incidents. Additional notification requirements relevant to oil spill incidents are included in the BROPEP.

Table 10-14: Notifying and Reporting Reportable Incidents

Reporting Requirement	Recipient	Submission Timing
Section 47 of the OPGGS(E) Regulations: Notification of reportable incidents		
The oral notification must contain: • all material facts and circumstances concerning the reportable incident known or by reasonable search or enquiry could be found out by the Titleholder. • any action taken to avoid or mitigate any adverse environmental impacts of the reportable incident. • the corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the reportable incident.	NOPSEMA[114]	Within 2 hours after the first occurrence of a reportable incident, or if the incident was not detected at the time of the first occurrence, at the time of becoming aware of the reportable incident.
A written record of the oral notification must be submitted. The written record is not required to include anything that was not included in the oral notification.	NOPSEMA NOPTA[115] Department of the responsible WA or NT Minister.	As soon as practicable after the oral notification.
Section 48 of the OPGGS(E) Regulations: Written report of reportable incidents		
A written report must contain: • all material facts and circumstances concerning the reportable incident known or by reasonable search or enquiry could be found out. • any action taken to avoid or mitigate any adverse environmental impacts of the reportable incident. • the corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the reportable incident. • the action that has been taken, or is proposed to be taken, to prevent a similar incident occurring in the future.	NOPSEMA	Must be submitted as soon as practicable, and in any case not later than 3 days after the first occurrence of the reportable incident unless NOPSEMA specifies otherwise.
	NOPTA Department of the responsible WA or NT Minister.	Must be submitted within 7 days after giving the written report to NOPSEMA.
NOPSEMA's Report of an Accident, Dangerous Occurrence or Environmental Incident form (N-03000-FM0831).	NOPSEMA	Within 3 days after the first occurrence of the reportable incident unless NOPSEMA specifies otherwise.

[114] To make an oral notification to NOPSEMA of a reportable environmental incident call: 1300 674 472.

[115] reporting@nopta.gov.au

10.11.4.3 Incident Notifications

Table 10-15: Externally Notifiable Incidents

Reporting Requirement	Recipient	Submission Timing
Any hydrocarbon spill that has entered or is likely to enter international waters.	DISR will notify DFAT who will notify the relevant foreign government. 02 6213 6000 opicc@industry.gov.au	Verbal notification within 8 hours, if the spill is likely to extend into international waters.
	DFAT	Follow up with email outlining details of incident.
Hydrocarbon spill within a marine park or likely to impact on a marine park.	DNP (Marine Park Compliance Duty Officer) 0419 293 465	As soon as possible.
Any oil spill or discharge of any pollutant which may impact WA managed fish breeding or fish stocks.	DPIRD environment@dpird.wa.gov.au	Within 24 hours.
Any confirmed introduced marine pest species in WA waters.	DPIRD (FishWatch) 1800 815 507 aquatic.biosecurity@dpird.wa.gov.au DPIRD (Aquatic Pest Biosecurity) 08 9203 0111 aquatic.biosecurity@dpird.wa.gov.au	Within 24 hours.
Any ship strike incident with cetaceans.	DCCEEW (Australian Antarctic Division, Australian Marine Mammal Centre) Report to the National Ship Strike database[116]:	As soon as possible but no later than 72 hours.
Death or injury of EPBC Act listed threatened, migratory, marine or cetacean species.	DCCEEW EPBC.permits@environment.gov.au	As soon as possible but no later than 7 days.
	NOPSEMA Secure File Transfer service or by email to submissions@nopsema.gov.au	
Any sighting and entanglements of a cetacean.	DCCEEW (Australian Antarctic Division, Australian Marine Mammal Centre)[117].	Within 2 months.
Vessel spill to marine environment: including all discharges/spills or probable discharges/spills to the marine environment of oil or oily mixtures, or noxious liquid substances in the marine environment from vessels: Report vessel spills that are released to the marine environment.	AMSA JRCC 1800 641 792 rccaus@amsa.gov.au	Within 2 hours of incident.
Marine pollution incidents in NT waters.	NT Department of Environment, Parks and Water Security (Territory Emergency Management Council). 1800 064 567 pollution@nt.gov.au	Verbal notification as soon as practicable. Pollution report (POLREP) (Harmful

[116] https://data.marinemammals.gov.au/report/shipstrike
[117] sightingsdata@aad.gov.au

Reporting Requirement	Recipient	Submission Timing
		Substances Report - oil), within 24 hours. Situation report (SITREP), as required.
Hydrocarbon spill predicted to enter NT waters.	NT Department of Environment, Parks and Water Security (Territory Emergency Management Council (TEMC)). 1800 064 567 Pollution@nt.gov.au	Verbal notification as soon as practicable. POLREP (Harmful Substances Report - oil), within 24 hours SITREP, as required.
Hydrocarbon spill predicted to enter WA waters.	WA DoT (Maritime Environmental Emergency Response) Chief Executive Officer (CEO) of the DoT (Hazard Management Agency [HMA]). 08 9480 9924 (24 hours) Marine.pollution@transport.wa.gov.au	Verbal notification as soon as practicable. POLREP (Harmful Substances Report – oil), within 24 hours SITREP, as required.
Marine pollution incidents in WA waters.	HMA–CEO of the WA DoT (Maritime Environmental Emergency Response). 08 9480 9924 (24 hours) marine.pollution@transport.wa.gov.au	As soon as practicable.
Marine POLREP[118] and (SITREP).	AMSA Rescue Coordination Centre (RCC). mailto:rccaus@amsa.gov.au and WA DoT marine.pollution@transport.wa.gov.au	As requested by WA DoT and AMSA following verbal notification.
Notification detailing any Level/Tier 2 or 3 hydrocarbon spill which has the potential to impact communities and environment. The notification to contain: • all material facts and circumstances concerning the incident (including emergency response timeframes and expected environmental impacts) • actions taken to avoid or mitigate any adverse impacts. • corrective actions taken.	NLC Relevant Persons contact details as held in Shell's relevant persons consultation database.	Immediately following establishment of potential impacts.
Notification detailing any Level/Tier 2 or 3 hydrocarbon spill which has the potential to impact each Tier 1 and Tier 2[119] Indigenous Relevant Persons functions, interests or activities. The notification to contain: • all material facts and circumstances concerning the incident (including emergency response timeframes and expected environmental impacts). • actions taken to avoid or mitigate any adverse impacts. • corrective actions taken.	Relevant Persons contact details as held in Shell's Relevant Persons consultation database.	Immediately following establishment of potential impacts to Relevant Persons functions, interests, or activities.

[118] www.transport.wa.gov.au/mediaFiles/marine/MAC-F-PollutionReport.pdf.

[119] Tiers as defined in Table 5-10.

Reporting Requirement	Recipient	Submission Timing
Notification to WAFIC detailing any Level/Tier 2 or 3 hydrocarbon spill which has the potential to impact on WA fisheries. The notification is to include: • all material facts and circumstances concerning the incident (including emergency response timeframes and expected environmental impacts). • Actions taken to avoid or mitigate any adverse impacts. • Corrective actions taken. Shell IMT would like to utilise WAFIC's fee for a service to contact any potentially impacted commercial fishing licence holders in the event of an emergency scenario.	WAFICs contact details (email) as held in Shell's Relevant Persons consultation database.	Within 24 hours of Incident.
Quarantine regulations breach.	DAFF (National Maritime Centre) 1300 004 605 maraitimenc@agriculture.gov.au	As soon as practicable.

10.12 Details of Titleholder and Liaison Person

In accordance with section 23 of the OPGGS(E) Regulations, details of the titleholder, liaison person and arrangements for notifying changes are described below.

Titleholder:

Shell Australia Pty. Ltd. (ACN/ABN: 009663576/14009663876)

562 Wellington Street, Perth 6000 WA

Activity Contact:

Brendan Herbst

Vice President Prelude/Crux

Email: SDA-Crux-Project@shell.com

Phone: 1800 059 152

If the titleholder, titleholder's nominated liaison person or the contact details for either change, Shell will notify NOPSEMA in writing of the change within two weeks or as soon as practicable.

10.13 Record Keeping

Compliance records will be maintained. Record keeping will be in accordance with section 52(7) of the OPGGS(E) Regulations, which addresses maintaining quantitative records of emissions and discharges, environmental performance, monitoring, and calibration of devices that are made in accordance with the EP in force for an activity under the title that are accurate and can be monitored and audited against the environmental performance standards and measurement criteria.

10.14 Emergency Preparedness and Response

Under section 22(8) of the OPGGS(E) Regulations, the Implementation Strategy must contain an OPEP and provisions for updating it throughout the activity. Section 22(9) of the OPGGS(E) Regulations outlines the OPEP requirements, which must include adequate arrangements for timely response to and monitoring of an oil pollution event. A summary of Shell Australia's emergency and incident management framework and arrangements are described in the following sections.

10.14.1 Emergency Management Manual

Shell's Emergency Management Manual (HSE_GEN_010996) provides a tiered response framework that classifies incidents based on the level of resourcing and support required. It also outlines communication arrangements associated with each level of emergency, emergency response roster arrangements, emergency response training and competencies, and requirements for emergency management drills and exercises.

10.14.2 Incident Management Team (West) Emergency Response Plan

The IMT(W) ERP (HSE_GEN_011209) is a supporting document to the Shell Australia Standard Emergency Management Manual (HSE_GEN_010996) and is consistent with national and state emergency management arrangements. The IMT(W) ERP (HSE_GEN_011209) provides specific assistance and guidance to the IMT(W) in support of Shell-owned, operated, or contracted facilities. This ERP contains these details:

- Emergency and incident management plans and arrangements.
- IMT(W) role checklists and duty cards.
- Incident management, action planning, Incident Command System (ICS) forms and briefing templates.
- IMT(W) communications.
- Guidance and forms for responding to emergencies.
- Lists of supporting SME units.
- De-escalation and recovery.

10.14.3 Oil Pollution Emergency Plan

The Shell Browse Regional Oil Pollution Emergency Plan (BROPEP) (HSE_GEN_016765) outlines emergency management arrangements to respond to credible spill scenarios associated with all offshore activities in the Browse Region, including the Crux Platform and associated Pipeline between Crux and Prelude FLNG. The BROPEP provides the information and reference to documents required for an effective response in the unlikely event of an unplanned release of petroleum products. The BROPEP details the actions to be taken in response to the incident and provides contact details of emergency specialist response groups, statutory authorities and other external bodies requiring notification.

10.14.4 Operational and Scientific Monitoring Framework

Shell is required to have in place arrangements for monitoring oil pollution as part of its BROPEP. Shell has adopted the use of the Joint Industry OSMP (APPEA 2021a) and its associated OMPs and SMPs to guide environmental monitoring that may be implemented in the event of a Level/Tier 2–3 spill of hydrocarbons. Further information on how the Joint Industry OSMP Framework interfaces with Shell's activities, spill risks and internal management systems is presented in Shell's Browse Regional Operational and Scientific monitoring Bridging Implementation Plan (HSE_PRE_016370).

10.14.5 WAFIC Loss Adjustment

In response to consultation with WAFIC, the adjustment protocols developed and included in the NERA Collaboration EP (taken to mean the NERA Collaborative Seismic Environment Plan) will be applied in the event of an unplanned spill or introduction of IMS. Shell refers to Appendix D3 (page 622) of the NERA Collaborative Seismic Environment Plan (Revision 1) as information previously given under section 56(1) of the OPGGS(E) Regulations. The full text NERA Collaborative Seismic Environment Plan is available on the NOPSEMA Environment Plans website (https://info.nopsema.gov.au).

10.14.6 Shell Australia's Emergency Management Structure

Shell Australia applies the ICS methodology for emergency management. The ICS is designed to manage incidents by integrating facilities, equipment, personnel, procedures, and communications operating under one structure. An ICS is commonly structured into functional areas that facilitate incident management activities, including operations, planning, logistics, finance, and incident command.

Shell also applies a graduated response framework that increases resource involvement based on the significance and escalation potential of the incident. This graduated framework involves three key emergency management teams:

- Emergency Response Team (ERT), which is based on the facility and is responsible for the initial response to the incident. The Facility Incident Commander will liaise closely with the onshore IMT(W) leader and will identify when additional support is required to respond to an incident.
- IMT(W), which is based onshore within the Perth Shell office will support the ERT by providing advice, logistical and asset support and managing the operational and technical aspects of the response with knowledge and technical support from Shells Global Response Support Network (GRSN).
- Crisis Management Team (CMT), which is also based onshore within the Perth Shell office and is responsible for the overall management of the incident from a strategic, commercial, legal, reputational, and high-level liaison perspective with knowledge and technical support from Shells GRSN.

The ERT and IMT(W) are scalable to the nature and scale of the response (i.e. one person can take on multiple roles where circumstances permit and vice versa). The mobilisation of the ERT is at the directive of the Facility Incident Commander or delegate. To mobilise the IMT(W), the Facility Incident Commander contacts the on-duty IMT(W) Leader who will then mobilise the IMT(W) as the situation warrants. Duty positions within the IMT(W) area are staffed by a roster system where each position has required personnel identified for the role. On-call positions within the IMT(W) provide specific functional expertise that helps the business respond to relevant incident scenarios. On-call positions are activated as part of the IMT(W) at the discretion of the IMT(W) Leader based on known or potential requirements. Several people are identified and trained for each on-call position, with a rotating on-call list used to contact these personnel.

Figure 10-22 outlines the emergency management escalation process adopted by the IMT(W); Figure 10-23 shows the IMT(W) structure.

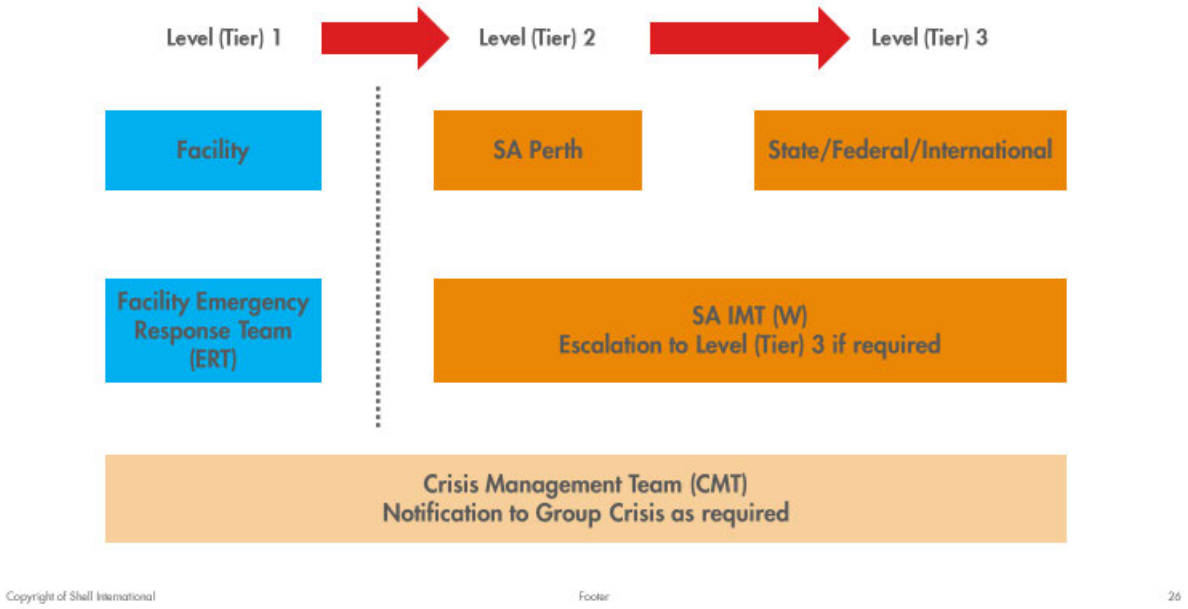


Figure 10-22: Emergency Management Escalation Process Adopted by IMT(W)

SA = Shell Australia

Interface between the IMT and CMT is outlined in the Shell Australia Weekly Contact List (HSE_GEN_011648). The affected facility business executive will be notified by the IMT (W) leader and IMT (W) will notify the Shell Australia CMT leader.

In addition to these resources, Shell Australia can activate additional support through the Shell GRSN. The GRSN is a network of emergency response trained Shell Staff employed in a wide range of positions within Shell's global and local businesses who have received specific training related to oil spill response and who may be called upon to support any business or Country globally which is responding to a large-scale incident. Shell Australia also has access to the Well Control Virtual Emergency Response Team (WCVERT) to provide virtual or physical mobilisation of a wide range of technical expertise to support an emergency event.

Shell Australia could also activate external additional resources for Level/Tier 2–3 spills to fill various ERT and IMT roles for the duration of the response if they were required. This includes oil spill response organisation personnel and trained mutual aid personnel (as per AMOS Plan), as outlined in the BROPEP (HSE_GEN_016765).

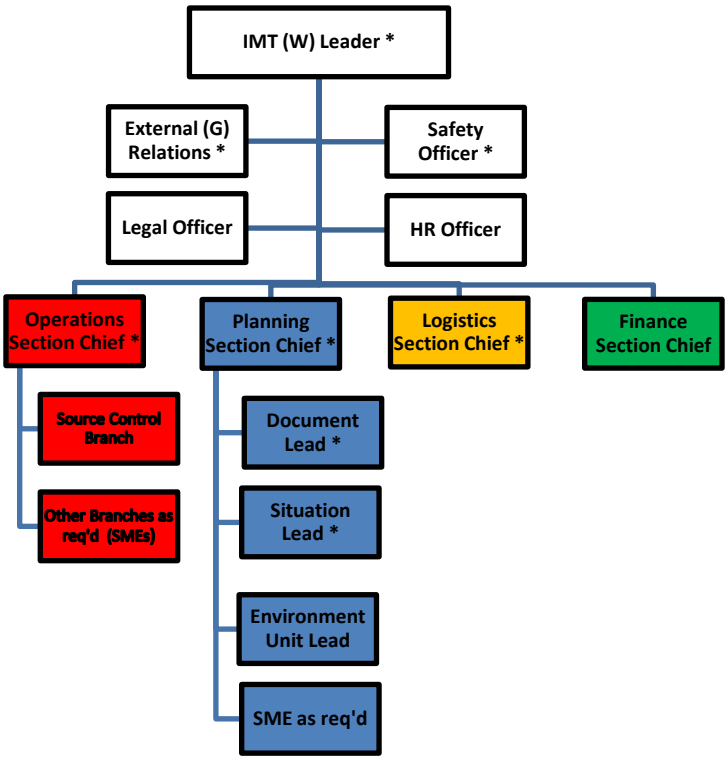


Figure 10-23: Incident Management Team (West) Structure

** indicates duty roles; all other positions are on-call*

HR = Human Resources

10.14.7 Emergency Management Roles and Responsibilities

Shell's IMT(W) ERP (HSE_GEN_011209) and Crux Facility ERP provide detailed guidance on the roles and responsibilities for all emergency management personnel, during periods when the Crux facility is manned or unmanned.

Table 10-16 outlines the key incident response roles and responsibilities for Shell personnel. Table 10-17 outlines the roles and responsibilities of Shell personnel who are required to work within the WA DoT organisational structure, where WA DoT has responsibilities for spill response as a control agency, as per their Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements. WA DoT will provide two roles to Shell's IMT (W)/CMT in a coordinated response; their roles and responsibilities are listed in Table 10-18.

Table 10-16: Summary of Roles and Responsibilities of Key Emergency Management Personnel

Key Roles	Responsibilities
Facility Incident Commander (Offshore)	• Maintain the safety of all Prelude and Crux personnel and initiate actions to protect the environment and assets. • Ensure all first-strike actions are carried out as per the BROPEP. • Control source of spill (if practicable). • Classify the Level/Tier of spill. • Notify and maintain regular communications with IMT(W) Leader of incident. • Verbally notify NOPSEMA (within 2 hours of spill) if spill is within Commonwealth Waters. • Initiate surveillance, modelling and visualisation activities, as per the BROPEP.
On-scene Commander (Offshore)	• Responsible for coordinating the emergency scene and the safety of all personnel at the emergency scene. • Move ERT forward when authorised by the Facility Incident Commander. • Provide regular situation updates to the Operations Section Chief (OSC) on incident progress against response plan priorities.
IMT(W) Leader (Onshore)	• Ensure all first-strike actions are carried out as per the BROPEP. • Activate IMT, if required. • Conduct overall management of incident response operations. • Assess the situation and confirm or adjust the spill classification Level/Tier in consultation with the OIM and OSC. • Notify CMT Leader of event and initial response level. • Determine incident priorities and objectives for IMT. • Confirm Incident Action Plan (IAP) is being developed; approve and authorise implementation of IAPs. • Confirm all external notifications and reporting have been made, as outlined in the BROPEP. • Mobilise external support, if required, as per the BROPEP.
Operations Section Chief (OSC) (Onshore)	• Oversee all operational resources and activities supporting an emergency. • Establish communications with ERT. • Provide overview of response operations at initial IMT briefing. • Communicate incident updates provided by the ERT to IMT through meetings and team briefings. • Provide incident details to the Planning Section Chief (PSC) and Situation Unit Lead for developing the initial IAP and help develop incident objectives and strategies. • Determine Activity Areas (e.g. staging areas, forward command, incident area, oiled wildlife receiving, and demobilisation areas). • Execute IAPs for each operational period. • Responsible for safety of all personnel involved in response.
Planning Section Chief (PSC) (Onshore)	• Facilitate all IMT meetings. • Help the IMT(W) Leader develop incident objectives. • Facilitate development of IAP for next operational period. • Mobilise Environment Unit. • Monitor situation reports and update status displays with additional information; adjust IAP as necessary.
Logistic Section Chief (LSC) (Onshore)	• Source all logistical requirements to complete response operations, including personnel, equipment and supplies for ongoing incidents. • Liaise with PSC on specialist resource requirements being considered in response strategies; verify availability of these resources as this may affect strategy selection. • If required incident resources are not immediately available through existing contracts, liaise with Contracts and Procurement to develop contractual arrangements as required.

Key Roles	Responsibilities
Environment Unit Lead (EUL) (Onshore)	• Conduct relevant external notifications, as outlined in the BROPEP. • Review OMP initiation criteria and activate OSMP contractor where required. • Confirm protection priorities. • Validate strategic SIMA and generate the initial operational SIMA. • Provide the OSC with guidance on environmental management measures to be followed during response operations.
Situation Unit Lead (Onshore)	• Responsible for collecting, processing and organising incident information relating to the growth, mitigation or intelligence activities taking place on the incident. • Manage all situational awareness and intelligence information relating to the incident, including geospatial/meteorological information. • Ensure status boards are updated, retain clear records of out-of-date vs current information. • Prepare and disseminate resource and situation status information as required, including special requests.
Documentation Unit Lead (Onshore)	• Responsible for maintaining accurate, up-to-date incident files (i.e. IAP, incident reports, communications logs). • Compile and collate all unit logs, communications, and other records so that a consolidated set of incident documentation is maintained. • Liaise with the Situation Unit Lead to collate and store all relevant documentation produced for Situation Updates.
External (Government) Relations/Public Information Officer (Onshore)	• Conduct relevant external notifications, as outlined in the BROPEP. • Manage all external communications until CMT assumes responsibility. • Evaluate the need for a joint information communication centre. • Ensure active and ongoing engagement with all relevant stakeholders and external response agencies; prepare stakeholder management plan for approval by IMT. • Develop material for use in media releases.
Safety Officer (Onshore)	• Conduct hazard assessment and advise OIM of recommended safety actions and safe approach routes. • Assist the OSC and LSC by facilitating risk assessments during event response and recovery plan development, as required. • Review IAPs for safety implications.
Finance Section Chief (Onshore)	• Responsible for all financial, administrative, and cost analysis aspects of an emergency. • Provide financial and cost analysis information as requested.

Table 10-17: Shell Personnel Roles Positioned within the State Maritime Environmental Emergency Coordination Centre (MEECC)/WA DoT IMT

Key Roles	Responsibilities
Crisis Communications Support Team Liaison Officer	• Provide a direct liaison between Shell and the State MEECC. • Facilitate effective communications and coordination between the Shell CMT Leader and the State Maritime Environmental Emergency Coordinator (SMEEC). • Advise SMEEC on matters pertaining to Shell's crisis management policies and procedures.

Key Roles	Responsibilities
Deputy Incident Officer	• Provide a direct liaison between the DoT IMT and the Shell IMT. • Facilitate effective communications and coordination between the Shell IMT(W) Leader and the DoT Incident Controller. • Advise the DoT Incident Controller on matters pertaining to Shell's incident response policies and procedures. • Advise the Safety Coordinator on matters pertaining to Shell's safety policies and procedures particularly as they relate to Shell employees or contractors operating under the control of the DoT IMT.
Intelligence Support Officer	• As part of the Intelligence Team, assist the Intelligence Officer in the performance of their duties in relation to situation and awareness. • Facilitate the provision of relevant modelling and predictions from the Shell IMT. • Help interpret modelling and predictions originating from the Shell IMT. • Facilitate the provision of relevant situation and awareness information originating from the DoT IMT to the Shell IMT. • Facilitate the provision of relevant mapping from the Shell IMT. • Help interpret mapping originating from the Shell IMT. • Facilitate the provision of relevant mapping originating from the Shell IMT.
Deputy Planning Officer	• As part of the Planning Team, help the Planning Officer perform their duties in relation to interpreting existing response plans and developing IAPs and related subplans. • Facilitate the provision of relevant IAPs and subplans from the Shell IMT. • Help implement the Shell BROPEP. • Help develop the Shell IAPs and subplans from the Shell IMT. • Facilitate the provision of relevant IAPs and subplans originating from the DoT IMT to the Shell IMT. • Help interpret Shell's existing resource plans. • Facilitate the provision of relevant components of the resource subplan originating from the DoT IMT to the Shell IMT. • (Note: The Deputy Planning Officer must have intimate knowledge of the Shell BROPEP and planning processes).
Environmental Support Officer	• As part of the Planning Team, help the Environmental Officer perform their duties in relation to providing environmental support into the planning process. • Help implement the Shell BROPEP and relevant TRP plans. • Facilitate in requesting, obtaining, and interpreting environmental monitoring data originating from the Shell IMT. • Facilitate the provision of relevant environmental information and advice originating from the DoT IMT to the Shell IMT.

Key Roles	Responsibilities
Public Information Support and Media Liaison Officer	• As part of the Public Information Team, provide direct liaison between the Shell media team and DoT IMT media team. • Facilitate effective communications and coordination between the Shell and DoT media teams. • Help release joint media statements and conduct joint media briefings. • Help release joint information and warnings through the DoT Information and Warnings team. • Advise the DoT Media Coordinator on matters pertaining to Shell media policies and procedures. • Facilitate effective communications and coordination between Shell and DoT Community Liaison teams. • Help conduct joint community briefings and events. • Advise the DoT Community Liaison Coordinator on matters pertaining to Shell's community liaison policies and procedures. • Facilitate the effective transfer of relevant information obtained from through the Contact Centre to the Shell IMT.
Deputy Logistics Officer	• As part of the Logistics Team, help the Logistics Officer perform their duties in relation to providing supplies to sustain the response effort. • Facilitate the acquisition of appropriate supplies through Shell's existing OSRL, AMOSC and private contract arrangements. • Collect Request Forms from DoT to action via the Shell IMT. • (Note: The Deputy Logistics Officer must have intimate knowledge of the relevant Shell logistics processes and contracts).
Deputy Operations Officer	• As part of the Operations Team, help the Operations Officer perform their duties in relation to implementing and managing operations activities undertaken to resolve an incident. • Facilitate effective communications and coordination between the Shell Operations Section and the DoT Operations Section. • Advise the DoT Operations Officer on matters pertaining to Shell's incident response procedures and requirements. • Identify efficiencies and help resolve potential conflicts around resource allocation and simultaneous operations of Shell and DoT response efforts.
Deputy Waste Management Coordinator	• As part of the Operations Team, help the Waste Management Coordinator perform their duties in relation to managing and disposing waste collected in State Waters. • Facilitate the disposal of waste through Shell's existing private contract arrangements related to waste management and in line with legislative and regulatory requirements. • Collect Waste Collection Request Forms from DoT to action via the Shell IMT.
Deputy Finance Officer	• As part of the Finance Team, help the Finance Officer perform their duties in relation to setting up and paying accounts for those services acquired through Shell's existing OSRL, AMOSC and private contract arrangements. • Facilitate the communication of financial monitoring information to Shell to allow them to track the overall cost of the response. • Help the Finance Officer track financial commitments through the response, including the supply contracts commissioned directly by DoT and to be charged back to Shell.

Key Roles	Responsibilities
Deputy On Scene Commander (Forward Operations Base (FOB))	• As part of the Field Operations Team, help the On Scene Commander perform their duties in relation to overseeing and coordinating field operations activities undertaken in line with the IMT Operations Section's direction. • Provide a direct liaison between Shell's FOB/s and the DoT FOB. • Facilitate effective communications and coordination between the Shell and DoT On Scene Commanders. • Advise the DoT On Scene Commander on matters pertaining to Shell's incident response policies and procedures. • Help the Safety Coordinator deployed in the FOB perform their duties, particularly as they relate to Shell employees or contractors. • Advise the Safety Coordinator deployed in the FOB on matters pertaining to Shell's safety policies and procedures.

Table 10-18: Roles and Responsibilities of DoT Personnel to be Positioned in Shell's IMT/CMT

Key Roles	Responsibilities
DoT Liaison Officer	• Facilitate effective communications between DoT's SMEEC and Incident Controller and Shell's CMT Leader and Incident Controller. • Provide enhanced situational awareness to DoT of the incident and the potential impact on State Waters. • Help provide DoT support to Shell. • Facilitate the provision of technical advice from DoT to Shell's Incident Controller, as required.
Media Liaison Officer	• Provide a direct liaison between Shell's media team and DoT's IMT media team. • Facilitate effective communications and coordination between Shell and DoT media teams. • Help release joint media statements and conduct joint media briefings. • Help release joint information and warnings through the DoT Information and Warnings team. • Advise the Shell Media Coordinator on matters pertaining to DoT and wider government media policies and procedures.

10.14.8 Emergency Management Exercises, Training and Competencies

Shell follows the approved ICS and IMO emergency management training requirement for ICS command and general staff. Specific competencies for IMT members are defined in the Shell Operational HSSE Competence Framework and are tracked in the Shell Open University. Table 10-19 outlines the training requirements and core competencies for key ERT, IMT and CMT personnel. Table 10-20 outlines oil spill responder training requirements.

Only those who have completed all mandatory training requirements can be placed on the IMT roster. Training status of IMT personnel is reviewed monthly (or following significant personnel or policy change by the Emergency Response Coordinator) and notifications issued in advance to those requiring revalidation by training and/or emergency response exercise participation.

Table 10-19: Exercise and Training Requirements for Key ERT, IMT and CMT Personnel

Key Roles	Exercises	Training
ERT personnel	In accordance with vessel/asset emergency exercise schedule and SOPEP exercise schedule.	As specified via each respective contractor HSSE management system.
IMT personnel IMT(W) Leader	80% of personnel must participate in an IMT exercise annually.	All IMT personnel: ICS 100, 200 and IMT induction.

Key Roles	Exercises	Training
		IMT(W) Leader: AMOSC – IMO3 Oil Spill Command and Control.
OSC PSC LSC EUL	80% of personnel must participate in an IMT exercise annually. Participation in exercises is tracked in the Exercises and Training Schedule and is reviewed monthly or following significant personnel or policy change by the Emergency Response Coordinator.	AMOSC – IMO2 Oil Spill Management.
CMT personnel	Level/Tier 2–3 exercise every 2 years.	Shell-specific – Group Crisis Training.

Table 10-20: Oil Spill Responder Training and Resources

Key Roles	Exercises/Training	Available Resources
Shell AMOSC Core Group Members	AMOSC Core Group Workshop (refresher training every 2 years), Operations stream and management stream.	As defined in AMOSC contractual core group requirements.
AMOSC Core Group Responders	AMOSC Core Group Workshop (refresher training every 2 years).	As defined in AMOSC contractual core group requirements.
OSRL Oil Spill Response Personnel	As per OSRL training and competency matrix.	As defined in OSRL Service Level Agreement.
AMOSC Oil Spill Response Specialists	As per AMOSC training and competency matrix.	As defined in AMOSC Master Services Agreement.
Operational and Scientific Monitoring Service Providers	As defined in the Shell Australia Operational and Scientific Monitoring Bridging Implementation Plan (HSE_PRE_016370).	As per Standby Capability and Competency Report.
Oiled Wildlife Responders (Level 2–4) Shoreline clean-up personnel	As per DBCA OWR requirements (WA ORP Plan). As per WA DoT requirements.	As per OWR state board (AMOSC and DBCA). As defined in AMOSC Master Services and OSRL Service Level Agreements. Team members available through labour hire contracts (training provided prior to deployment).

Shell maintains an Exercise and Training Schedule (as detailed in the Emergency Management Manual [HSE_GEN_010996]) to ensure its competency in responding to and managing major incidents, including oil spills. The Exercise and Training Schedule is reviewed and revised (if required) annually.

As part of this schedule, Shell conducts various exercises, as described in Table 10-21.

Table 10-21: Exercise Types, Objectives and Frequency

Exercise Type	Objective	Frequency
Notification exercise	To test all communication and notification processes to service providers and regulatory agencies defined within the BROPEP.	At least annually. When BROPEP is accepted or introduced. When response arrangements have been significantly amended. If a new location for the activity is added after the response arrangements have been tested.

Exercise Type	Objective	Frequency
Equipment deployment exercises	To focus on Shell's deployment capability. To inspect and maintain the condition of Shell's oil spill response equipment. To maintain training of field response personnel.	As per Shell Australia's Exercise and Training Schedule.
Tabletop exercise	To encourage interactive discussions of a simulated scenario amongst IMT members and refresh roles and responsibilities.	As per Shell Australia's Exercise and Training Schedule.
Incident management exercise	To activate IMT and establish command, control, and coordination of simulated Level/Tier 2 or 3 incident and test response arrangements as described in the BROPEP.	Minimum of one oil spill exercise per year for Shell's activities. If the response arrangements are the same for several activity specific OPEPs, one exercise may be used to test the response arrangements for the OPEPs at the same time. At the discretion of the Well Operations Manager these exercises may be combined in a single event.
National Plan exercises or WA DoT exercises	Participate as required to ensure alignment between National/State Response Framework and Shell's Response Framework.	As determined by AMSA and/or WA DoT, Shell may not be requested to participate every year.
Shell Global Response Support Network (GRSN)	To test the functionality of Shell's Regional Core Group Level/Tier 3 oil spill response capabilities. To achieve a target of 100% for participation of Shell Australia's Core Group personnel in GRSN regional exercises, as required.	Annually. Every 2 years.
AMOSC audit	To test deployment readiness and capability of AMOSC as per its Master Services Agreement with Shell.	Annually.
OSRL audit	To test deployment readiness and capability of OSRL in Singapore as per OSRL's Service Level Agreement with Shell.	Every 2 years.

As part of the exercise process, several documents are prepared to ensure exercises are well planned, conducted and evaluated. These documents are used to support this document preparation:

- Exercise scope document provides background context to the exercise, outlines the exercise need, aim, objectives, details of the scenario, participating groups and agencies, exercise deliverables and management structure. This document can be used to engage a third-party contractor to help conduct the exercise.
- Exercise plan and instructions provides instructions and 'play' (including any injects) for conducting the exercise.
- Post exercise report includes an after-action review of the exercise, evaluating how the exercise performed against meeting its aim and objectives.

10.14.9 Effectiveness of the Response Arrangements

Shell routinely undertakes post-exercise debriefings following Level/Tier 2–3 BROPEP exercises to evaluate the effectiveness of response arrangements against the exercise objectives, identify opportunities for improvement and communicate lessons learned. Shell sets Specific, Measurable, Achievable, Realistic and Timely (SMART) objectives for oil spill exercises so that they can be clearly evaluated as being met or not.

An assessor (internal or external) examines the effectiveness of the response arrangements during a spill exercise. They then make written findings and recommendations to Shell, which Shell uses to help identify deficiencies in the response arrangements and to continually improve their overall response readiness.

Recommendations from the tests will have SMART actions added to them, where appropriate, and these actions will be tracked to closure in Sphera (Shell's action tracking system). The Sphera system assigns a responsible person and due date against each action to ensure they are tracked to closure.

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11.1 Shell References

Title	Document Number
Basis for Design Part 3 Execution Requirements	2200-010-AA-7704-00105
Chemical Change Process	HSE_GEN_007879
Chemical Programme Treatment Guide	TEC_PRE_006805
Crux Completions, Hot Commissioning, Start-up and Operations Environment Plan	2200-010-HE-5880-00006
Crux Development Drilling EP	2200-010-HX-5880-00001
Crux Development Drilling Template Installation Environment Plan	2200-010-HE-5880-00004
Crux Installation and Cold Commissioning Environment Plan	2200-010-HE-5880-00002
Crux Management of Change Procedure	2200-010-FA-6180-00001
Crux Seabed Survey Environment Plan	2200-010-HE-5880-00001
Emergency Management Manual	HSE_GEN_010996
Emergency Response Plan	HSE_GEN_011209
Environmental Reporting Procedure	HSE_GEN_003179
HSSE Incident Reporting, Investigation and Follow up Procedure	HSE_GEN_000027
Management of Change Manual	TEC_GEN_001465

Title	Document Number
Offshore Environmental Regulatory Approvals and Compliance Procedure	HSE_GEN_00318
Permit to Work Manual	HSE_PRE_004404
Prelude Facility Emergency Response Plan	HSE_PRE_005612
Shell Browse Regional OPEP (BROPEP)	HSE_GEN_016765
Shell's Browse Regional Operational and Scientific Monitoring Bridging Implementation Plan	HSE_PRE_016370
Shell's WOMP – Crux Development, Well Construction Phase 1	2200-010-ZW-5880-00007
Weekly Contact List	HSE_GEN_011648

12 List of Acronyms

Acronym	Definition
~	Approximately
″	Inch (measurement unit)
<	Less then/fewer than
>	Greater than/more than
≤	Less than or equal to
° C	Degrees Celsius
µg	Micrograms
AAPA	Aboriginal Areas Protection Authority
ABC	Australian Broadcasting Corporation
ABF	Australian Border Force
ABN	Australian Business Number
ABS	Australian Bureau of Statistics
ACCU	Australian Carbon Credit Unit
ACMA	Australian Communications and Media Authority
ACN	Australian Company Number
ACT	Australian Capital Territory
Activity Area	defined as the production licence AC/L10 and pipeline licences WA-33-PL and AC/PL1.
ADB	Asian Development Bank
ADF	Australian Defence Force
ADIOS2	Automated Data Inquiry for Oil Spills
AEP	Australian Energy Producers (formerly Australian Petroleum Production and Exploration Association [APPEA])
AFMA	Australian Fisheries Management Authority
AHO	Australian Hydrographic Office
AHRC	Australian Human Rights Commission
AHT	Anchor Handling Tug
AIATSIS	Australian Institute of Aboriginal and Torres Strait Islander Studies
AIMS	Australian Institute of Marine Science
AIPSM	Asset Integrity & Process Safety Management
AIS	Automatic Identification System
ALARP	As low as reasonably practicable
ALRA	*Aboriginal Land Rights (Northern Territory) Act 1976* (Cth)
AMCS	Australian Marine Conservation Society
AMOP	Arctic and Marine Oil Spill Program
AMOSC	Australian Marine Oil Spill Centre
AMP	Australian Marine Park
AMS	Asset Management System
AMSA	Australian Maritime Safety Authority

Acronym	Definition
ANSI	American National Standards Institute
ANU	Australian National University
ANZECC	Australian and New Zealand Environment Conservation Council
ANZG	Australian and New Zealand Governments
API	American Petroleum Institute
APPEA	Formerly Australian Petroleum Production and Exploration Association Limited (now AEP)
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ARP	Applied Research Program
ARPA	Automatic Radar Plotting Aid
AS	Australian Standard
ASBTIA	Australian Southern Bluefin Tuna Industry Association
ASM	American Society for Microbiology
ASV	Accommodation Vessel
AUD INJ	Auditory Injury
AUV	Autonomous underwater vehicle
AWSG	Australasian Wader Studies Group
BAC	Balanggarra Aboriginal Corporation
BAT	Best Available Techniques
BEP	Best Environmental Practices
BESS	Battery energy storage system
Bg	Becquerel
BIA	Biologically Important Area
BJNAC	Bardi and Jawi Niimidiman Aboriginal Corporation
BOD	Biological Oxygen Demand
BOM	Bureau of Meteorology
BOP	Blowout Preventers
BP	Bollard Pull
BROPEP	Browse Regional Oil Pollution Emergency Plan
BSDG	Black Start Diesel Generator
BTEX	Benzene, toluene, ethylbenzene, xylenes
CA	Conservation Advice
CAES	Catch and Effort System
CALM	Former Western Australian Department of Conservation and Land Management (now DBCA)
CAMBA	China-Australia Bilateral Agreement on the Protection of Migratory Birds
CCTV	Closed-Circuit Television
CEO	Chief Executive Officer
CER	Clean Energy Regulator
CHARM	Chemical Hazard Management Risk Management

Acronym	Definition
CIN	CHARM Implementation Network
CLT	Country Leadership Team
CMMS	Computerised Maintenance Management System
CMPT	Corrective Management Prioritisation Tool
CMT	Crisis Management Team
CO	Carbon Monoxide
CO_2	Carbon dioxide
CO_2-e	Carbon dioxide equivalent
CoA	Commonwealth of Australia
COLREGS	International Regulations for Preventing Collisions at Sea 1972
Commonwealth Waters	Waters stretching from 3–200 nautical miles (5.55–370.4 km) from the Australian coast.
cP	Centipoise
CPT	Cone Penetration Test
CR	Corporate Relations (Shell)
CRA	Corrosion Resistant Alloy
CS	Carbon Steel
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSU	Commissioning & Start-Up
CTA	Cable termination assembly
Cth	Commonwealth
CTU	Coiled tubing unit
DAC	Djarindjin Aboriginal Corporation
DAFF	Commonwealth Department of Agriculture, Fisheries and Forestry
DAM	Discipline Authorities Module
DAWE	Former Commonwealth Department of Agriculture, Water and the Environment (now split into DCCEEW and DAFF)
dB	Decibel
dB PK	The maximum instantaneous sound pressure level, in a stated frequency band, within a stated period. Also called zero-to-peak pressure level. Unit: decibel (dB).
dB re 1 μPa^2s	Unit for cumulative measure related to the sound energy in one or more pulses.
dB re 1 µPa	Unit for sound pressure level and stands for decibels referenced to 1 micropascal
dB re 1 µPa rms @ 1 m	decibels referenced to 1 micropascal Root Mean Square at a distance of 1 metre
dB re 1 μPa^2m^2	Unit for sound pressure level or sound exposure level measured 1 metre from a theoretical point source that radiates the same total sound power as the actual source
dB re 1 μPa^2m^2s	Unit for sound pressure level or sound exposure level measured 1 metre from a theoretical point source that radiates the same total sound power as the actual source
dB SEL_{24h}	Unit for that stands for decibels sound exposure level over a 24-hour period
dBA	A-weighted decibel
DBCA	Western Australian Department of Biodiversity, Conservation and Attractions

Acronym	Definition
DC	Drill Centre
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
DCS	Distributed Control System
DEC	Former Commonwealth Department of the Environment (now DCCEEW)
DEM	Design and Engineering Management
DEMIRS	Western Australian Department of Energy, Mines, Industry Regulation and Safety
DEP	Design and Engineering Publications
DEPWS	Northern Territory Department of Environment, Parks and Water Security
DEWHA	Former Commonwealth Department of Environment Water Heritage and Arts (now DCCEEW)
DFAT	Commonwealth Department of Foreign Affairs and Trade
DGF	Dissolved Gas Flotation
DGV	Default Guideline Values
DHA	Commonwealth Department of Home Affairs
DIFFS	Deck Integrated Fire Fighting System
DISER	Former Commonwealth Department of Industry, Science, Energy and Resources (now DISR)
DISR	Commonwealth Department of Industry, Science, and Resources
DITT	Northern Territory Department of Industry Tourism and Trade
DLV2000	Derrick Lay Vessel 2000
DNP	Director of National Parks (Cth)
DNV	Det Norske Veritas
DO	Dissolved Oxygen
DTA	Direct Toxicity Assessment
DoEE	Former Commonwealth Department of Environment and Energy (now DCCEEW)
DOI	Digital Object Identifier
DoT	Western Australian Department of Transport
DP	Dynamic Positioning
DPAW	Department of Parks and Wildlife
DPIRD	Western Australian Department of Primary Industries and Regional Development
DPLH	Department of Planning Lands and Heritage
DSEWPaC	Former Commonwealth Department of Sustainability, Environment, Water, Population and Communities Energy (now DCCEEW)
DTH	Down the Hole
DVC	Digital Valve Controller
DWER	Western Australian Department of Water and Environmental Regulation
E	East (compass direction)
e.g.	For example
EAAF	East Asian–Australasian Flyway
EC50	A concentration or dose that yields biological effects in 50% of test animals/species
ECE	Environmental Critical Element

Acronym	Definition
eDNA	Environmental DNA
EEZ	Exclusive Economic Zone
EFL	Electrical Flying Leads
EIAPP	Engine International Air Pollution Prevention (certificate)
EMBA	Environment that May Be Affected
ENC	Environmental Non-Compliance
ENE	East-north-east (compass direction)
ENMCS	Electrical Network Monitoring and Control System
ENVID	Environmental Impact Identification
EP	Environment Plan
EPA	Western Australian Environmental Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPO	Environmental Performance Outcome
EPS	Environmental Performance Standard
ER	Emergency Response
ER95%	95th percentile Exposure Range
ERM	Environmental Resources Management (company)
ERP	Emergency Response Plan
ERT	Emergency Response Team
ESD	Ecological Sustainable Development
ESDV	Emergency Shutdown Valve
ESE	East-south-east (compass direction)
ESHIA	Environmental, Social and Health Impact Assessment
ETS	Energy Transition Strategy
EUL	Environment Unit Lead
FCA	Federal Court of Australia
FCAFC	Full Court of the Federal Court of Australia
FCGT	Flood, Clean, Gauge and Test
FFG	Flame front generator
FGS	Fire and Gas System
FLBM	Frontline Barrier Management
FLNG	Floating Liquefied Natural Gas
FMP	Field Management Plan
FOB	Forward Operations Base
FOCT	Fibre-optic Cable Termination
FPSO	Floating Production Storage and Offloading (facility)
FRDC	Fisheries Research and Development Corporation
FSANZ	Australian and New Zealand Food Standard

Acronym	Definition
FSR	Facility Status Report
ft	Foot (measurement unit)
g	Gram
GDA	Geocentric Datum of Australia [GDA] 2020
GFA	Global Framework Agreements
GHG	Greenhouse Gas
GHGEM	Greenhouse Gas and Energy Management
GHGEMP	Greenhouse Gas and Energy Management Plan
GHGEMS	Greenhouse Gas and Energy Management System
GMAS	Group Maritime Assurance System
GRSN	Global Response Support Network (Shell)
GTG	Gas Turbine Generator
HAZID	Hazard Identification
HAZOP	Hazard and Operability
HEI	High Energy Ignition
HEMP	Hazards and Effects Management Process
HEPA	High-Efficiency Particulate Air
HF	High Frequency
HFO	Heavy Fuel Oil
HMA	Hazard Management Agency
HMI	Human Machine Interface
HP	High Pressure
HPLT	High Pressure Leak Testing
hr	Hour
HSE	Health, Safety and Environment
HSSE & SP	Health, Security, Safety, Environment and Social Performance
HVAC	Heating, Ventilation and Air Conditioning
HWU	Hydraulic Workover Unit
Hz	Hertz
i.e.	That is
IAP	Incident Action Plan
IAPP	International Air Pollution Prevention (Certificate)
ICS	Incident Command System
ICSS	Integrated Control and Safeguarding System
ID	Identity/identification
ID	Internal diameter
IEA	International Energy Agency
IEE	International Energy Efficiency (Certificate)

Acronym	Definition
IFO	Intermediate Fuel Oil
ILSC	Indigenous Land and Sea Corporation
ILUA	Indigenous Land Use Agreement
IMCRA	Integrated Marine and Coastal Regionalisation of Australia
IMO	International Maritime Organization
IMR	Inspection, Maintenance and Repair
IMS	Invasive Marine Species
IMSA	Integrity Management System Application
IMT	Incident Management Team
IMT(W)	Incident Management Team (West)
IOC	Integrated Operations Centre
IOGP	International Association of Oil and Gas Producers
IOPP	International Oil Pollution Prevention
IPA	Indigenous Protected Area
IPCC	Intergovernmental Panel on Climate Change
IPIECA	International Petroleum Industry Environmental Conservation Association
IPS	Instrumented Protective System
ISO	International Organization for Standardisation
ISPP	International Sewage Pollution Prevention (Certificate)
ISWAG	Kimberley Indigenous Saltwater Advisory Group
ITOPF	International Tanker Owners Pollution Federation
IUCN	International Union for Conservation of Nature
JAMBA	Japan-Australia Bilateral Agreement on the Protection of Migratory Birds
JASMINE	JASCO Animal Simulation Model Including Noise Exposure
JRCC	Joint Rescue Coordination Centre
JTSI	Department of Jobs, Tourism, Science and Innovation
KALACC	Kimberley Aboriginal Law and Cultural Centre
KDC	Kimberley Development Commission
KEF	Key Ecological Feature
kg	Kilogram
kHz	Kilohertz
KLC	Kimberley Land Council
km	Kilometre
KMTA	Kimberley Marine Tourism Association
KO	Knockout
KP	Kilometre Point
KPI	Key Performance Indicator
kW	Kilowatt

Acronym	Definition
L	Low
L	Litre
L/min	Litres per minute
LAT	Lowest Astronomical Tide
LBL	Long Baseline
LC50	Concentration or dose found to be lethal in 50% of a group of test species.
LDAR	Leak Detection and Repair
LED	Light-emitting Diode
LF	Low Frequency
LNG	Liquefied Natural Gas
LOC	Loss of Containment
LOWC	Loss of Well Control
LP	Low Pressure
LPG	Liquefied Petroleum Gas
LSC	Logistic Section Chief
LSMGO	Low Sulphur Marine Gas Oil
m, m^2, m^3	Metre, square metre, cubic metre
MAC	Managed Asset Care
MAE	Major Accident Event
MARPOL	International Convention for the Prevention of Pollution from Ships, adopted by the International Conference on Marine Pollution, convened by IMO, 1973/78.
MARS	Maritime Arrivals Reporting System
MBC	Maritime Border Command
MBES	Multibeam Echo Sounder
MC	Measurement Criteria
MDO	Marine Diesel Oil
MEE	Major Environmental Event
MEECC	Western Australian Maritime Environmental Emergency Coordination Centre
MEG	Monoethylene glycol
MESA	Marine Education Society of Australasia
Metocean	Meteorological and Oceanographic
mg	Milligram
MGO	Marine Gas Oil
mm	Millimetre
MMPATF	Marine Mammal Protected Areas Task Force
MNES	Matters of National Environmental Significance
MOC	Management of Change
MODU	Mobile Offshore Drilling Unit
MOU	Memorandum of Understanding

Acronym	Definition
MP	Management Plan
MPR	Modular Platform Rig
MQC	Multi-Quick Connect
MRP	Maintenance Reference Plan
MS	Management System
MT	Metric Tonnes
Mt	Million Tonnes
MTAC	Maintenance, Turnaround & Construction
MTO	Manage Threats and Opportunity
MW	Megawatt
MWS	Marine Warranty Surveyor
N	North (compass direction)
NATA	National Association of Testing Authorities
N/A	Not Applicable
NAXA	North Australian Exercise Area
NCI	Net carbon intensity
NDC	Nationally Determined Contribution
NE	North-east (compass direction)
NEPM	National Environment Protection Measures
NERA	National Energy Resources Australia
NGER	National Greenhouse and Energy Reporting
NGO	Non-government Organisation
NIAA	National Indigenous Australians Agency
NLC	Northern Land Council
nm	Nautical Mile
NNE	North-north-east (compass direction)
NNM	Not Normally Manned
NNTT	National Native Title Tribunal
NNW	North-north-west (compass direction)
NO	Nitrogen oxide
NOAA	National Oceanic and Atmospheric Administration (US)
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Administrator
NO_x	Nitrogen oxides, typically expressed as NO_2
NMR	North Marine Region
NPD	Naphthalene, phenanthrene and dibenzothiophene compounds
NPI	National Pollutant Inventory
NSW	New South Wales

Acronym	Definition
NT	Northern Territory
NTRB	Native Title Representative Bodies
NW	North-west (compass direction)
NWCS	North-West Cable System
NWMR	North-West Marine Region
NZS	New Zealand Standard
OCNS	Offshore Chemicals Notification Scheme
OCIMF	Oil Companies International Marine Forum
OD	Outside Diameter
ODS	Ozone depleting substances
OGMP	Oil & Gas Methane Partnership 2.0
OIE	Offset Installation Equipment
OIM	Offshore Installation Manager
OIW	Oil-in-water
OMP	Operational Monitoring Plan
OP	Operating Plan
OPEP	Oil Pollution Emergency Plan
OPGGS Act	Commonwealth *Offshore Petroleum and Greenhouse Gas Storage Act 2006*
OPGGS(E) Regulations	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023
OPP	Offshore Project Proposal
OSC	Operations Section Chief
OSMP	Operational and Scientific Monitoring Plan
OSPAR	Oslo and Paris Convention for the Protection of the Marine Environment of the North-east Atlantic
OSRL	Oil Spill Response Limited
OVID	Offshore Vessel Inspection Database (owned by Oil Companies International Marine Forum)
OWR	Oiled Wildlife Response
PAH	Polycyclic Aromatic Hydrocarbon
PBC	Prescribed Bodies Corporate
PC	Protective Concentration for determined percentage of species e.g. PC80, PC95 and PC99.
PDC	Pilbara Development Commission
PEH	Plantwide Event Historian
PFAS	Per- and polyfluoroalkyl substances
PFW	Produced Formation Water
pH	Measure of acidity or basicity of a solution
PI	define
PIC	Person in Charge
Pig	Pipeline Inspection Gauge

Acronym	Definition
PK	Peak (sound pressure level)
PLET	Pipeline End Termination
PLONOR	Poses Little or No Risk
PM	Particulate Matter
$PM_{2.5}$, PM_{10} etc.	Particulate matter with a diameter of 2.5/10 micrometres or less
PME	Perform Maintenance Execution
PML	Preventative Maintenance Library
PMS	Power Management System
PMST	Protected Matters Search Tool (EPBC Act)
PNEC	Predicted no-effects concentration
POB	Persons on Board
POLREP	Pollution Report
ppb	Parts per billion
ppm	Parts per million
Project Area	Defined in the accepted OPP (NOPSEMA ID: A742335) as the in-field development area (30 km radius around the proposed Crux platform) and export pipeline corridor (1 km buffer either side of the route with a 2 km radius around the Prelude end) encompassing ~314,000 ha.
PSBR	Process Safety Basic Requirements
PSC	Planning Section Chief
PSI	Process Safety Information
PSU	Practical Salinity Units
PSZ	Petroleum Safety Zone
PTM	Proactive technical monitoring
PTS	Permanent Threshold Shift
PTW	Permit to Work
PW	Produced Water
QA	Quality Assurance
QC	Quality Control
Qld	Queensland
RA	Risk Assessment
RAM	Risk Assessment Matrix
RAMSAR	The City, Ramsar
RASCI	Responsibilities, accountability, supporting, consulting, informed
RATSIB	Representative Aboriginal/Torres Strait Islander Body Areas
RBI	Risk Based Inspection
RCC	Rescue Coordination Centre
RESDV	Riser Emergency Shutdown Valve
RFSU	Ready for Start-up
R_{max}	Maximum Range

Acronym	Definition
RNTBC	Registered Native Title Bodies Corporate
RO	Reverse Osmosis
ROKAMBA	Republic of Korea–Australia Migratory Bird Agreement
ROV	Remotely Operated Vehicle
RP	Recovery Plan
RWIS	Relief well injection spool
S	South (compass direction)
s	Second (time)
SAI	Shell Aircraft International
Safeguard Mechanism	National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015 (Cth), National Greenhouse and Energy Reporting Act 2007 (Cth)
SAP	Systems, Applications, and Products (Enterprise Resource Planning software)
SBP	Sub-Bottom Profiler
SBT	Southern bluefin tuna
SCAT	Shoreline Clean-up Assessment Technique
SCE	Safety Critical Element
SCERP	Source Control Emergency Response Plan
SCSSV	Surface-controlled subsurface safety valve
SE	South-east (compass direction)
SEAM	Safety, Environment & Asset Management
SEEMP	Ship Energy Efficiency Management Plan
SEL	Sound Exposure Level
SFL	Steel Flying Leads
SGRAO	Shell Group Requirements for Aircraft Operations
Shell	Shell Australia Pty Ltd
SIMA	Spill Impact Mitigation Assessment
SIMAP	Spill Impact Model Application Package
SIMOPS	Simultaneous Operations
SITREP	Situation Report
SMART	Specific, Measurable, Achievable, Realistic and Timely
SME	Subject Matter Expert
SMEEC	State Maritime Environmental Emergency Coordinator (WA)
SO_2	Sulphur dioxide
SOF	Statement of Fitness
SOLAS	International Convention for the Safety of Life at Sea 1974
SOPEP	Shipboard Oil Pollution Emergency Plan
SO_x	Sulphur oxides
SP	Social Performance
SPF	Shell Performance Framework

Acronym	Definition
SPL	Sound Pressure Level
SSC	Species Survival Commission
SSE	South-south-east (compass direction)
SSIV	Subsea Isolation Valve
SSS	Side-scan Sonar
State waters	The marine environment within 3 nautical miles (5.55 km) of the mainland of Western Australia or its islands
STCW Convention	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978
SURU	Start-up and ramp-up
SW	South-west (compass direction)
t	Tonnes
TDG	Temporary Diesel Generator
TEACA	Top End Aboriginal Coastal Alliance
TEG	Triethylene glycol
TEMC	Territory Emergency Management Council
TI	Technical Integrity
TKN	Total Kjeldahl Nitrogen
TLC	Tiwi Land Council
TPH	Total Petroleum Hydrocarbon
TSS	Total Suspended Solids
TSSC	Threatened Species Scientific Committee
TTS	Temporary Threshold Shift
UCH Act	Commonwealth *Underwater Cultural Heritage Act 2018*
UHF	Ultra-high frequency
UK	United Kingdom
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UPS	Uninterruptable power supply
US/USA	United States/United Sates of America
USBL	Ultra-short Baseline
UTH	Umbilical Termination Head
UTL	Universal Tag Locator
UV	Ultraviolet
UXO	Unexploded Ordnance
VHF	Very high-frequency
VOC	Volatile Organic Compound
VP	Vice President

Acronym	Definition
VSAT	Very small aperture terminal
W	West (compass direction)
WA	Western Australia
WAFIC	Western Australian Fishing Industry Council
WAGFA	Western Australian Game Fishing Association
WAM	Western Australia Museum
WAMSI	WA Marine Science Institute
WAOWRP	Western Australian Oiled Wildlife Response Plan
WCVERT	Well Control Virtual Emergency Response Team
WET	Whole-effluent Toxicity
WGAC	Wunambal Gaambera Aboriginal Corporation
WHO	World Health Organization
WHRU	Waste heat recovery units
WNW	West-north-west (compass point)
WOMP	Well Operating Management Plan
WRFM	Wells, Reservoir, Facility Management
WSW	West-south-west (compass point)
WT	Wall thickness
WWF	World Wildlife Fund

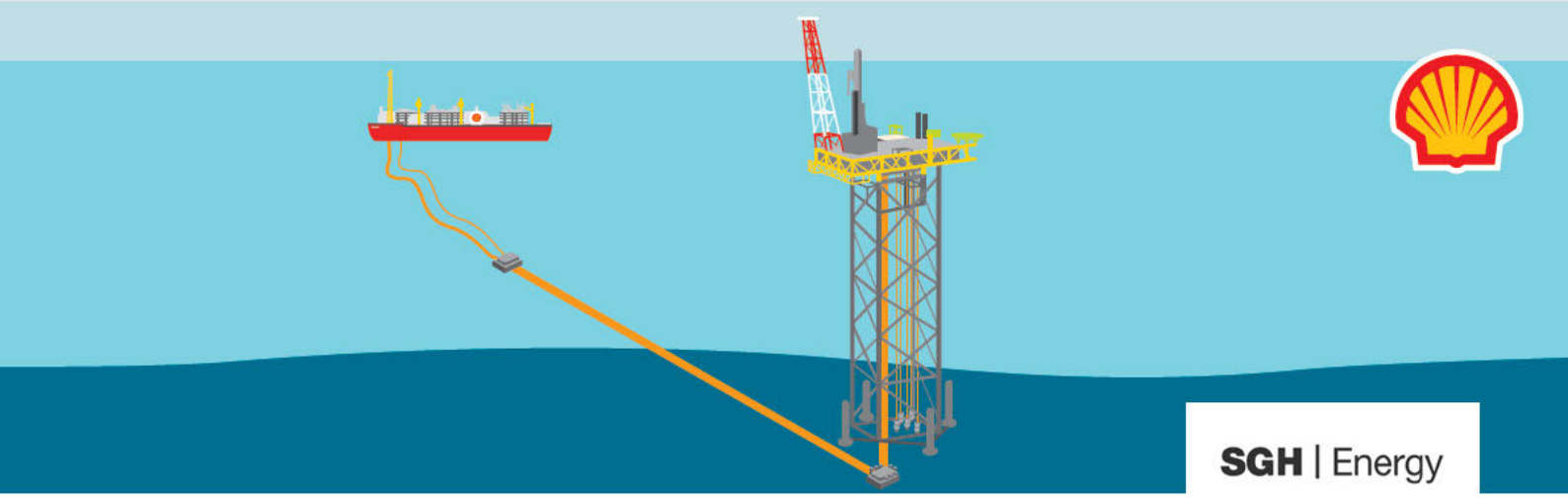
Appendix A Consultation Material

Appendix A - Consultation Material

Crux Completions, Commissioning, Start-up and Operations Environment Plan

Appendix A - Consultation Material – Table of Contents

Content	
1. Information Sheets	1.00 Completions, Commissioning, Startup and Operations Environment Plan Information Sheet **Supporting Information Sheets** 1.01 General Environment Plan Information Sheet 1.02 Cultural and Social Values Information Sheet 1.03 Hydrocarbon Release Information Sheet
2. Information Booklet	2.00 Crux Information Booklet – *distributed in hard copy only.*
3. Maps	3.00 Completions, Commissioning, Startup and Operations Planning Area Map 3.01 Community Map
4. Public Notices	4.00 Crux advertising campaign – proof of placement 4.01 Drop-in session advert • Broome • Derby • Kununurra and Wyndham 4.02 Community information session advert • Broome 4.03 Community Drop-in Session • Broome 4.04 Drop-in session social media post • Broome • Derby • Kununurra and Wyndham
5 Community / Industry Presentations	5.00 Community Briefing - Broome
6 Videos	6.00 Crux Animation Video 6.01 Crux Animation Transcript
7 Indigenous RPs consultation material and emails *Note many in this category were sent a tailored email which is available in the Sensitive Information Report.	7.00 Standard presentation template 7.01 Initial email to Indigenous RPs – April 2024 7.02 Reminder email to Indigenous RPs – June 2024 7.03 Reminder email to Indigenous RPs – August 2024 7.04 Final call to Indigenous RPs – October 2024
8. NOPSEMA	8.00 NOPSEMA Consultation on Offshore Petroleum Environment Plan Brochure
9. Emails to all RPs *(excluding Indigenous RPs)*	9.00 Initial email to all RPs – March 2024 9.01 Reminder email to all RPs – June 2024 9.02 Update email to all RPs – August 2024 9.03 Final call to all RPs – October 2024



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ENVIRONMENT PLAN INFORMATION SHEET: CRUX COMPLETIONS, COMMISSIONING, START UP AND OPERATIONS

Shell Australia is seeking to consult with people in preparation for the Completions, Commissioning, Start up, and Operations Environment Plan/s (EP/s) for the Crux project.

We want to hear from you if your functions, interests, or activities, may be affected by the activities, risks and impacts described in this EP/s, or if you have cultural heritage interests, or if you know someone else who may be affected.

ABOUT CRUX

The Crux project forms an important part of Shell Australia's gas portfolio and will be backfill for the existing Prelude Floating Liquefied Natural Gas (FLNG) facility. The project consists of a not normally attended platform with five production wells, in ocean waters approximately 165m deep. The facility will be connected to the Prelude FLNG facility via a 160km export pipeline and will be operated remotely from Prelude.

The project is being progressed by operator Shell Australia in joint venture with SGH Energy.

EP Feedback

Feedback we receive from you will be documented in the EP when submitted to NOPSEMA for assessment. Once accepted, the EP will be published online. You may request that sensitive information you provide is not published.

Shell Australia respectfully acknowledges the many Traditional Owner groups of the lands and waters on which we operate and pay our respect to the Elders past, present and emerging.

Location:

Browse Basin, 190km offshore north-west Australia and 620km north-east of Broome.

Offshore petroleum titles:

In Commonwealth Waters and the Territory of Ashmore and Cartier Islands. Petroleum title AC/L10 and pipeline licenses AC/PL1 and WA-33-PL.

Proposed activity:

This Crux EP covers:

- well completions and clean-up of the five production wells
- hot commissioning, startup and ramp-up, and
- production operations.

Water depth:

- ~165m
- At pipeline: ~165-280m

Designed production rates:

550 million standard cubic feet of gas and condensate (approximately 2.9 million tonnes per year equvalent LNG).

Timing:

Activities are planned to commence in 2026.

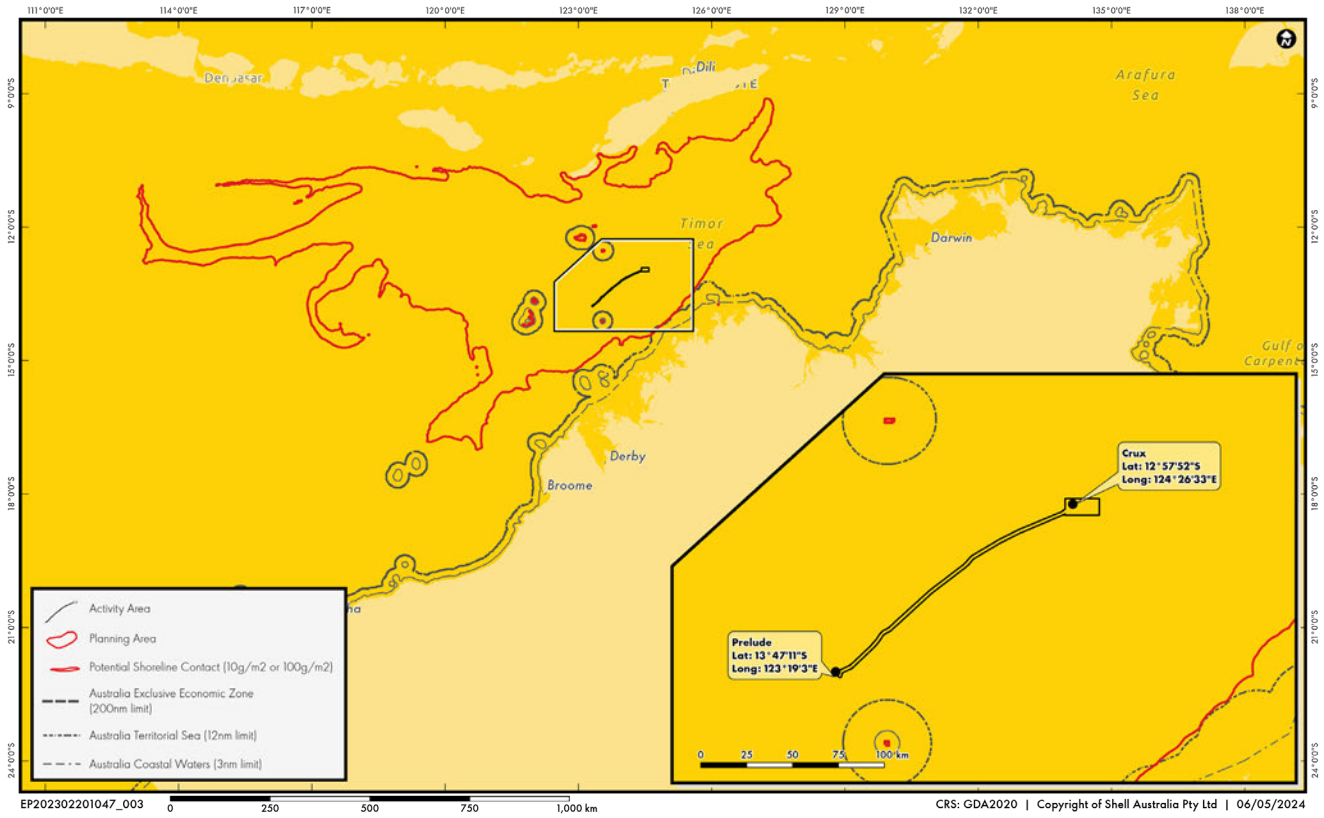
Duration:

Well completions and clean-up of the five production wells, hot commissioning and startup are planned for 2026 to 2027.

Production operations will be ongoing from 2027.

CONTACT US Community Hotline: 1800 059 152 Email: SDA-crux-project@shell.com www.shell.com.au/crux

Shell Australia welcomes any feedback on Environment Plan submissions, including requests for further information.
If you have functions, interests or activities that may be affected, or you know someone else who might have, Shell Australia invites you to get in touch.
For further information about our consultation obligations under the Offshore Petroleum and Greenhouse Gas Storage Act 2006, visit www.nopsema.gov.au



THE PLANNING AREA

This is the largest area where the Crux Completions, Commissioning, Start-up, and Operations activity could have a direct or indirect environmental or socio-economic impact.

In an unplanned scenario, the planning area represents the total area that a spill could travel along many possible pathways depending on surface conditions, currents, and weather at the time of an incident. These combined pathways are developed using sophisticated spill modelling, and the planning area boundary captures the greatest extent of the hundreds of potential release pathways produced by the modelling software.

In the highly unlikely event of one of these scenarios occurring, only a small part of the planning area would be impacted. Understanding the greatest extent of a release ensures Shell Australia has appropriate response plans in place.

Shell continues to undertake modelling work to understand unplanned impacts related to this EP.

ENVIRONMENTAL APPROVALS

Before Shell commences substantial work on major projects or existing facilities, regulatory, environmental, and social impacts are assessed, alongside commercial and technical considerations.

The purpose of this consultation is to give you an opportunity to provide input into:

- our understanding of the existing environment which may be affected by Shell's proposed activities, including the cultural features of that environment;
- how our activities might impact the existing environment (including its cultural features); and
- how controls and mitigation measures may be adopted to reduce the environmental impacts and risks associated with the proposed activities.

The Crux Offshore Project Proposal was accepted in August 2020 by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) and is publicly available on the NOPSEMA website.

NOTIFICATION TO MARINERS

A 500 m Petroleum Safety Zone has been established under the *Offshore Petroleum and Greenhouse Gas Storage Act (2006)* and administered by NOPSEMA around the Crux platform. This zone is marked on all relevant marine navigation charts issued through the Australian Hydrographic Office. A notice to mariners will be issued via the Australian Hydrographic Office in advance of any activities, detailing the Petroleum Safety Zone and associated restrictions of entry.

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ACTIVITY DESCRIPTION

The activities include:

- **Completions: the process of cleaning up and making the five wells ready for production after drilling operations.**

  This will be undertaken using a hydraulic workover unit which is installed temporarily on the platform. Each well will be tied back by one or more tubulars (steel pipe used to drill the well, case the wellbore, and produce the reservoir fluids) and a surface wellhead system (providing the interface between the wellbore and the platform that allows gas to be extracted and transported to the surface).

  A valve which prevents blow outs (called a Blowout Preventor) will be installed, well suspension plugs will be recovered, and production tubing installed.

  A hole will be made in a section of the well to allow gas to flow into the well. The well can then be cleaned up and tested using dedicated equipment to remove non-hydrocarbon fluids and solids from the well and reservoir.

- **Hot commissioning and startup: the process of testing systems with gas to ensure they work as planned.**

  This will be carried out using gas from Prelude. Once tested, gas production rates will be slowly increased to system capacity.

- **Operations: the process of operating the wells to meet production requirements.**

  The process system on the platform receives the incoming reservoir fluids, dehydrates the gas, and removes water from the liquids component of the reservoir fluids. Dry gas and condensate are transported to Prelude through the export pipeline whilst the separated water is treated and discharged.

  This phase will have periodic maintenance visits, turn arounds and potential platform brownfield modifications such as addition of an accommodation module.

  Contingent activities during this phase may include well workovers and other activities required in order to maintain production of the Crux reservoir.

- Remote Operations

  The transition to remote operations is expected to take approximately 12 months from start-up. Until then, there will be varying requirements for personnel on the platform:

  - **Well completions, commissioning, and start-up activities**: an operational team will be required. The facility is designed that it can use a walk-to-work vessel for accommodation.
  - **Early operations phase**: personnel will provide operational and maintenance support until the platform facilities are operating reliably.
  - **Interim operations model**: once facilities are operating reliably, the number of personnel will be reduced to undertake field operations and maintenance.
  - **Not normally attended**: once reliable remote operations are achieved, the platform may be visited during planned campaigns and other maintenance activities.

ENVIRONMENTAL MANAGEMENT

Aspect	Control
Physical presence, vessel movements and seabed disturbance	▪ Australian Hydrographic Office Notice to Mariners. ▪ 500 m Petroleum Safety Zone implemented. ▪ All project vessels operating within the activity area will adhere to navigation safety requirements within the International Regulations for Preventing Collisions at Sea 1972 (COLREGS), Chapter 5 of The International Convention for the Safety of Life at Sea 1974 (SOLAS Convention), International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW Convention), the Navigation Act 2012 and any subsequent Marine Orders, which specify standards for crew training and competency, navigation, communication, and safety measures. ▪ Maintenance of a minimum 1 km buffer from shoals and the activity area. ▪ Vessels will adhere to the requirements of the EPBC Regulations Part 8.1 – Interacting with cetaceans, (except in emergency conditions or when maneuvering is not possible). ▪ Vessels used for inspection, maintenance, and repair will not anchor under routine operations ▪ Wet parked items will be tracked and removed from the seabed

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Aspect	Control
Noise	▪ Maintenance of a minimum 1 km buffer from shoals and the activity area. ▪ EPBC Regulations Part 8.1 – Interacting with cetaceans.
Light	▪ Lighting limited to the minimum required for navigational and safety requirements, except for emergency events.
Utility discharges	▪ All planned discharges from vessels will comply with relevant requirements of MARPOL 73/78, the Navigation Act 2012, Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and any subsequent Marine Orders requirements. ▪ Platform deck drainage will be treated through an oil water separator before discharge overboard. ▪ Offshore discharge of sewage from vessels will be in accordance with Marine Order 96. ▪ Vessel food wastes will be macerated to < 25 mm particle size whilst operational prior to discharge to sea, in accordance with Marine Order 95. ▪ Where there is the potential for loss of primary containment of oil and chemicals on the platform or vessels, bunding or drainage systems are in place to contain spills.

Produced water discharge	▪ Prior to discharge, produced water will be treated to reduce dispersed oil.
	▪ Marine discharges managed according to regulatory requirements.
	▪ Oil-in-water concentrations will be monitored by an online analyser and the discharge rate will be measured using a flow meter.
	▪ The discharge limit for dispersed oil will be a 24-hour average of 30 mg/L. Should this limit be exceeded, the water will be manually diverted inboard for reprocessing. Exceptions for specific, non-routine periods are planned to be allowed for, not exceeding a discharge limit of 95 mg/l 24-hour average of dispersed oil in water.
	▪ Shell's Chemical Management Process will be used to ensure the level of impact is acceptable and ALARP.
	▪ Produced water sample testing will include:
	  ▪ chemical characterisation
	  ▪ whole effluent ecotoxicological testing.
	▪ Adaptive management will be put in place should results from the monitoring program meet thresholds for further action.

Chemical discharges	▪ Shell's Chemical Management Process will be used to ensure the level of impact is acceptable and ALARP.
Atmospheric emissions	▪ Facility designed to be an inherently minor source of atmospheric emissions. ▪ Vessels comply with relevant requirements of the International Convention for the Prevention of Pollution from Ships (MARPOL) and associated regulations. ▪ Relevant vessels to have a valid International Air Pollution Prevention Certificate. ▪ Use of low sulphur fuel.
Greenhouse gas emissions	▪ Comply with the National Greenhouse and Energy Reporting Act (2007) and National Greenhouse and Energy Reporting Regulations (2008). ▪ Comply with safeguard mechanism requirements as they apply to Crux. ▪ Comply with International Convention for the Prevention of Pollution from Ships (MARPOL) requirements and associated regulations. ▪ Greenhouse gas and energy management plan implemented from Operate phase onwards to reduce emissions to as low as reasonably practicable (ALARP) and acceptable levels. This includes monitoring of all GHG emissions sources and an annual review of measures to further reduce GHG emissions to ALARP. ▪ Maintain flare to maximise efficiency of combustion.

Waste management	▪ Comply with regulatory requirements for the prevention of marine pollution and handling of hazardous wastes.
	▪ Where retrieval is not reasonably practicable and/ or safe, material items (property) lost to the marine environment will undergo an impact assessment and will be added to the inventory for the title.
	▪ Solid waste/equipment dropped to the marine environment will be recovered where safe and practicable to do so.
	▪ Waste management procedure implemented that provides for:
	  ▪ waste segregation
	  ▪ safe handling and transportation
	  ▪ appropriate waste classification
	  ▪ disposal, and recycling at licensed waste facilities.
	▪ Discharge of waste from vessels will comply with relevant International Convention for the Prevention of Pollution from Ships (MARPOL) requirements and associated regulations.

Emergency events	▪ Well Operations Management Plan in place for all wells. ▪ Environment Plan and Oil Pollution Emergency Plan in place. ▪ Operational and Scientific Monitoring Plan. ▪ Maintenance management system. ▪ Simultaneous operations management plans where required. ▪ Safety case in place prior to commencing operations. ▪ Shell Source Control Emergency Response Plan. ▪ Align with relevant International Convention for the Prevention of Pollution from Ships requirements and subsequent regulations. ▪ Valid Shipboard Oil Pollution Emergency Plan or Shipboard Marine Pollution Emergency Plan (as appropriate for vessel classification). ▪ Spill kits positioned around vessels and the platform (near potential spill points such as transfer stations) ▪ Implementation of national and international regulations and conventions for collision prevention, safety, and navigation at sea. ▪ Offshore Vessel Inspection Database process.
Introduction of invasive marine species from vessels	▪ Ballast water exchange operations will comply with the international conventions and associated national regulations. ▪ Biofouling management for vessels in accordance with state, national and international biofouling management requirements. ▪ Biofouling management in compliance with state and commonwealth regulations. ▪ Vessels (of appropriate class) will have a valid International Anti-Fouling System Certificate. ▪ Maintenance of a minimum 1 km buffer from shoals.

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ENVIRONMENT PLAN GENERAL FACT SHEET

SHELL AUSTRALIA

Shell has operated in Australia for over 120 years. From operating Australia's first oil refinery, which was central to meeting Australia's fuel needs, to fuelling the first Qantas commercial flight in the 1920s, to playing a foundation role in building some of Australia's largest and most innovative natural resource developments - as the energy needs of Australia have changed, so have we.

Today, we are a leading natural gas producer and are playing our part in the transition to a low-carbon future by investing in the power sector, renewable energy solutions and carbon abatement activities.

WHAT IS AN ENVIRONMENT PLAN (EP)?

An Environment Plan, or EP, outlines all the environmental impacts and risks of an activity and how these are managed to minimise impacts and risks to the environment. It is required by the Australian Government regulator the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for acceptance, prior to starting an offshore oil and gas activity.

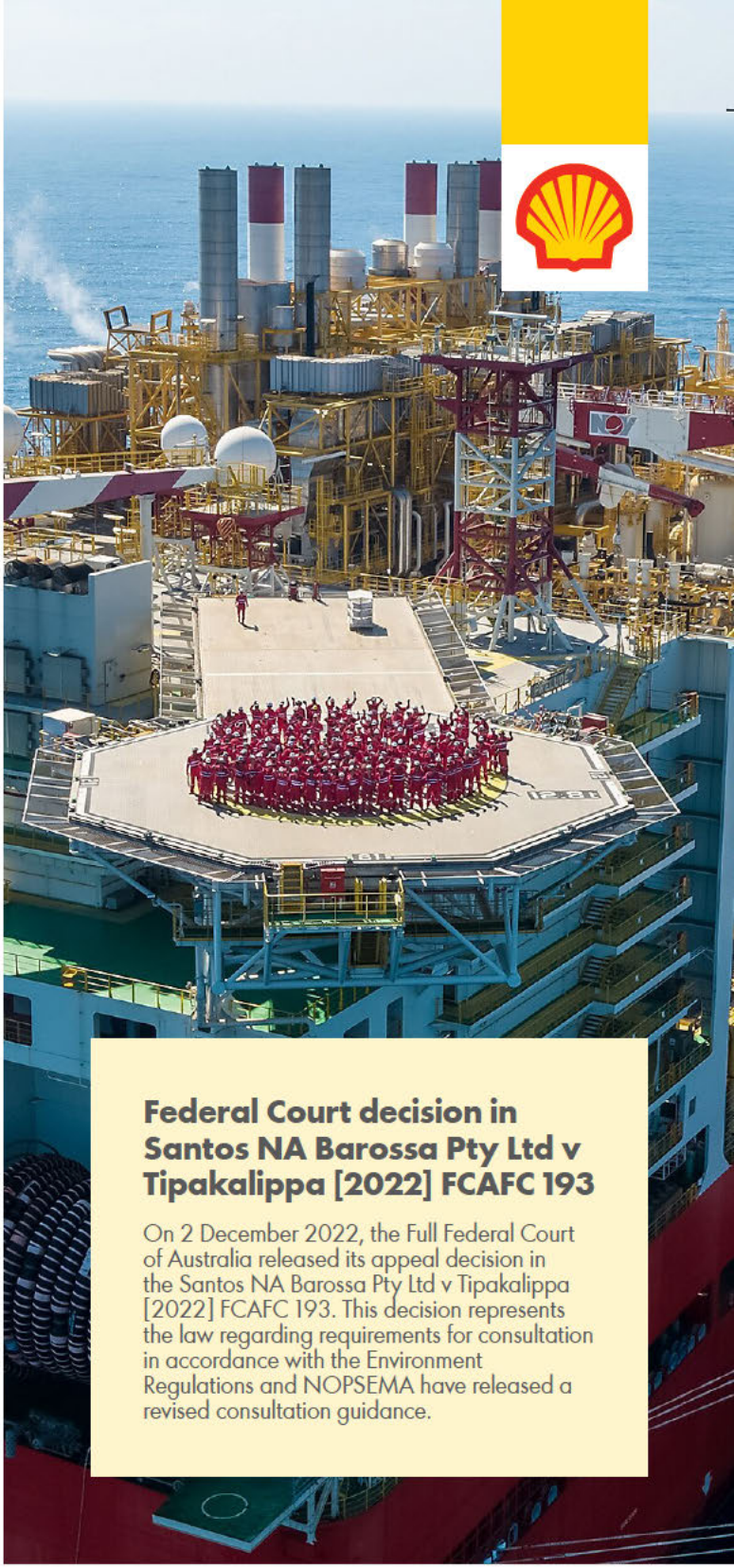
CONSULTATION IS KEY TO THE EFFECTIVE DEVELOPMENT OF AN EP

Guidelines for consultation are outlined in the Offshore Petroleum and Greenhouse Gas Storage Environment Regulation 11A.

The purpose is to ensure that authorities, persons or organisations that are potentially affected by oil and gas activities are consulted, and their input considered in the development of an EP.

Consultation is designed to ensure that relevant persons are identified and given sufficient information and a reasonable period to allow them to make an informed assessment of the possible consequences of the proposed petroleum or greenhouse gas activity on them. It is also intended to help inform a better understanding of the environment.

Shell Australia must consider and adopt appropriate measures in response to the matters raised by relevant persons. These actions will in turn inform the management of environmental impacts and risks to which the activity and EP relate.



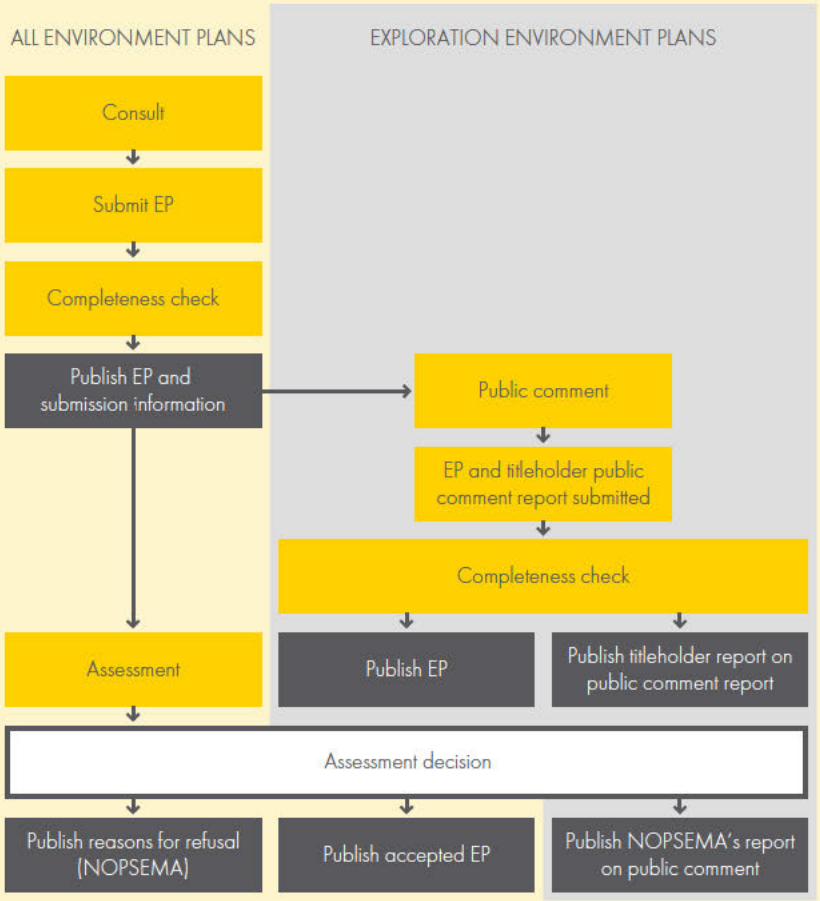
Federal Court decision in Santos NA Barossa Pty Ltd v Tipakalippa [2022] FCAFC 193

On 2 December 2022, the Full Federal Court of Australia released its appeal decision in the Santos NA Barossa Pty Ltd v Tipakalippa [2022] FCAFC 193. This decision represents the law regarding requirements for consultation in accordance with the Environment Regulations and NOPSEMA have released a revised consultation guidance.

National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA)

The National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) is Australia's independent expert regulator for health and safety, structural (well) integrity and environmental management for all offshore energy operations and greenhouse gas storage activities in Commonwealth waters, and in coastal waters where regulatory powers and functions have been conferred.

NOPSEMA'S ASSESSMENT PROCESS FOR EPS



FEEDBACK

At Shell, we recognise the environmental, heritage, social, cultural, and economic values of the region. Shell has undertaken extensive surveys, studies, and a comprehensive review of available information in order to understand and detail the sensitivities and values within the region.

We welcome and seek feedback from relevant persons on our understanding of these values. We are committed to working with relevant persons as part of our ongoing efforts to engage and improve our understanding of the sensitivities and values of the region. Additionally, values and sensitivities are assessed during the risk and impact assessments for any project. Shell will demonstrate how those impacts and risks will be reduced to a level that is as low as reasonably practicable through additional control measures and/or project modifications.

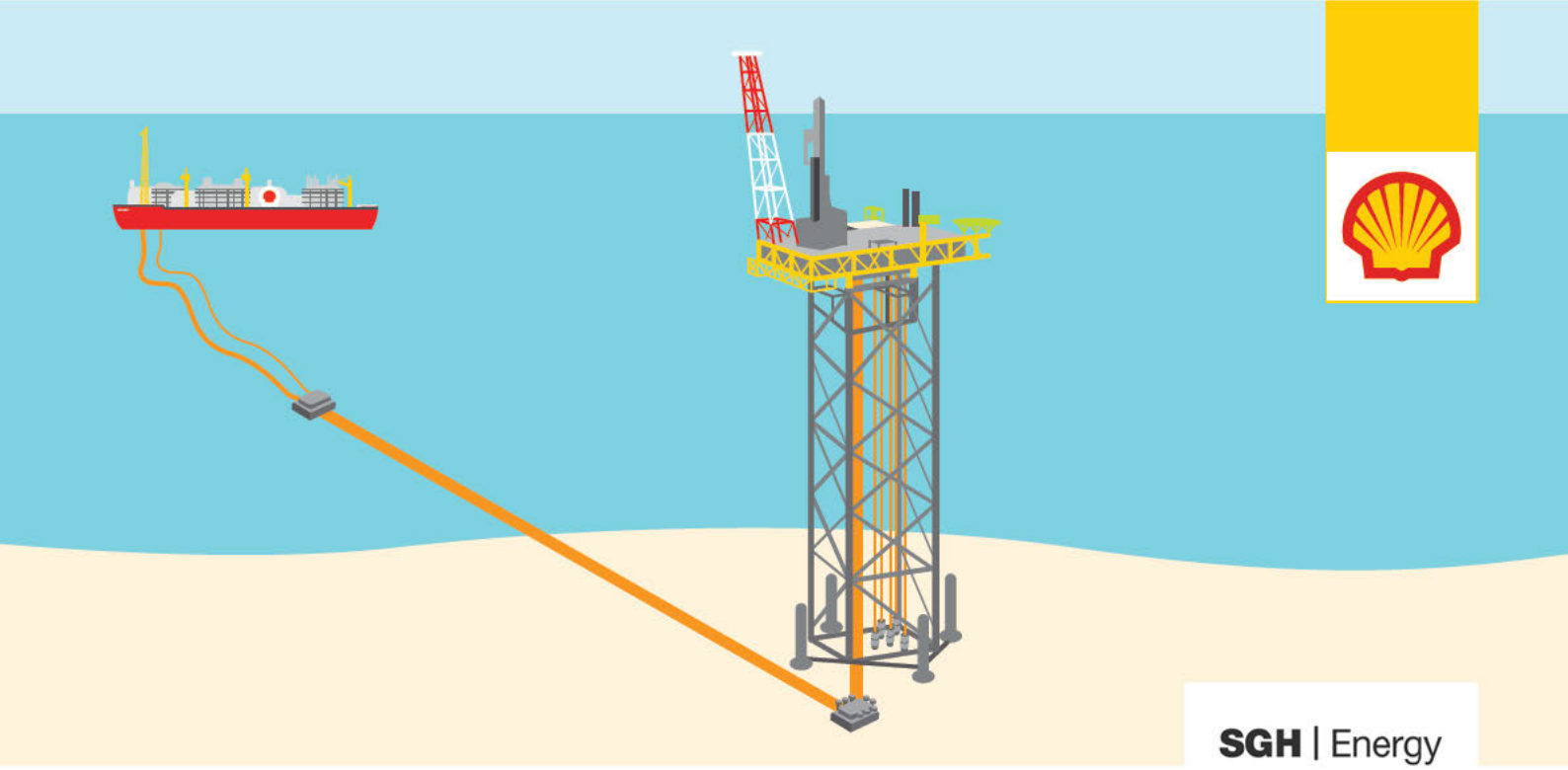
Shell welcomes any feedback, including requests to receive further information. If you have functions, interests or activities that may be affected by any of our projects, Shell Australia invites you to get in touch.

GLOSSARY

Term	Definition
Functions	Refers to "a power or duty to do something"
Activities	To be read broadly and is broader than the definition of 'activity' in regulation 4 of the Environment Regulations and is likely directed to what the relevant person is already doing
Interests	To be construed as conforming with the accepted concept of "interest" in other areas of public administrative law includes "any interest possessed by an individual whether or not the interest amounts to a legal right or is a proprietary or financial interest or relates to reputation"
Reasonable Period	The titleholder must allow a relevant person a reasonable period for the consultation.
Sufficient Information	For the purpose of the consultation, the titleholder must give each relevant person sufficient information to allow the relevant person to make an informed assessment of the possible consequences of the activity on the functions, interests or activities of the relevant person.
Relevant Persons	In the course of preparing an environment plan, or a revision of an environment plan, a titleholder must consult each of the following (a relevant person): a) each Department or agency of the Commonwealth to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant; b) each Department or agency of a State or the Northern Territory to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant; c) the Department of the responsible State Minister, or the responsible Northern Territory Minister; d) a person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the environment plan, or the revision of the environment plan; e) any other person or organisation that the titleholder considers relevant.

CONTACT US Community Hotline: 1800 059 152 Email: SDA-crux-project@shell.com **www.shell.com.au/crux**

If you have functions, interests or activities that may be affected by any of our projects, Shell Australia invites you to get in touch.



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EXISTING ENVIRONMENT CULTURAL AND SOCIAL VALUES SUMMARY

ABOUT CRUX

The Crux project forms an important part of Shell Australia's gas portfolio and will be backfill for the existing Prelude FLNG facility. The project consists of a not normally manned platform with five production wells, in ocean waters approximately 165m deep. The facility will be connected to Prelude via a 160km export pipeline and will be operated remotely from the Prelude FLNG facility.

The project s being progressed by operator Shell Australia n jo nt venture with SGH Energy

As part of the project's approvals process Shell is required to identify the cultural and environmental values of the Prelude-Crux Planning Area which may be affected by Shell's activities.

At Shell, we recognise the importance of environmental, heritage, social, cultural, and economic values

Shell has undertaken comprehensive surveys, studies and a review of available information to understand and detail the sensitivities and values within the region

We will demonstrate how these impacts and risks wil be reduced to a level that is as low as reasonably practicable through additional control measures, seeking first to avoid and then minimise impacts.

We are committed to working with relevant persons as part of our ongoing efforts to engage and improve our understanding of the sensitivities and values of the region and welcome and seek feedback on these.

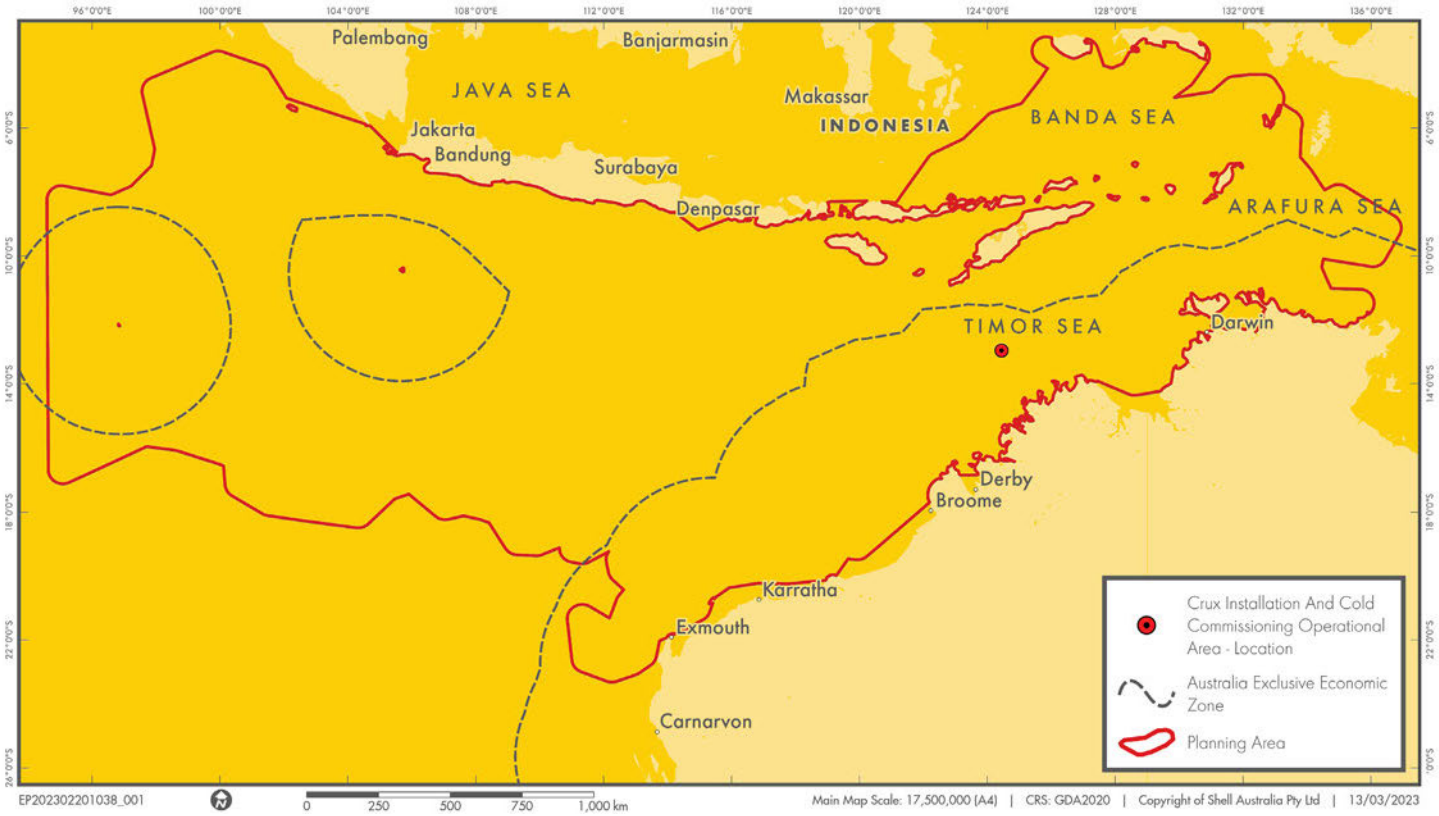

Figure 1: The planning area

THE PLANNING AREA

This is the largest area where the Crux Project could potentially have direct or indirect environmental impacts, as a result of an unplanned hydrocarbon spill. The planning area includes both inshore (State and Territory) and Commonwealth waters, as well as the claimable continental shelf beyond the Exclusive Economic Zone (Figure 1). The planning area extends to the highwater mark.

The planning area represents the total area of many possible pathways that a spill could travel, depending on sea surface conditions, currents and weather at the time of an incident. These combined pathways are developed using hydrocarbon release modelling, and the planning area boundary captures the greatest extent of hundreds of potential release pathways produced by the modelling software.

This means that in the highly unlikely event of one of these scenarios occurring, only a small part of the planning area would be impacted. Understanding the greatest extent of a release allows Shell to ensure that it has adequate response plans to effectively respond.

IDENTIFICATION OF CULTURAL AND SOCIAL VALUES

To understand the cultural and social values of the planning area, information on ecosystems and human activities in the planning area were gathered across the following themes:

- Biological and physical characteristics – identifying the biologically important areas and key ecological features
- Protected areas - including world, commonwealth, state and territory protected areas, Indigenous protected areas and their associated values
- Human activities - including recreational, commercial and research activities
- Community values and aspirations - cultural and social
- Indigenous values and aspirations and connection to land and sea Country
- Indigenous functions and activities with reference to land ownership (i.e., Native Title), Indigenous land, sea and resource management and use.

CULTURAL AND SOCIAL VALUES

The table below provides a summary of the key cultural and social values that exist within the planning area.

Cultural and Social Values	Description
Indigenous Culture	Indigenous peoples have connection to different and overlapping geographic locations within the planning area. Common cultural values link groups to land and sea. These values include an understanding that all natural features, flora and fauna, and marine processes (tides) are the result of journeys and actions taken by ancient creation ancestors. The planning area includes an extensive sea area. Sea country is equally important to Indigenous people as land country. Many of the Indigenous peoples along the Western Australia (WA) and Northern Territory (NT) coastline are saltwater people who have an intimate connection to the sea and associated marine and coastal habitats. For saltwater people all aspects of social, cultural, and economic life are intimately connected to the health of their lands and seas. Features such as reefs and shoals, and marine animals such as sawfish, turtle, whale and dolphin are elements of sea country that are deeply ingrained in Indigenous people's culture, including creation stories. Many of the marine and freshwater fauna species are totemic featuring in art, craft and stories. Connection to sea country is accompanied by cultural rights and responsibilities some of which have been recognized through Native Title determinations, the creation of Indigenous Protected Areas, and Land Trusts in WA and NT. Database searches identified more than 2000 coastal Aboriginal heritage places in WA that overlap with the planning area. These Aboriginal heritage sites include shell middens, fish traps, stone artefacts, stone arrangements and rock paintings and carvings (incl. petroglyphs).
Indigenous Land and Sea Resource Use	Contemporary Indigenous land and sea resource use within the planning area includes: ▪ Hunting and fishing for consumption, cultural and ceremonial purposes ▪ Collection of resources for medicinal and cultural purposes ▪ Commercial resource harvesting ▪ Land and sea management activities conducted by land and sea ranger groups across WA and NT.
Native Title	Native Title determinations within WA and the NT overlap with the planning area. These determinations include both land and sea areas. There are also a number of registered Native Title claims and Indigenous Land Use Agreements overlapping with the planning area.
Conservation Values and Sensitivities	The planning area includes the Ningaloo Coast and the Shark Bay World Heritage Areas, and the tentatively listed Murujuga Cultural Landscape World Heritage Area. Commonwealth, State and Territory protected areas overlap the Planning Area and include several Australian marine parks, biologically important areas, Indigenous Protected Areas, Ramsar wetlands, parks and reserves. These protected areas contain environmental and cultural values of significant interest, importance and value to individuals and communities including Indigenous peoples. Maritime archaeological heritage sites (e.g., shipwrecks), protected under national heritage, and state and local heritage legislation, are also located within the planning area.
Communities	There are many regional centres and remote communities, including Indigenous communities and outstations located along the coastline of the mainland and on islands located within or close to the planning area. Key regional communities include Exmouth, Port Headland, Broome, and Darwin.
Commercial Fisheries	Commercial fisheries overlap the Planning Area and include Commonwealth, WA and NT fishers. Fisheries activities in the planning area include net and line fishing as well as pearling and aquaculture. Indigenous commercial fishing activities are also undertaken in the planning area.
Commercial tourism activities	Protected areas in the planning area support a diverse range of nature-based recreational and tourism activities. Commercial tourism activities undertaken within the planning area include diving, snorkelling, sailing and kayaking, fishing, whale watching and sunset cruising. Nearby land-based activities include birdwatching and chartered tours of coastline areas. Indigenous based commercial tourism activities also occur within the planning area and include on-country experiences, camping with custodians, guided tours of land and sea, marine based fishing experiences. Tourism accommodation operations are located along the mainland coastline and on some islands within or close to the planning area. Many accommodation providers offer marine based tourism activities (for example charter fishing activities) to guests.
Recreational activities	Camping, fishing, beach combing, swimming, snorkelling, diving and kayaking, sailing and bird watching activities are undertaken within or close to the planning area. Many recreation-based interest groups (e.g. fishing, sailing and surf lifesaving clubs) conduct activities that overlap with the planning area

CONTACT US Community Hotline: 1800 059 152 Email: SDA-crux-project@shell.com **www.shell.com.au/crux**

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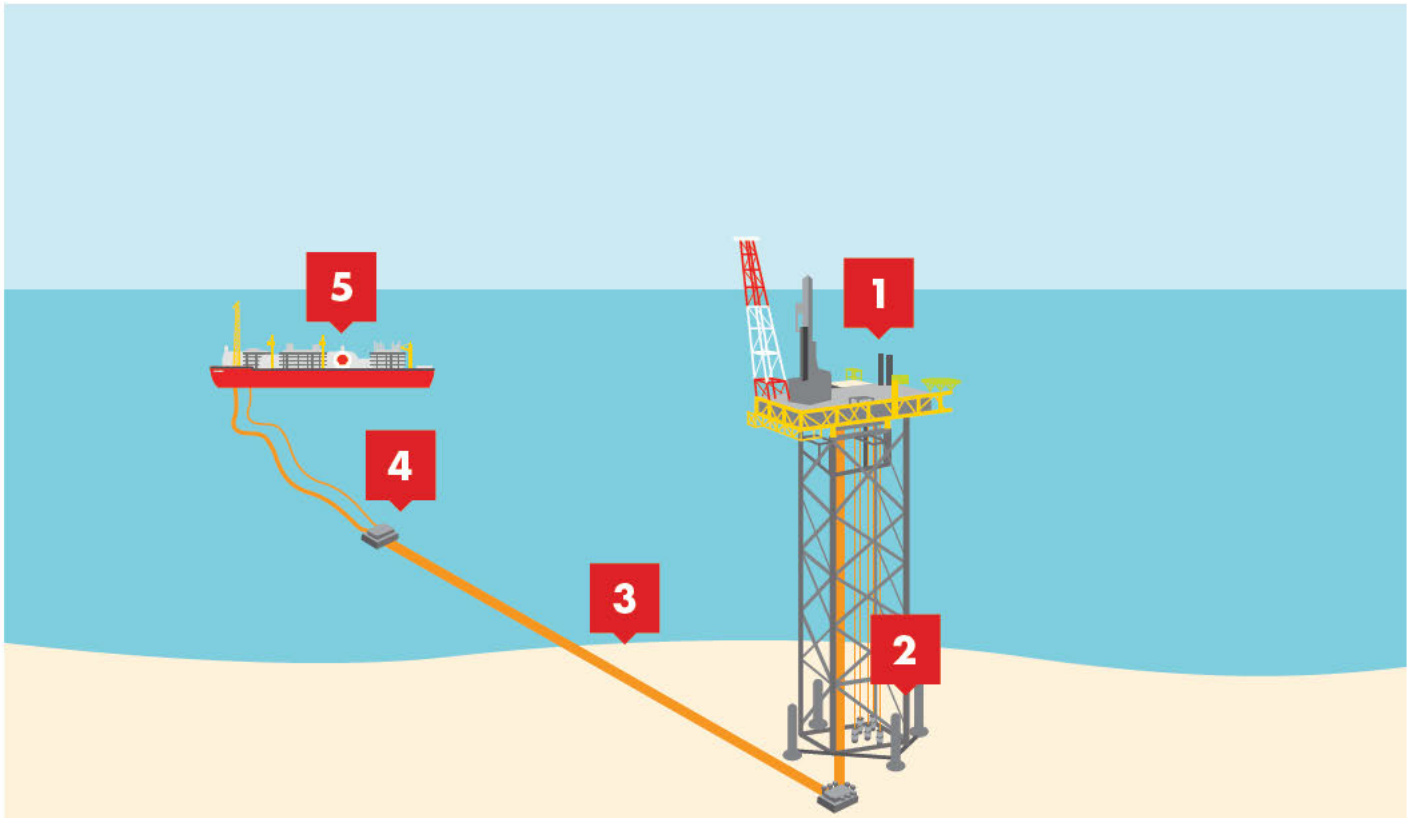
CRUX HYDROCARBON RELEASE FACTSHEET

ABOUT CRUX

The Crux project forms an important part of Shell Australia's gas portfolio and remains an important backfill opportunity for the existing Prelude FLNG facility. The project consists of a not normally manned platform with five production wells, in ocean waters approximately 165m deep. The facility will be connected to Prelude via a 160km export pipeline and will be operated remotely from the Prelude FLNG facility.

The project is being progressed by operator Shell Australia in joint venture with SGH Energy.



1

A NOT NORMALLY MANNED PLATFORM which includes dry trees, minimal processing facilities and associated utility systems.

2

5 PRODUCTION WELLS connected to the Not Normally Manned Platform for completions, perforations, unloading and future operations.

3

AN EXPORT PIPELINE approximately 165km long, which lies in the Crux platform back to the Prelude FLNG facility.

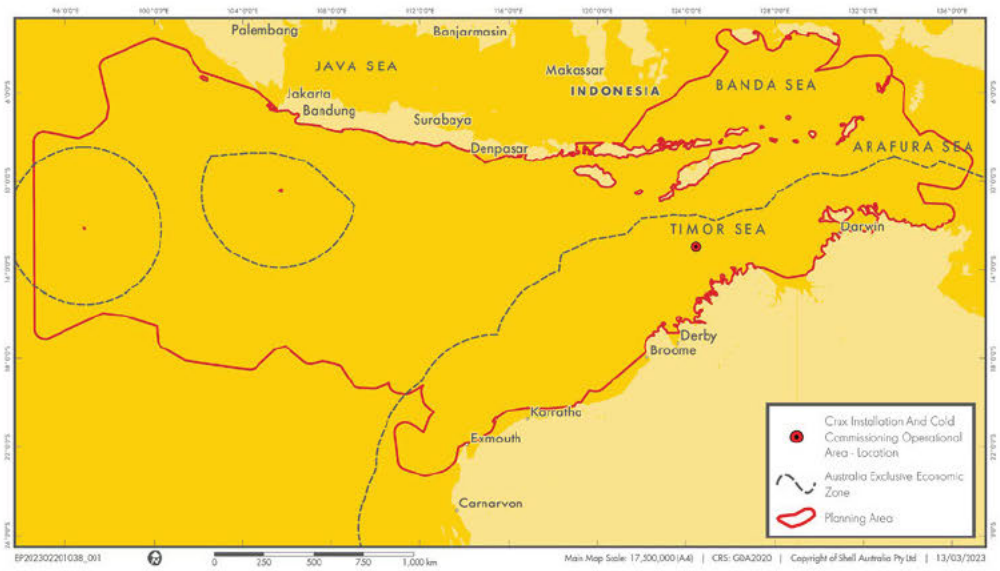
4

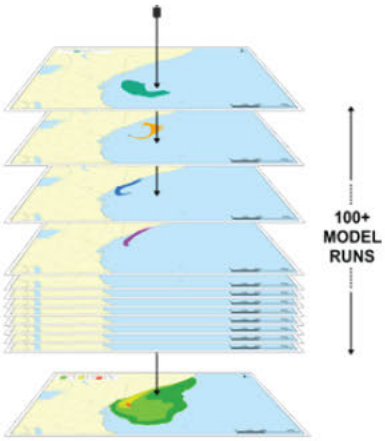
SUBSEA TIE-IN SYSTEM connecting the export pipeline system between the Crux Not Normally Manned Platform and the Prelude FLNG facility.

5

REMOTE OPERATIONS the Crux Platform is connected to and remotely operated from the Prelude FLNG facility.

Concept Schematic of the Crux Project





THE PLANNING AREA

This is the largest area where the Crux Project could potentially have a direct or indirect environmental impact, as a result of:

- loss of well control during drilling and operations
- loss of process storage tank containment on the Crux platform
- loss of subsea containment from the export pipeline, or
- loss of fuel from a vessel.

The planning area represents a combined area of many possible pathways that a spill could travel, depending on sea surface conditions, currents and weather at the time of an incident. These combined pathways are developed using a computer model, and the planning area boundary represents the greatest extent of the hundreds of potential release pathways produced by the modeling software.

This means that in the highly unlikely event of one of these scenarios occurring, only a small part of the planning area would be impacted. Understanding the greatest extent of a release allows Shell to ensure that it has adequate response plans to effectively respond.

SUMMARY OF THE MODELED HYDROCARBON SPILL SCENARIOS

SCENARIO	LOCATION NAME	LATITUDE	LONGITUDE	DEPTH (M)	HYDROCARBON TYPE	DURATION	TOTAL VOLUME (M^3)
LOSS OF WELL CONTROL	Platform	12° 57′ 12.46″	124° 26′ 33.21″	169	Crux condensate	80 days	206,225
LOSS OF PROCESS TANK CONTAINMENT ON CRUX PLATFORM	Platform	12° 57′ 12.46″	124° 26′ 33.21″	Surface	Crux condensate	Instant	88
LOSS OF CONTAINMENT FROM EXPORT PIPELINE	Near Haywood Shoal - export pipeline	13° 15′ 29.00″	123° 54′ 39.00″	199	Crux condensate	< 6 hours	2,037
LOSS OF FUEL FROM VESSEL	Platform	12° 57′ 12.46″	124° 26′ 33.21″	Surface	IFO - 180	1 hour	1,000

RISK MANAGEMENT

Shell has extensive experience with safe and environmentally responsible drilling and reservoir engineering worldwide and safe design and operation of subsea pipelines. Shell has developed a detailed understanding of the Crux field through historical seismic surveys and drilling.

The oil and gas industry routinely implements a range of design standards and operational inspections to ensure pipeline and infrastructure integrity. This is reflected in the very low likelihoods of significant hydrocarbon releases from pipelines in jurisdictions similar to Australia.

Australian regulations require that all environmental risks be managed to a level that is "as low as practically possible" and acceptable. This is done through NOPSEMA's Environment Plan (EP) framework. All petroleum activities will be undertaken under an accepted EP.

All wells will be drilled and operated in accordance with an accepted Well Operations Management Plan (WOMP) in accordance with the Offshore Petroleum and Greenhouse Gas Storage Act (OPGGS).

LOSS OF PROCESS STORAGE TANK CONTAINMENT

The Crux platform will process well fluids, before exporting the hydrocarbon to the Prelude FLNG facility for processing. The process equipment on the Crux platform will store considerable volumes of condensate, that could be released to the environment in the event of loss of containment from process infrastructure.

A significant loss of containment from process equipment is highly unlikely. The offshore oil and gas industry routinely implements safety by design to reduce the likelihood of a process loss of containment and reduce personnel exposure to significant risks (a key safety benefit of a Not Normally Manned design of the Crux platform). This is reflected in industry statistics, which indicate a significant release of liquid hydrocarbons from offshore process equipment is very low, particularly for unmanned platforms.

LOSS OF CONTAINMENT FROM CRUX EXPORT PIPELINE

The export pipeline will contain a significant volume of gas and condensate during production operations. A loss of containment from the pipeline may lead to the release of condensate to the marine environment. Pipeline loss of containment events can range from small 'pinhole' leaks (localised corrosion) through to complete rupture of the pipeline (significant mechanical impacts such as a drilling rig anchor being dragged over the export pipeline).

LOSS OF FUEL FROM A VESSEL

The Crux project will require considerable use of a range of project vessels, from small platform support vessels to heavy lift and pipeline installation vessels. The frequency and duration of vessel activities will vary considerably depending on the project phase.

Installation and decommissioning will be peak periods of vessel activity, and vessels will include heavy lift and construction vessels. The commissioning and operations phases (the longest phases of the Crux project) will involve relatively low vessel activity, comprised primarily of platform support vessels.

The nature and scale of the environmental risks and impacts from a loss of fuel from a vessel varies significantly based on the vessel type and activities. Vessels such as heavy lift and pipeline vessels typically store relatively large quantities of fuel. Often these types of vessels are fueled using relatively heavy fuel oils.

Smaller vessels, such as platform support vessels, typically store smaller quantities of fuel. Smaller vessels are typically fueled using lighter fuel oils such as marine diesel, which are less persistent in the environment than heavier fuel oils.

LOSS OF WELL CONTROL

The Crux project involves drilling and completion of, and production from, a series of subsea wells.

Shell's engineering standards require a range of features that manage the risk of a loss of well control to very low levels. However, there is a possibility that a loss of well control may occur during drilling and operation of the Crux platform.

While the likelihood is very small, a complete loss of well control (a well blowout) has the potential to release significant volumes of condensate into the environment. Such a release could result in significant environmental damage.

The likelihood and volume of condensate that could be released during such an event will change during different phases of the Crux project. Most loss of well control incidents do not result in a worst-case well blowout scenario, and typically release relatively small masses of hydrocarbons.

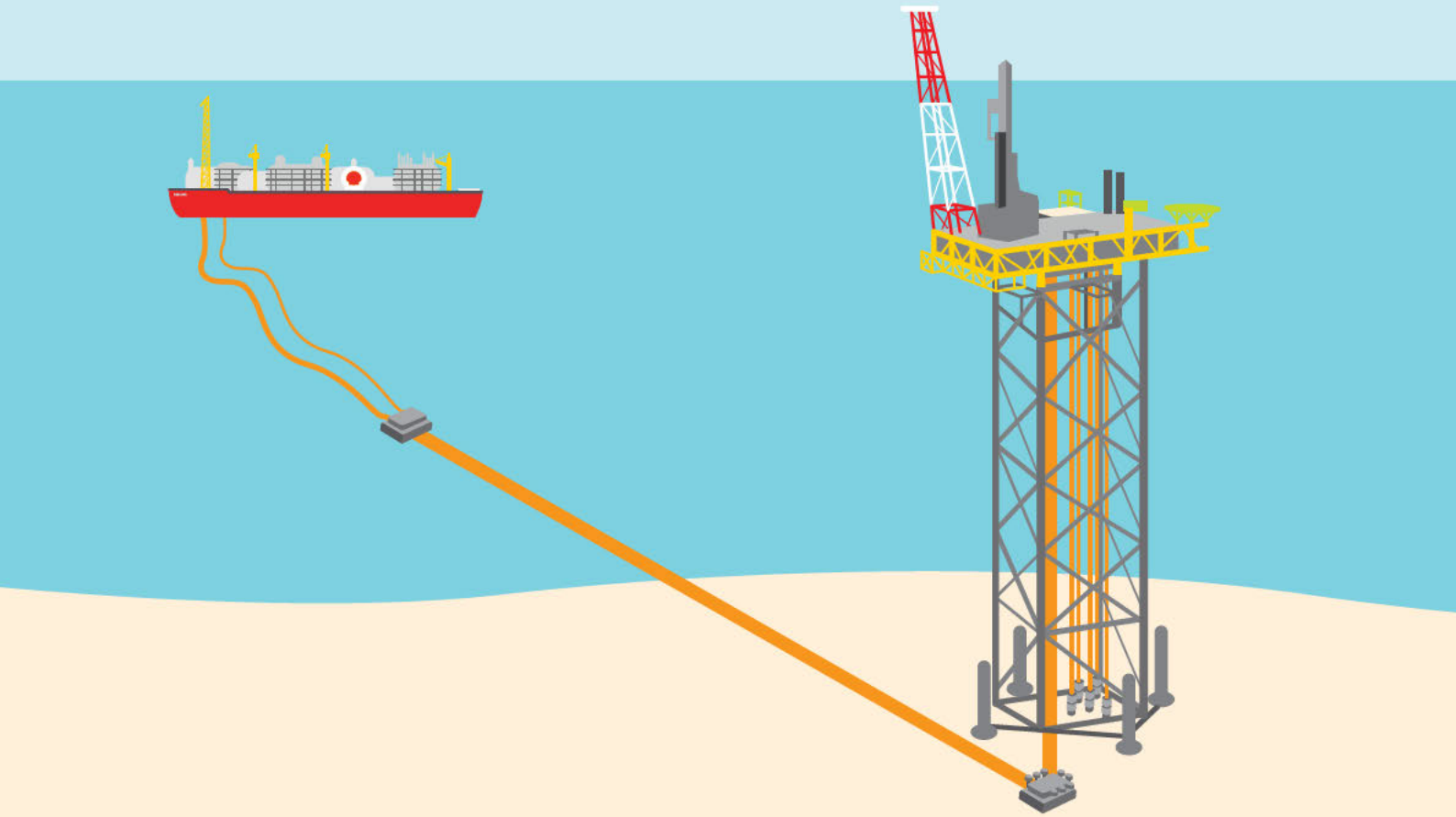
The likelihood of a well blowout from development drilling and production are considerably lower than a loss of containment from an exploration well, as are the likely release volumes. Exploration wells will not be drilled during the Crux project.

At Shell, we recognise the importance of environmental, heritage, social, cultural, and economic values.

Shell has undertaken comprehensive surveys, studies and a review of available information to understand and detail the sensitivities and values within the region.

We will demonstrate how these impacts and risks will be reduced to a level that is as low as reasonably practicable through additional control measures, seeking first to avoid and then minimise impacts.

We are committed to working with relevant persons as part of our ongoing efforts to engage and improve our understanding of the sensitivities and values of the region and welcome and seek feedback on these.



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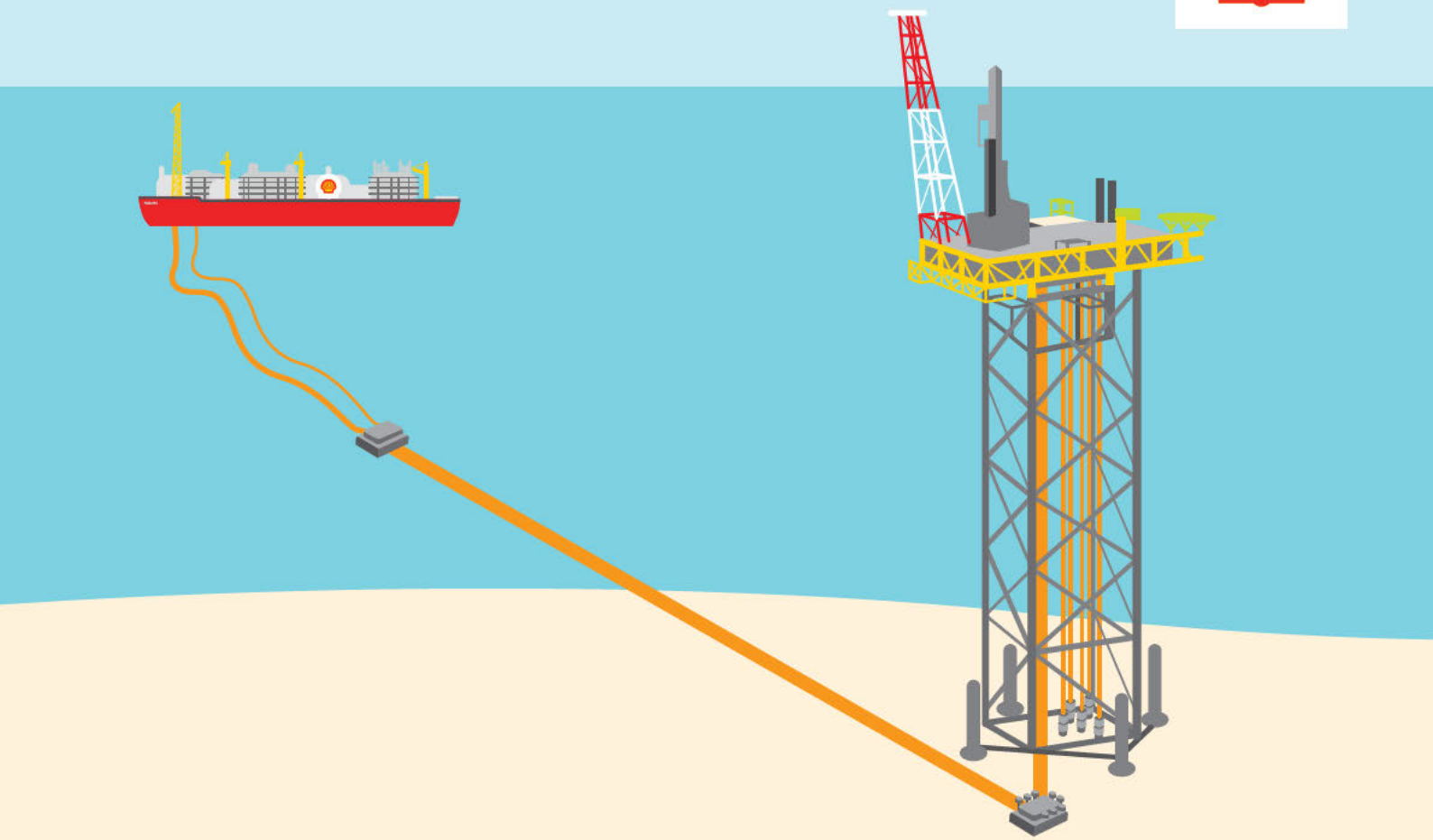


SGH | Energy

SHELL'S CRUX PROJECT

2023

INTRODUCTION

Shell has operated in Australia for over 120 years. From operating Australia's first oil refinery, which was central to meeting Australia's fuel needs, to fuelling the first Qantas commercial flight in the 1920s, to playing a foundation role in building some of Australia's largest and most innovative natural resource developments - as the energy needs of Australia have changed, so have we.

Today, we are a leading natural gas producer and are playing our part in the transition to a low-carbon future by investing in the power sector, renewable energy solutions and carbon abatement activities.

ABOUT CRUX

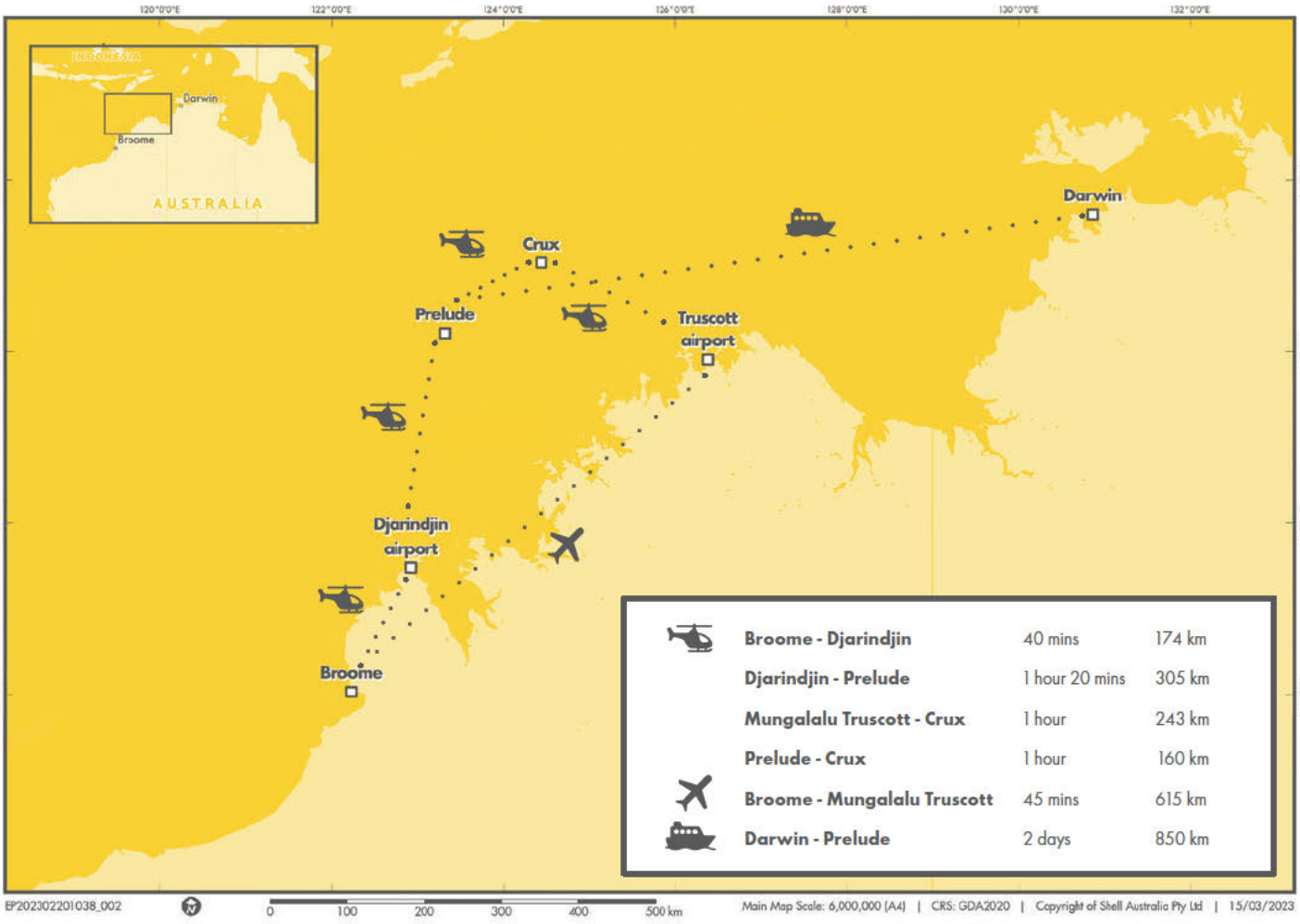
The Crux project forms an important part of Shell Australia's gas portfolio and remains an important backfill opportunity for the existing Prelude FLNG facility. The project consists of a not normally manned platform with five production wells, in ocean waters approximately 165m deep. The facility will be connected to Prelude via a 160km export pipeline and will be operated remotely from the Prelude FLNG facility.

The project is being progressed by operator Shell Australia in joint venture with SGH Energy.

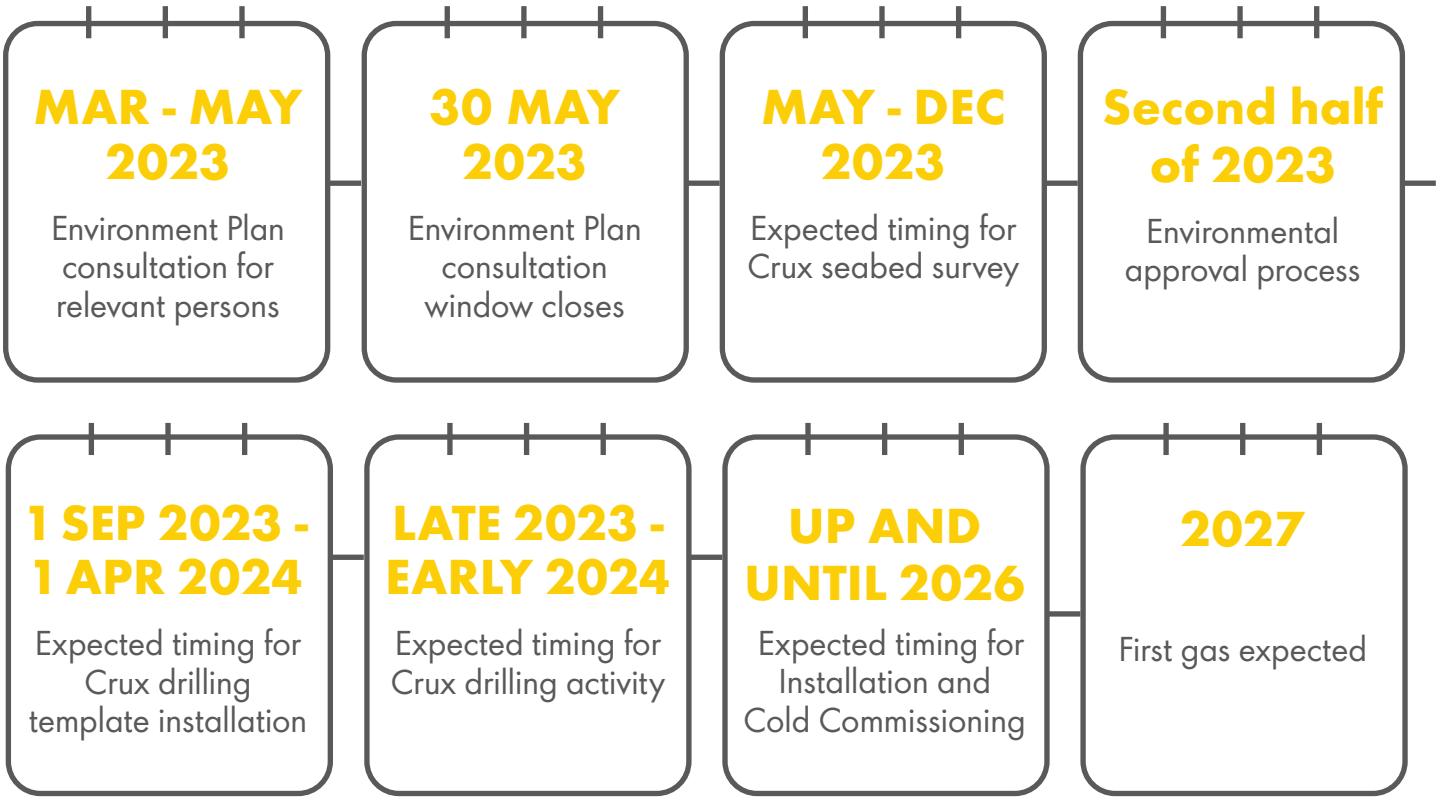
THE LOCATION OF OUR OPERATIONS

Prelude is located approximately 475km north-east of Broome, Western Australia, in the Browse Basin.

Once installed, the Crux platform will be connected to Prelude via a 160km, located approximately 190 km off the Kimberley coast of Western Australia and 620 km north-east of Broome.



TIMING



**Dates for the commencement of activities and durations are subject to change and are pending regulatory approvals.*

Shell is planning to commence engagement with relevant persons end of March 2023.

Construction activities are planned to start in late 2023, with drilling planned to commence in early 2024.

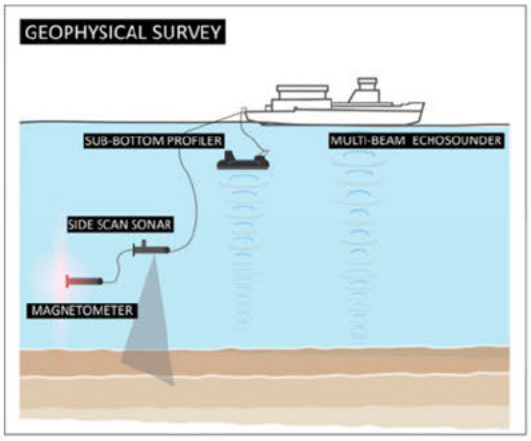
RELEVANT PERSONS

At Shell, we recognise the environmental, heritage, social, cultural, and economic values of the region. Shell has undertaken extensive surveys, studies, and a comprehensive review of available information in order to understand and detail the sensitivities and values within the region.

We welcome and seek feedback from relevant persons on our understanding of these values. We are committed to working with relevant persons as part of our ongoing efforts to engage and improve our understanding of the sensitivities and values of the region. Additionally, values and sensitivities are assessed during the risk and impact assessments for any project. Shell will demonstrate how those impacts and risks will be reduced to a level that is as low as reasonably practicable through additional control measures, seeking first to avoid and then minimise impacts.

PROJECT ACTIVITIES

SEABED SURVEY

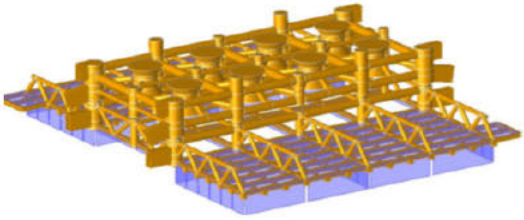


A survey of the seabed along the Crux pipeline route will be carried out using technology like sonar mounted on the hull of a survey vessel. The pipeline will connect the Crux field with the Prelude Floating Liquified Natural Gas (FLNG) facility.

The survey will make sure we have accurate information about the seabed along the pipeline, so construction of the pipeline can be carried out safely and all environment impacts are effectively managed.

The survey is expected to be completed within a five-day period during a single vessel-based campaign operating 24 hrs/day.

DRILLING TEMPLATE INSTALLATION



Drilling Template Structure including mudmats

The steel prefabricated drilling template will be installed on the seabed to act as a guide to the drill bit during drilling operations. Once installed the drilling template will remain in place for the life of Crux.

The drilling template includes eight drill slots to support an initial five well development drilling campaign.

Once installed the drilling template will remain in place for the life of the Crux activity.

The drilling template installation campaign is expected to occur over a one-month period subject to weather and subsurface conditions. The drilling template will be installed within approximately 24 hrs. The activity window is 1 month to account for variability in weather and subsurface conditions

Once installed the template will remain in place for the life of the Crux Project.

PROJECT ACTIVITIES

DEVELOPMENT DRILLING

Representative Mobile Offshore Drilling Unit

Drilling the wells includes the installation of guideposts and five deviated production wells via the preinstalled drilling template.

Installation of guideposts

This ensures that the Crux substructure and topsides are accurately positioned over the drilling template when installed during the subsequent installation campaigns.
The guideposts will remain on location at the seabed for the life of the Crux Project.
The guideposts have an approximate structural footprint of Length 28 m X Width 9 m X Height 10 m.

Drilling and suspending the wells

The wells will be drilled from a Mobile Offshore Drilling Unit. They will be drilled from a single drill centre, via the pre-installed drilling template. The wells will be suspended and left in-situ with well completions planned to occur following installation of the Crux platform. The Mobile Offshore Drilling Unit will be a semi-submersible Mobile Offshore Drilling Unit – which will be held in position by anchor spread.

The drilling campaign is expected to be carried out for approximately 2 years with scope completed no later than the end of 2025. It will be supported by a range of services including helicopter transfers from mainland Australia, a dedicated installation vessel, four anchor handling, tug and support vessels and remotely operated vehicles undertaking inspection, maintenance and repair activities.

PROJECT ACTIVITIES

INSTALLATION AND COLD COMMISSIONING

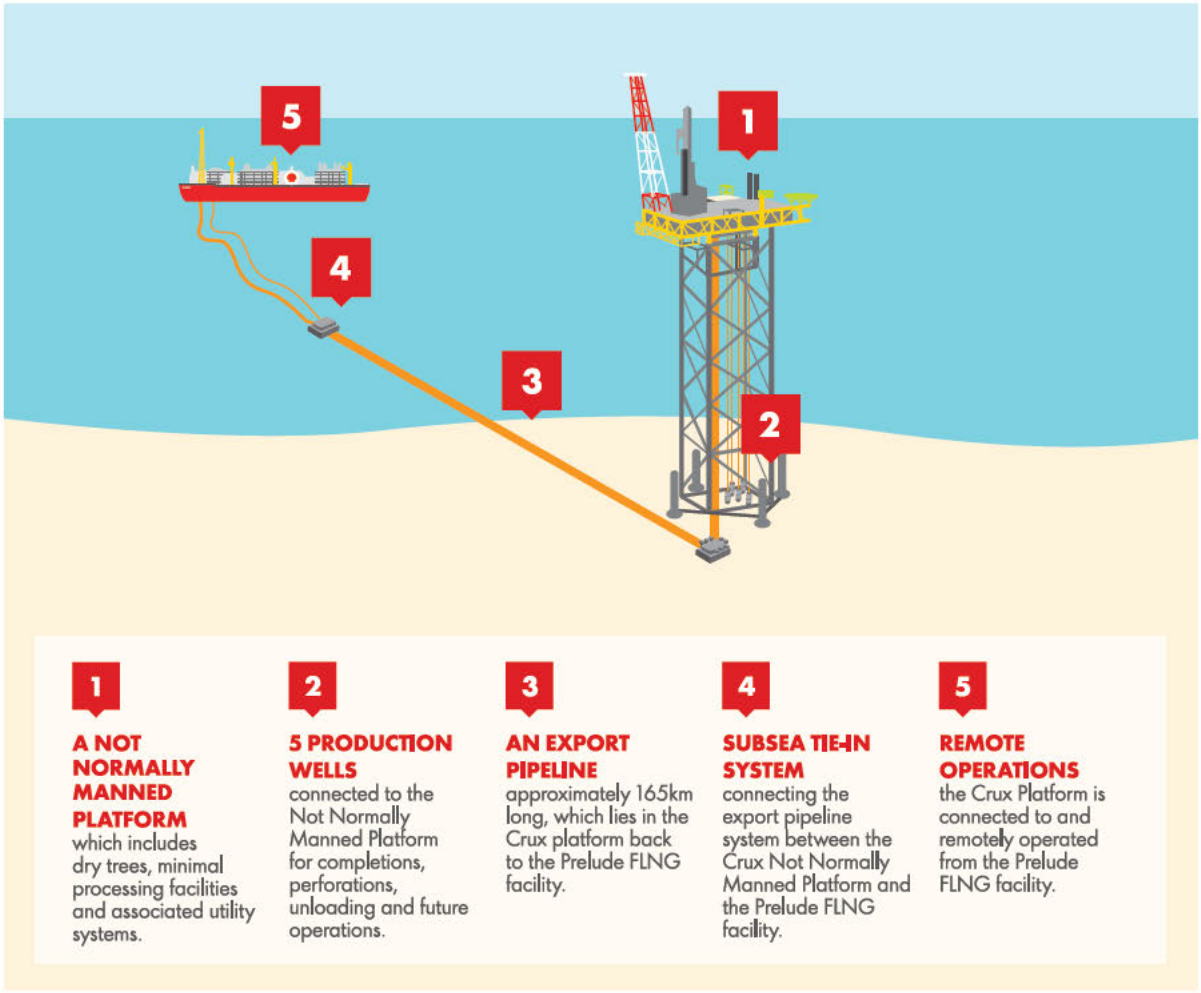
This covers a number of activities including:

- Installation of the subsea integration system, including the Crux pipeline to export gas from Crux field to Prelude FLNG facility for processing into LNG. The pipeline will be approximately 26 inches in diameter and approximately 165 km long.
- Installation of the Crux not-normally manned platform, jacket and topsides. The platform will be held in position by piled foundations on the seabed. It includes processing facilities and associated utility systems.
- Cold commissioning activities such as hydrotesting and dewatering of the pipeline.

The installation phase will be supported by crews being transported via helicopter from Broome, while supply vessels will be serviced from Darwin.

PROJECT ACTIVITIES

START UP AND OPERATIONS



Concept Schematic of the Crux Project

This is where operations to commence production will be completed including

- commissioning testing and monitoring topside equipment on the platform and the export pipeline
- well, flowline and riser operations
- remote production and processing operations

DECOMMISSIONING

This will include well abandonment, decommissioning of the platform and decommissioning of subsea facilities and export pipeline.

ENVIRONMENTAL IMPACT MANAGEMENT

Construction activities have been designed to operate and manage environmental risks to as low as reasonably practicable and acceptable levels.

LIGHT

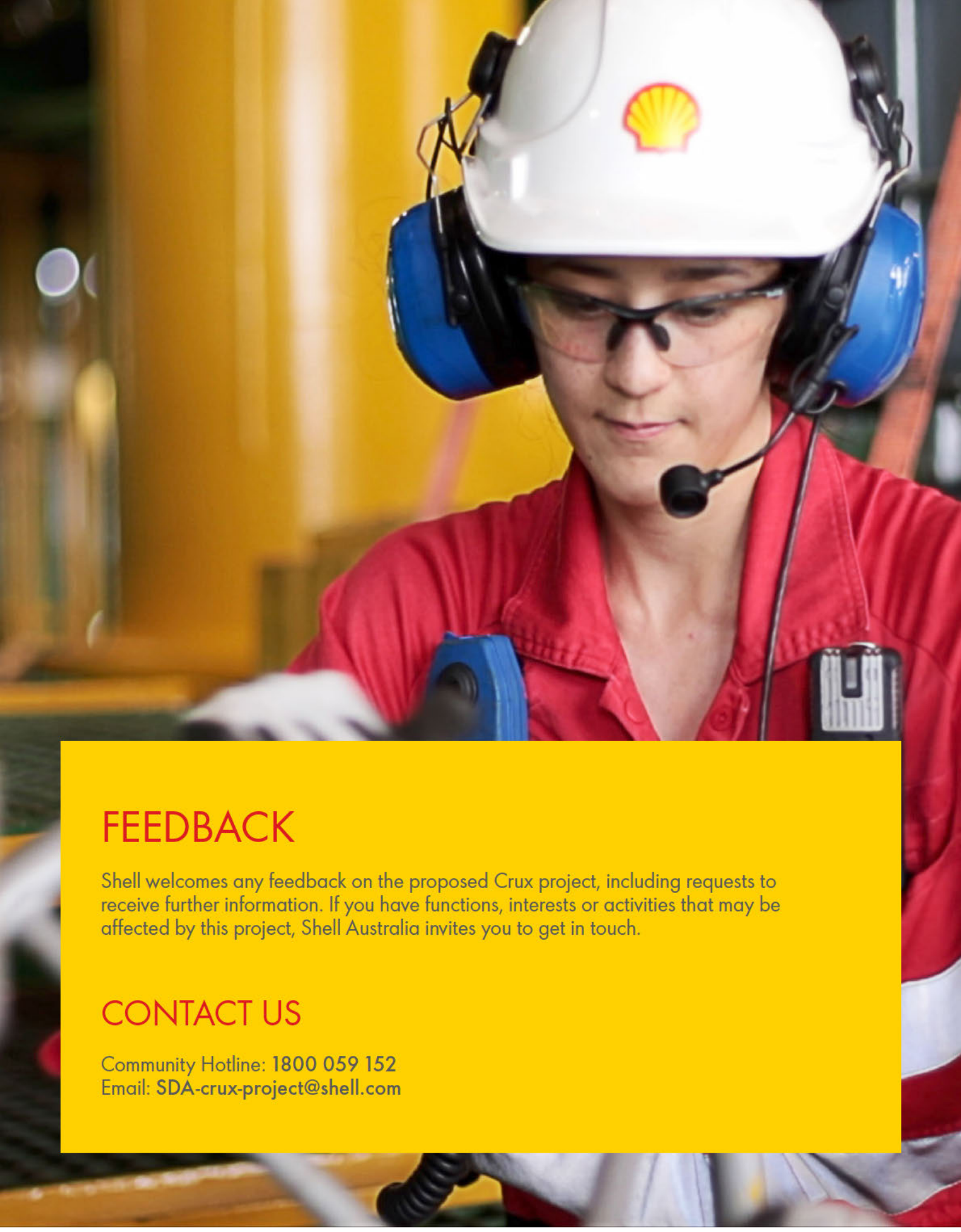
External lighting on offshore facilities have been minimised to the lowest levels possible to that required for navigation and safe operations on deck.

NOISE

There will be some noise during the day and night while the project is being constructed. Any marine life in the area will be monitored and there will be no activity within 1 km of any shoals.

NOTIFICATION TO MARINE USERS

The 500 m Petroleum Safety Zone will be in place and marked on all relevant marine navigation charts. The Safety Zone will remain in place for the life of the Crux project. A notice to mariners will be issued via the Australian Hydrographic Office in advance of any activities commencing.



FEEDBACK

Shell welcomes any feedback on the proposed Crux project, including requests to receive further information. If you have functions, interests or activities that may be affected by this project, Shell Australia invites you to get in touch.

CONTACT US

Community Hotline: **1800 059 152**
Email: **SDA-crux-project@shell.com**

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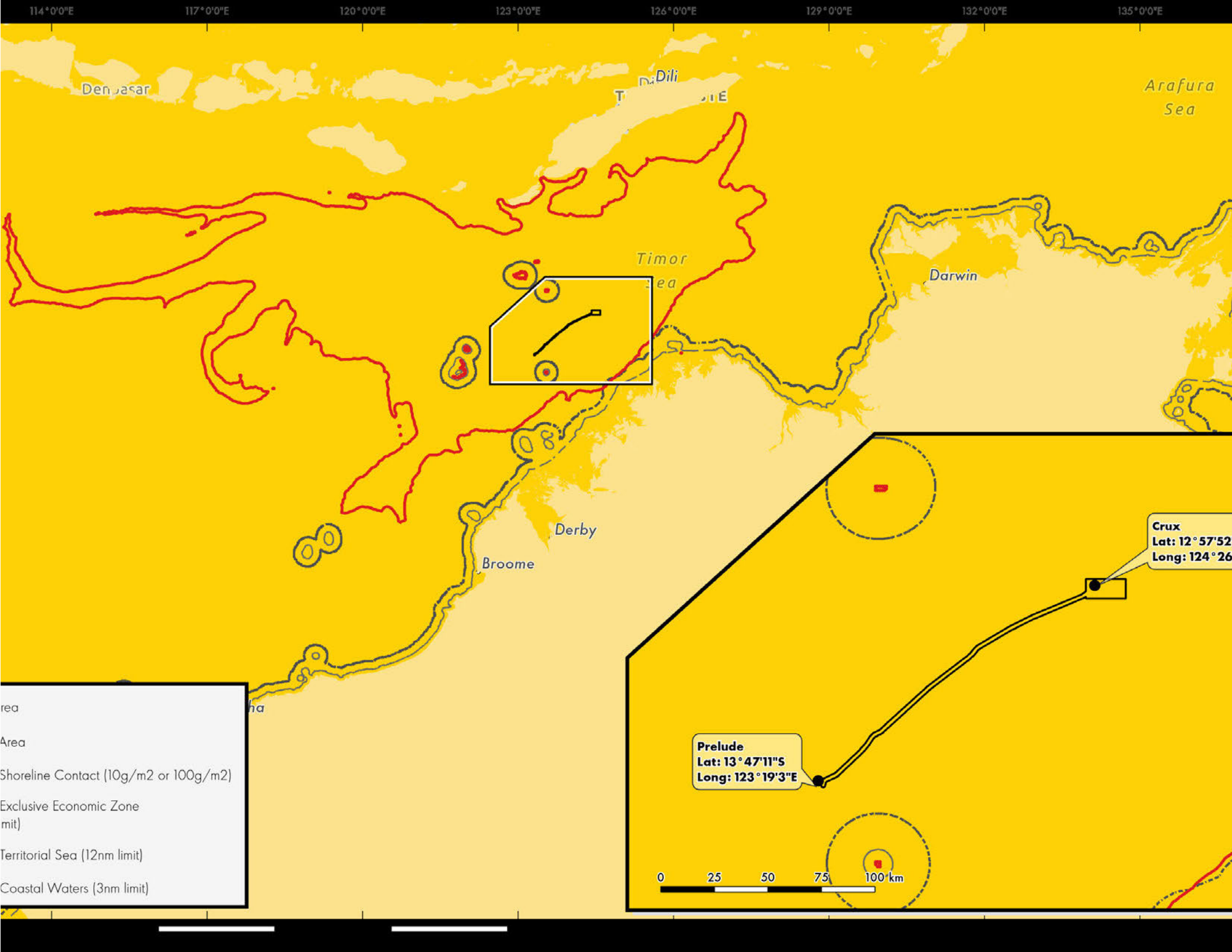
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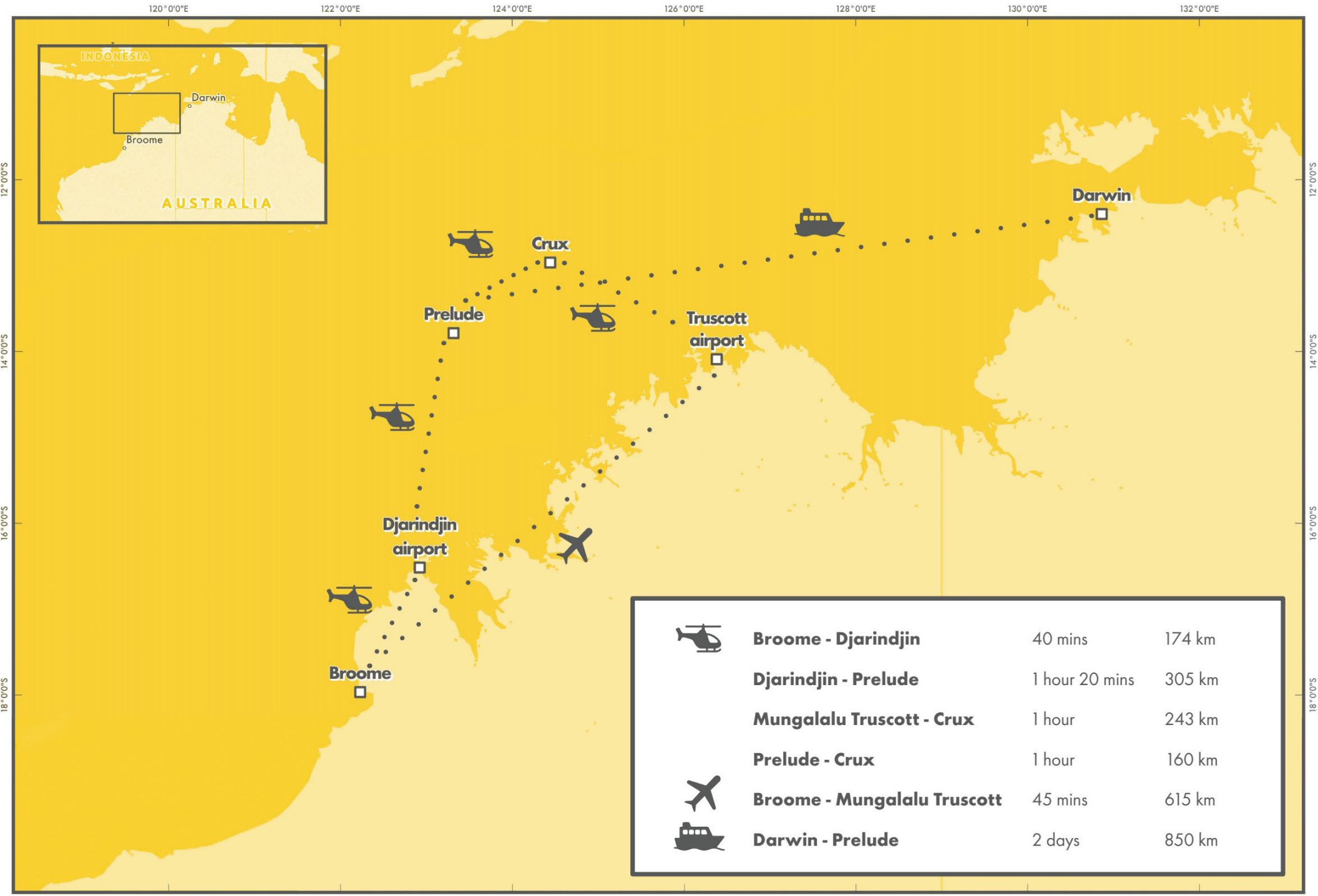
Territorial Sea (12nm limit)
Coastal Waters (3nm limit)



EP202302201038_002

Main Map Scale: 6,000,000 (A4) | CRS: GDA2020 | Copyright of Shell Australia Pty Ltd | 15/03/2023

SHELL CRUX
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PRINT

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Koori Mail
10th April

HAVAS

Wearing culture on the field

By ALF WILSON

PROUD Aboriginal artist Bradley Michael has designed an Indigenous jersey to be worn by the North Queensland Cowboys during the NRL Deadly Choices round.

Bradley was raised by a Balnggarrawarra father and a mother from the Nugal Clan of the Guugu Yimithirr speaking people and his design embodies a rich cultural heritage deeply rooted in his Indigenous background.

Entitled Nhinhinhi Guma Bamawi Guugu (how the giant Nhinhinhi fish changed the languages), the jersey will be worn by the Cowboys when they meet the West Tigers on May 24 at Townsville's Queensland Country Bank Stadium.

Bradley is a NRL Cowboys House staff member and the jersey was unveiled at a function in late March.

The Indigenous jersey design tells of a traditional tale from the Cooktown and Hopevale region of Far North Queensland and inspiring a unique collaboration.

The design and its story carry significant meaning, including values of respecting and learning people's culture, community, family and values.

His design tells the creation story of Nhinhinhi, a great giant Queensland Grouper. In a traditional story passed down to him by his grandfather, Tuki Gordon.

"The story place on our Country - there

Wearing the jersey in front of the Toyota Coaster are Jamal Shibasaki, artist Bradley Michael and Kaiden Lahrs.

are hundreds of cars that pass by the area each day, but most people would not know that the story existed or was about this area. My grandfather's connection to the story is because it was from his traditional homeland and my grandfather was a storyteller. This story was passed down to him from his Elders and then from him to my mum and us. I believe it is important for my generation and the ones to follow to know this story and be able to identify the area the story comes from," Bradley said.

At the official launch were Cowboys players Kaiden Lahrs and Jamal Shibasaki and along with Bradley were the first to wear the design alongside an eye-catching inclusion in this year's Cowboys Indigenous range, the 'Nhinhinhi'-inspired Toyota Coaster.

The 22-seat Coaster, donated by Toyota, provides essential daily transportation for NRL Cowboys House boarding students and now features the striking design artwork.

Toyota Australia Chief Marketing Officer Vin Naidoo said Toyota's support underscores their commitment to supporting and inspiring communities across Australia through the power of diversity, inclusion, unity and pride.

"The Toyota-donated Coaster will not only assist with the transportation of boarding students but will make education and training more accessible to young First Nations communities, creating a lasting positive impact for years to come," he said.

Cowboys Chief Community and Government Relations Officer Fiona Pelling said the club's embrace of the Nhinhinhi design showed a unified connection to recognising and honouring the contribution of Indigenous people to the community and rugby league across North Queensland.

"The Cooktown and Hopevale area is such a beautiful part of Far North Queensland and we're proud to wear and carry this traditional story from the region in 2024. We have a long history of hosting boarding students from Cooktown and Hopevale at NRL Cowboys House while our school community programs including Try for 5! are delivered to communities throughout that area. We're proud to have continually provided artists across North Queensland with a platform to showcase their art," Fiona said.

SHELL AUSTRALIA INVITES YOU TO GET IN TOUCH ON THE CRUX PROJECT

If you have functions, interests or activities that may be affected by this project, Shell Australia wants to hear from you.

In Australia, Shell has an integrated energy solutions portfolio which includes gas production and liquefaction, as well as renewable power and energy solutions businesses.

With our joint venture partner, SGH Energy, we are preparing to develop the Crux natural gas field. This is to ensure a continued supply of gas to Shell's Prelude Floating Liquefied Natural Gas (FLNG) facility, which extracts, liquefies and stores natural gas at sea, before it is transferred and shipped to customers. The Crux field is located 190km offshore north-west Australia.

Shell Australia is preparing the Crux Completions, Commissioning, Start up, and Operations Environment Plan(s) for submission to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). Consultation with relevant persons is an important part of this approval.

Please respond by 30 June 2024.

For more information please visit:
www.shell.com.au/crux

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Broome Advertiser
11th April

HAVAS

Retailer to take ASIC to court

NATIONAL INDIGENOUS TIMES
BRENDAN FOSTER

A key retailer for First Nations people in regional Australia is planning to take the corporate watchdog to court after it slapped two stop orders on the company.

In late February, the Australian Securities & Investments Commission made an interim stop order preventing Coral Coast Distributors (Cairns) Pty Ltd from having customers at its Urban Rampage retail stores enter agreements to pay for goods on credit through Centrepay deductions.

ASIC then extended the stop order until March 18, saying that nine of the 10 Urban Rampage's nationwide stores were involved in the alleged misconduct.

Urban Rampage's lawyer, Leon Loganathan from Ward Keller, claimed ASIC had refused to tell his client when it will make its final decision on an interim stop order, despite the company making multiple submissions. He wrote to ASIC recently claiming Urban Rampage was committed to a "co-operative approach with ASIC" but "we fail to understand why ASIC cannot provide any certainty as to when a final decision will be made". Mr Loganathan said ASIC consulted with financial advisors before imposing the stop order, but Urban Rampage had heard from more than 80 upset customers with written complaints.

Lease to seed way for cotton industry growth

OLIVIA FORD

The Cook Government has announced a lease agreement for new farmland in the Ord's Knox Plain in a move local leaders say will "pave the way" for the growth of a sustainable cotton industry.

The 5400ha lease agreement was granted to Kimberley Agricultural Investment, which is partnering with Keep Farming to develop Knox farmland.

Kimberley MLA Divina D'Anna said the agreement would help realise the full potential of WA's cotton industry, which would provide "significant" economic and employment opportunities in the East Kimberley.

"This is the largest agricultural project in WA's north, and a fantastic example of collaboration between government, local agricultural businesses, and Traditional Owners who are a proud partner in the Ord agricultural industry," she said.

The agreement comes after the WA Government allocated more than $77 million for vital water infrastructure upgrades to the Ord to help drive agricultural expansion in the area and support required water volumes to Knox.

This expands on previous WA Government investment of close to $4 million to install electricity supply infrastructure in the area.

Cotton growing in Kununurra. Picture: Cally Dupe

Lands Minister John Carey said this was a "significant" agreement which would aid long-term crop production in the Knox Plain, as well as new farmland developments.

"This agreement paves the way for the leaseholders to sustainably develop these fertile black-soil plains, create jobs and provide social and economic benefits for the region and the Miriuwung Gajerrong people," he said.

Traditional Owners, along with local growers, have backed the development which will deliver Native Title benefits as negotiated by the Miriuwung Gajerrong people under the Ord Final Agreement.

Regional Development Minister Don Punch said the announcement marked a "tremendous milestone" in the development of the Ord River irrigation area.

"Our Government has walked alongside industry for many years to help establish a new era of cotton production, diversifying the local economy and creating new job opportunities for the East Kimberley," he said.

He also said the widening of the main water supply (M1) channel was in the works to aid water supply to the area from Lake Argyle.

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Shell Australia is preparing the Crux Completions, Commissioning, Start up, and Operations Environment Plan(s) for submission to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). Consultation with relevant persons is an important part of this approval.

Please respond by 30 June 2024.

For more information please visit:
www.shell.com.au/crux

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Kimberley Echo
11th April

HAVAS

Quintis has second collapse

SEAN SMITH

The world's biggest Indian sandalwood grower has collapsed for the second time in six years, with receivers from FTI Consulting put into the privately owned WA company Quintis.

FTI said on Tuesday it had taken control of group flagship Quintis (Australia), as well as its operating and funding subsidiaries Sandalwood Properties, Quintis Forestry, Arwon Finance, Quintis Leasing, Fieldpark, Mt Romance Holdings, Quintis Sandalwood and About Time We Met.

FTI on Friday announced Quintis was being offered for sale, promoting it as offering "unsurpassed scale".

The failure of the firm threatens up to 150 jobs in Albany, Kununurra and Perth, and an estimated $230 million in upfront fees paid by investors in Quintis' managed investment schemes.

"As a result of their appointment, the receivers are now in control of the majority of the companies' businesses, operations and assets," FTI said.

The appointments include sandalwood plantations and land in the Kimberley and North Queensland, Quintis' operations centre in Kununurra and the Mt Romance oil distillation facility and shop near Albany.

FTI said the receivers would call for expressions of interest in the sale and/or recapitalisation of Quintis while urgently assessing the future viability of the group companies.

Quintis spans 3.5 million sandalwood trees on more than 9000ha of land, divided almost equally between its managed investment schemes growing trees on leased land, institutional and high net worth investors using the company to grow and market trees, and plantations owned by Quintis.

Owner-investors will now have to decide whether to try to harvest the trees themselves, or wipe off their long-term investments.

Quintis had been under stress for several months, having moved in December to wind up all of its 16 management investment schemes on independent advice most would not generate returns for investors.

Management has struggled to build demand for sandalwood, which is harvested for its aromatic wood and the essential oil that is used in perfumes, cosmetics and medicine.

The company has also laboured financially, hurt by COVID-19 restrictions and held back by weak sandalwood prices and China's 2020 suspension of timber imports from Australia.

Administrators from McGrathNicol and then receivers from KordaMentha were first sent into the then-ASX listed Quintis in January 2018 after the company was unable to meet a $87 million payment to a US fund manager.

US bondholders led by global investment giant BlackRock later took control of Quintis via a $175m recapitalisation that preserved growers' interests in the managed investment schemes but torched the group's 7500 shareholders.

Planted alongside host trees that sustain them, it can take more than 15 years before sandalwood trees are ready to be harvested.

Quintis started life as TPS in 1997 during the boom in tax-effective managed investment schemes, planting its first trees in the Ord area in 1999.

Sandalwood nut.

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Perth West Australian
13th April

HAVAS

Sussexes to make polo Netflix series

The Duke and Duchess of Sussex will be executive producers of two new non-fiction Netflix series focusing on lifestyle and polo.

One show will explore "the joys of cooking, gardening, entertaining and friendship", while the other will give "unprecedented access to the world of professional polo" and the US Open Polo Championship in Florida, Netflix said.

The shows will be made by Prince Harry and Meghan Markle's Archewell Productions company, with the Duchess to produce both series and the Duke to work on the polo series.

Both are in the early stages of production with titles and release dates to be announced in the coming months.

"Known primarily for its aesthetic and social scene, the series will pull the curtain back on the grit and passion of the sport, capturing players and all it takes to compete at the highest level," Netflix said of the polo series.

The Sussexes have previously released three documentaries with Netflix as part of a multi-million-dollar deal with the streaming giant: Heart Of Invictus, which aired last August, documentary Live To Lead and a six-part series titled Harry And Meghan in 2022.

A WIN FOR LU

Charges against businesswoman & socialite dropped by tax office

EMILY MOULTON

Charges against a businesswoman who, according to corporate records, was indirectly linked to failed building company Modco Residential have been dropped.

The Australian Taxation Office had charged glamorous socialite Cynthia Lu — a director of Ms Lu Holdings, which non-beneficially held a controlling stake in the builder — for not furnishing tax returns.

But during a brief hearing in Perth Magistrates Court on Friday, prosecutors revealed the Commonwealth was discontinuing the nine charges against the mother of one.

Ms Lu was not present for the hearing and she did not have a lawyer representing her.

When asked by the magistrate if Ms Lu was aware the charges against her were being discontinued, the prosecutor told the court the 22-year-old had been informed the Commonwealth was no longer pursuing the claims against her under section 25 of the Criminal Procedure Act. Under the Act, it says if no evidence has been adduced in relation to a charge, the prosecution may discontinue the charge and the court must dismiss the charge for want of prosecution.

It is a win for the luxury-loving Ms Lu who along with husband Yusuf Khan were once dubbed Perth's answer to the Kardashians.

Modco was launched in 2021 with an exclusive party and a promise to build homes in 20 weeks. But when it collapsed the business had 29 unfinished homes, regulators said.

The company owed $4.4 million, a November liquidator's report filed to the corporate regulator, the Australian Securities and Investments Commission, showed.

In February, a company directed by Mr Khan, which held the licence for the Library Nightclub in Northbridge, went into liquidation, roughly owing $1.8m to creditors, according to filings with the corporate regulator.

Library is being turned into a new nightclub called Preach.

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Perth West Australian
27th April

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The West Australian
Saturday, April 27, 2024

NEWS 11

Left: Ninette and Philip Simons recount their horror night. Above: Ninette after being bashed. Far left: Top cop Col Blanch. Main pictures: 7NEWS

out of hospital," he said. "But I could still hear the screaming and punching."

Mr Simons said the three men took rings, jewellery and cash from inside the home before leaving. They even took a bottle of Scotch. Only one of the items taken — a necklace — has so far been recovered.

Mr Simons said his wife's injuries in the immediate aftermath of the attack had devastated him.

"Her face was smashed up and bleeding . . . I just didn't know what to do," he said. "The bathroom was full of blood."

Ms Simons — who recently underwent three surgeries — said her family had been left traumatised by what happened.

"My grandson was more or less first on the scene with his dad, he is traumatised," she said. "It's made them very angry."

Ms Simons said she felt insecure by the fact the thugs who attacked them were still on the run. She said she hoped the trio were caught soon, or had the decency to hand themselves in to police.

"We didn't deserve this treatment," she said. "I wish they'd give themselves up and let justice take its course."

She said the public could play a big role in helping catch the three men.

"I just want to plead with the public to help the police catch them, so that we can all feel safe again," she said.

Less than 24 hours after the attack, Police Commissioner Col Blanch said the attack was a "disgrace".

"I saw the photo of the victim this morning and it made me sick to my stomach," Mr Blanch said at the time. "To have people at home suffer that type of attack is a disgrace and I hope officers bring those (offenders) to justice as soon as possible."

Police say two of the offenders are about 166cm tall and the third male is between 185cm to 190cm tall. They are all described as having olive complexions and were wearing dark-coloured long pants, shirts and long-sleeve jackets.

Detectives urge anyone with information or who saw, or has, CCTV or dash-cam vision, to contact Crime Stoppers on 1800 333 000.

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RADIO

Radio ads

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Radio advertisement transcripts.

Shell has reliably operated in Australia since 1901. Shell is preparing to develop the Crux natural gas field to ensure the supply of gas to their natural gas facility Prelude. The Crux field is located 190km offshore northwest Australia. Environmental approvals are being prepared for the Crux Completions, Commissioning, Start-up, and Operations Environment plans. If you have functions, interests or activities that may be affected by this project Shell invites you to get in touch. Responses are required by 30 June. For more information visit shell.com.au/crux

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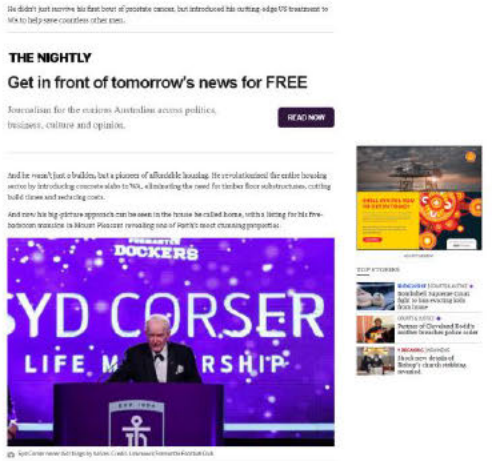

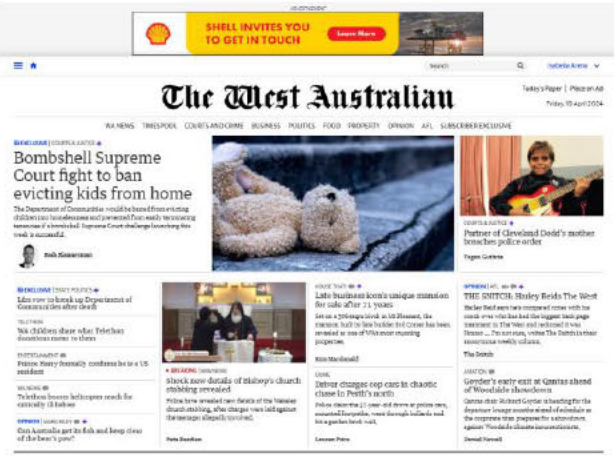

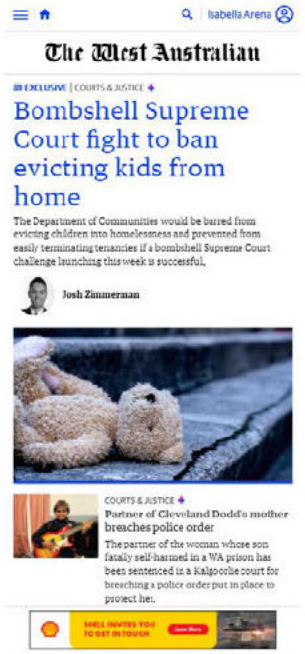

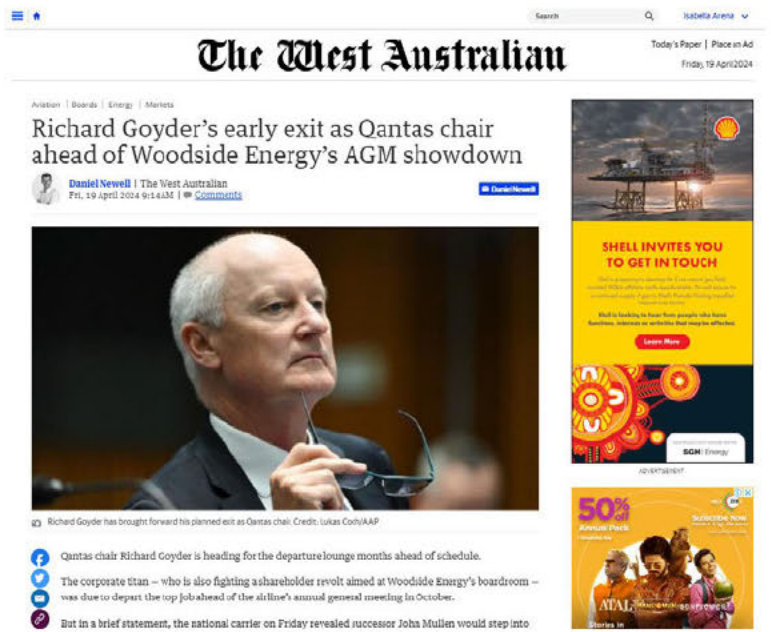

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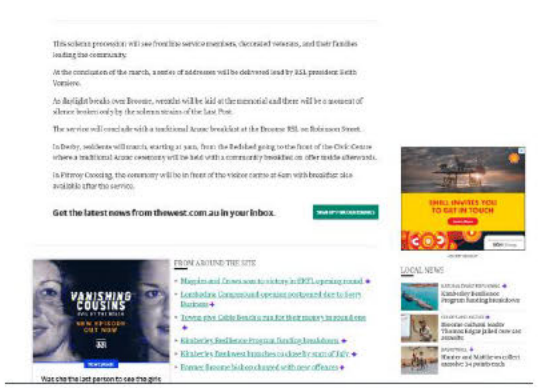

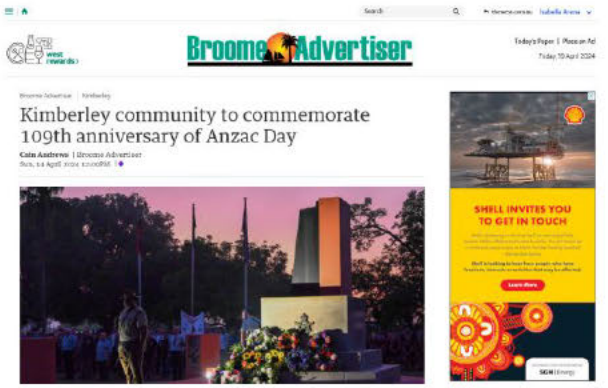

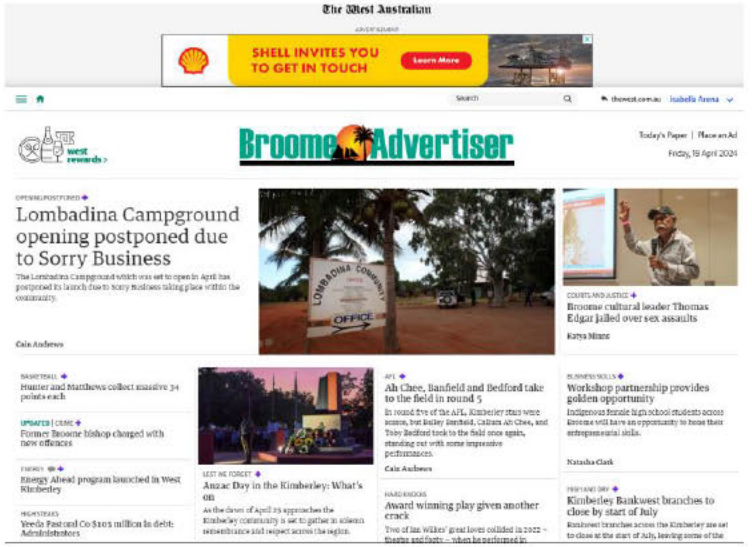

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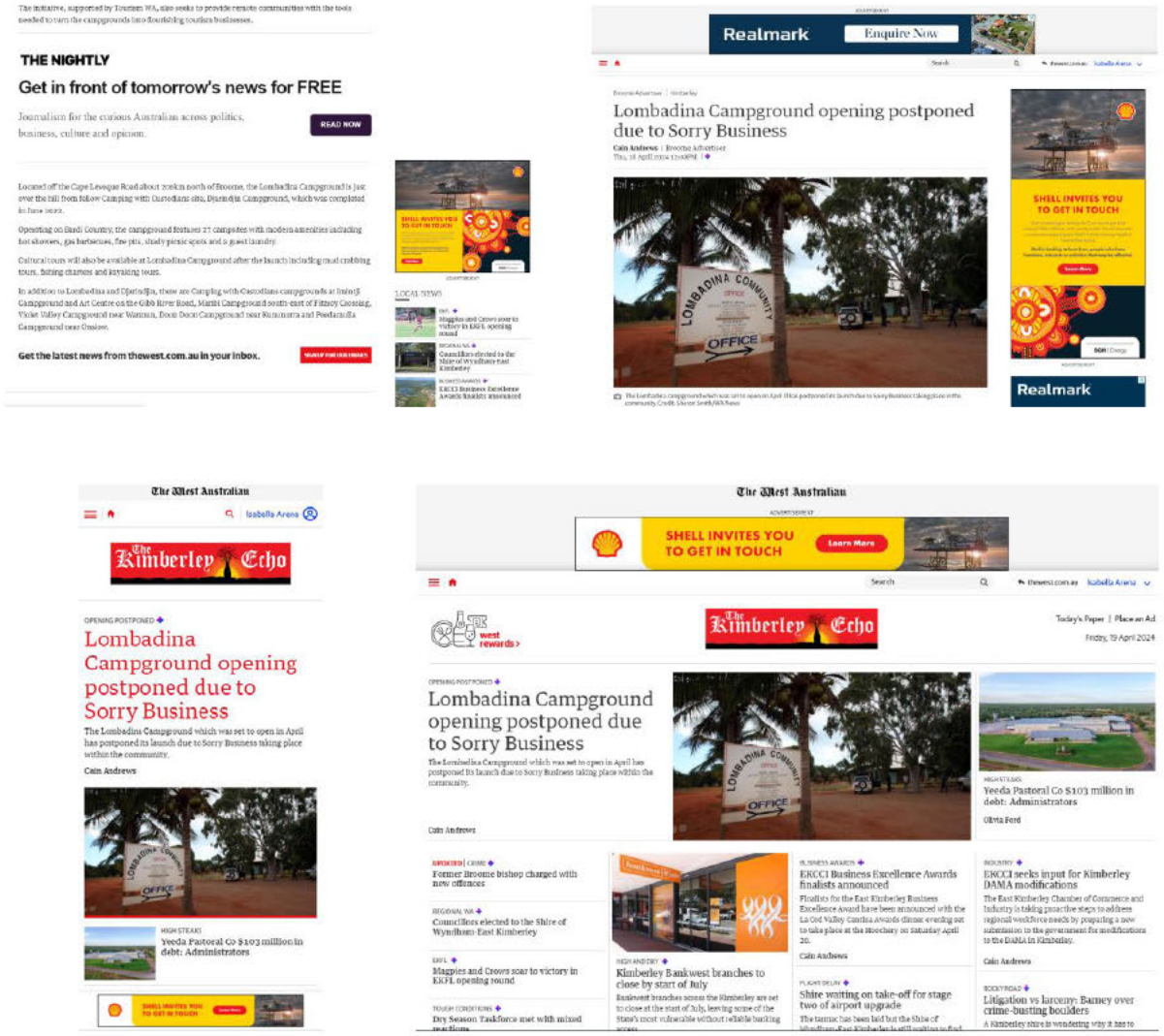

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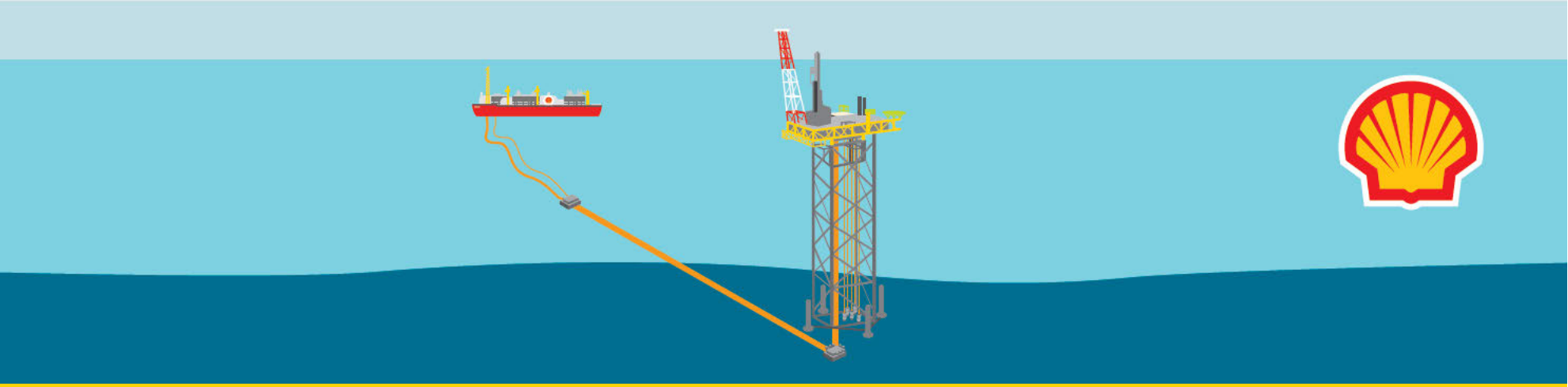

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Date: Thursday 16 May 2024 **Time:** 9.00 - 11.00am
Location: Mangrove Hotel,
47 Carnarvon Street, Broome

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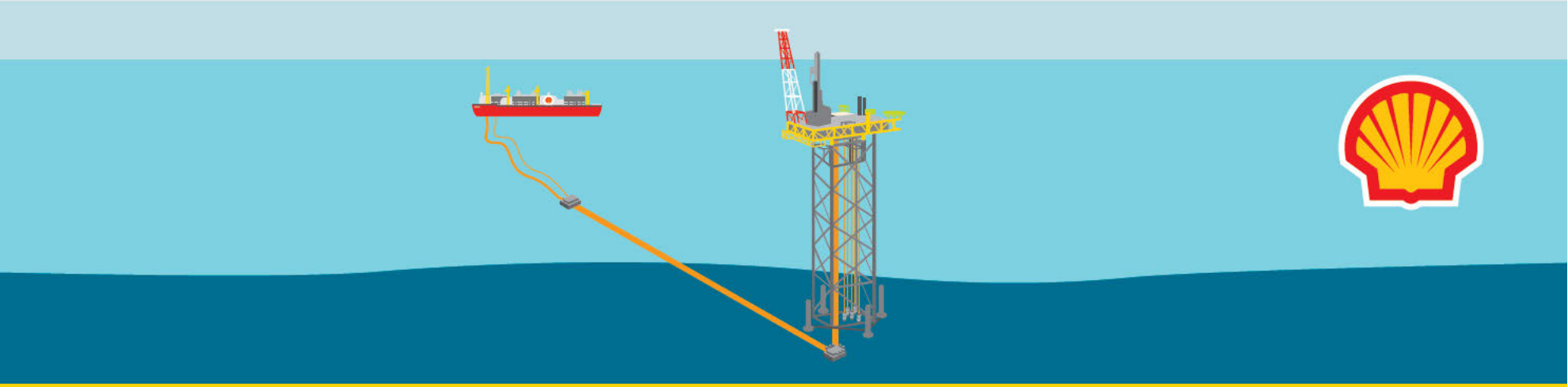
SGH | Energy



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If you are interested in learning more, Shell Australia invites you to join us at a drop-in session as follows:

Date: Tuesday 9 April 2024 **Time:** Between 12–6pm
Location: Derby Professional Centre – Conference Room, 2 Clarendon Street, Derby

Light lunch provided.

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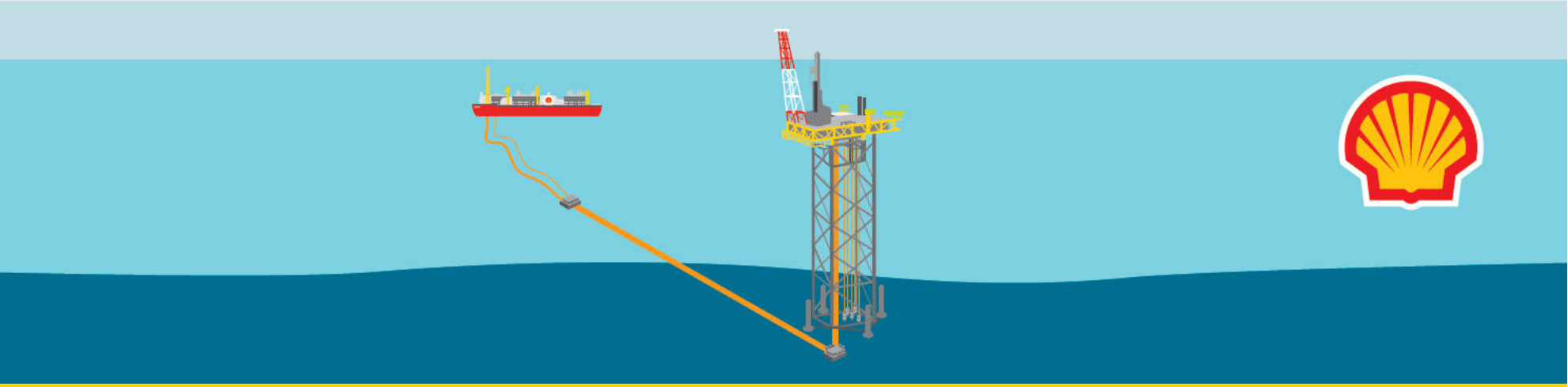

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If you are interested in learning more, Shell Australia invites you to join us at a drop-in session as follows:

Kununurra
Date: Tuesday 12 November 2024
Time: Please drop-in any time between 8am – 5pm
Location: Mirima Dawang Woorlab-Gerring, Speargrass Road, Kununurra

or

Wyndham
Date: Wednesday 13 November 2024
Time: Please drop-in any time between 8am – 3pm
Location: Council Chambers, 65 Koolama St, Wyndham

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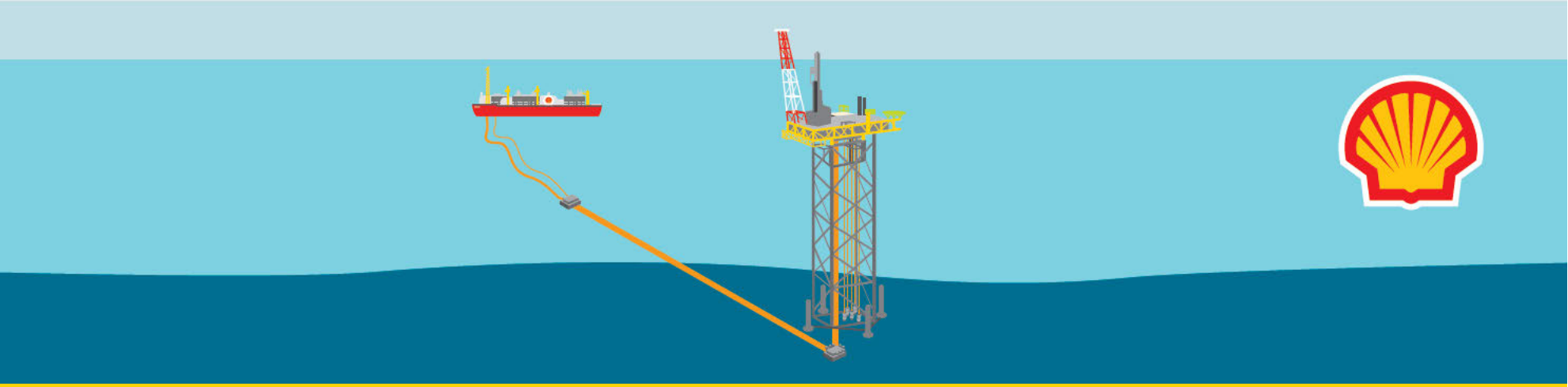

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If you are interested in learning more, Shell Australia invites you to join us at an information session as follows:

Date: Thursday 16 May 2024 **Time:** 7.15 - 8.30am
Location: Mangrove Hotel,
47 Carnarvon Street, Broome

Light breakfast provided. Registration open from 7am.

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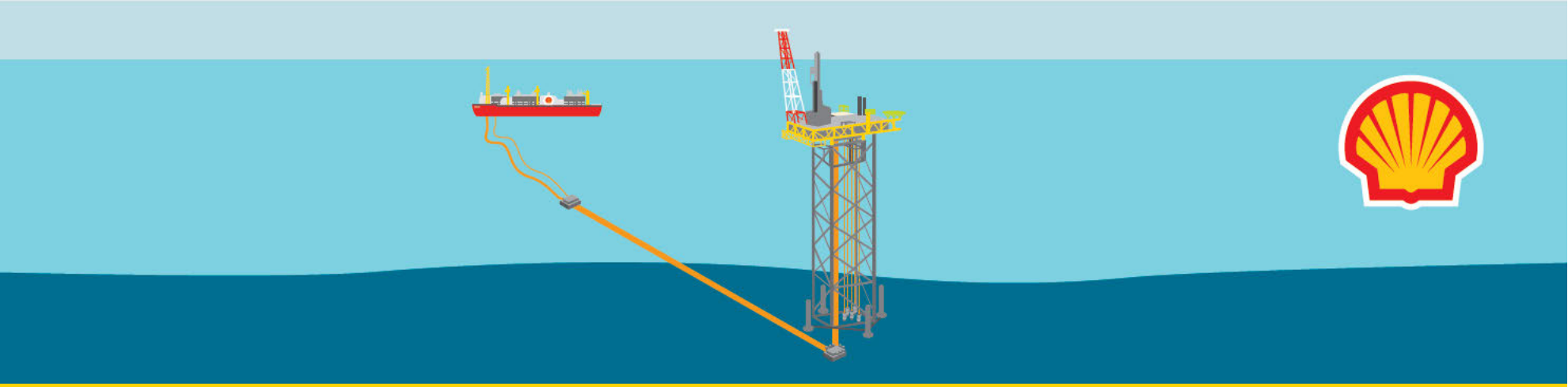

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CRUX PROJECT JOINT VENTURE PARTNER

SGH | Energy

Shell (AU)
May 2 ·

Shell is preparing to develop the Crux natural gas field and is looking to hear from people in Broome who have functions, interests or activities that may be affected. If you are interested in learning more, we invite you to our community drop-in session on Thursday 16 May 2024, between, 9am - 11am at Mangrove Hotel, 47 Carnarvon Street.

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Community Consultation | Shell Australia

Crux Environment Plans, Community Consultation, Events, Crux Completions, Commissioning, star...

Shell (AU)
April 1 ·

Shell is preparing to develop the Crux natural gas field and is looking to hear from people in Derby who have functions, interests or activities that may be affected. If you are interested in learning more, we invite you to our community drop-in session on Tuesday 9 April 2024, between 12pm – 6pm, at Derby Professional Centre, 2 Clarendon Street.

SHELL.COM.AU

Talk to us about the Crux Project

Join us on Tuesday 9th April 2024

Learn more

Shell (AU)
October 27 at 9:26 PM ·

Shell is preparing to develop the Crux natural gas field and is looking to hear from Kununurra and Wyndham locals who have functions, interests or activities that may be affected.

📍 Kununurra: Mirima Dawang Woorlab-Gerring, Speargrass Rd
📅 Date: Tuesday 12 November 2024
🕒 Drop-in session time: Anytime between 8am – 5pm

📍 Wyndham: Council Chambers, 6 Koolama St
📅 Date: Wednesday 13 November 2024
🕒 Drop-in session time: Anytime between 8am – 12pm

We look forward to hearing your thoughts and questions. Learn more about the project: https://go.shell.com/3UrG2jQ **See less**

Edit

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Most relevant

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View all 2 replies

Shell Australia
Crux Environmental Plan Consultation
Broome

16 May 2024

Shell Australia respectfully acknowledges the many Traditional Owner groups of the lands and waters on which we operate and pay our respect to the Elders past, present and emerging.

Definitions & cautionary note

Cautionary Note

The companies in which Shell plc directly and indirectly owns investments are separate legal entities. In this presentation "Shell", "Shell Group" and "Group" are sometimes used for convenience where references are made to Shell plc and its subsidiaries in general. Likewise, the words "we", "us" and "our" are also used to refer to Shell plc and its subsidiaries in general or to those who work for them. These terms are also used where no useful purpose is served by identifying the particular entity or entities. ''Subsidiaries", "Shell subsidiaries" and "Shell companies" as used in this presentation refer to entities over which Shell plc either directly or indirectly has control. Entities and unincorporated arrangements over which Shell has joint control are generally referred to as "joint ventures" and "joint operations", respectively. "Joint ventures" and "joint operations" are collectively referred to as "joint arrangements". Entities over which Shell has significant influence but neither control nor joint control are referred to as "associates". The term "Shell interest" is used for convenience to indicate the direct and/or indirect ownership interest held by Shell in an entity or unincorporated joint arrangement, after exclusion of all third-party interest.

Forward-Looking Statements

This presentation contains forward-looking statements (within the meaning of the U.S. Private Securities Litigation Reform Act of 1995) concerning the financial condition, results of operations and businesses of Shell. All statements other than statements of historical fact are, or may be deemed to be, forward-looking statements. Forward-looking statements are statements of future expectations that are based on management's current expectations and assumptions and involve known and unknown risks and uncertainties that could cause actual results, performance or events to differ materially from those expressed or implied in these statements. Forward-looking statements include, among other things, statements concerning the potential exposure of Shell to market risks and statements expressing management's expectations, beliefs, estimates, forecasts, projections and assumptions. These forward-looking statements are identified by their use of terms and phrases such as "aim", "ambition", ''anticipate", ''believe", ''could", ''estimate'', ''expect", ''goals", ''intend", ''may", "milestones", ''objectives", ''outlook", ''plan'', ''probably', ''project", ''risks", "schedule", ''seek", ''should", ''target", ''will'' and similar terms and phrases. There are a number of factors that could affect the future operations of Shell and could cause those results to differ materially from those expressed in the forward-looking statements included in this [report], including (without limitation): (a) price fluctuations in crude oil and natural gas; (b) changes in demand for Shell's products; (c) currency fluctuations; (d) drilling and production results; (e) reserves estimates; (f) loss of market share and industry competition; (g) environmental and physical risks; (h) risks associated with the identification of suitable potential acquisition properties and targets, and successful negotiation and completion of such transactions; (i) the risk of doing business in developing countries and countries subject to international sanctions; (j) legislative, judicial, fiscal and regulatory developments including regulatory measures addressing climate change; (k) economic and financial market conditions in various countries and regions; (l) political risks, including the risks of expropriation and renegotiation of the terms of contracts with governmental entities, delays or advancements in the approval of projects and delays in the reimbursement for shared costs; (m) risks associated with the impact of pandemics, such as the COVID-19 (coronavirus) outbreak; and (n) changes in trading conditions. No assurance is provided that future dividend payments will match or exceed previous dividend payments. All forward-looking statements contained in this presentation are expressly qualified in their entirety by the cautionary statements contained or referred to in this section. Readers should not place undue reliance on forward-looking statements. Additional risk factors that may affect future results are contained in Shell plc's Form 20-F for the year ended December 31, 2021 (available at www.shell.com/investor and www.sec.gov). These risk factors also expressly qualify all forward-looking statements contained in this [report] and should be considered by the reader. Each forward-looking statement speaks only as of the date of this presentation, 27 April 2023. Neither Shell plc nor any of its subsidiaries undertake any obligation to publicly update or revise any forward-looking statement as a result of new information, future events or other information. In light of these risks, results could differ materially from those stated, implied or inferred from the forward-looking statements contained in this presentation.

Shell's net carbon footprint

Also, in this presentation we may refer to Shell's "Net Carbon Footprint" or "Net Carbon Intensity", which include Shell's carbon emissions from the production of our energy products, our suppliers' carbon emissions in supplying energy for that production and our customers' carbon emissions associated with their use of the energy products we sell. Shell only controls its own emissions. The use of the term Shell's "Net Carbon Footprint" or "Net Carbon Intensity" are for convenience only and not intended to suggest these emissions are those of Shell plc or its subsidiaries.

Shell's net-Zero Emissions Target

Shell's operating plan, outlook and budgets are forecasted for a ten-year period and are updated every year. They reflect the current economic environment and what we can reasonably expect to see over the next ten years. Accordingly, they reflect our Scope 1, Scope 2 and Net Carbon Footprint (NCF) targets over the next ten years. However, Shell's operating plans cannot reflect our 2050 net-zero emissions target and 2035 NCF target, as these targets are currently outside our planning period. In the future, as society moves towards net-zero emissions, we expect Shell's operating plans to reflect this movement. However, if society is not net zero in 2050, as of today, there would be significant risk that Shell may not meet this target.

Forward Looking Non-GAAP measures

This presentation may contain certain forward-looking non-GAAP measures such as [cash capital expenditure] and [divestments]. We are unable to provide a reconciliation of these forward-looking Non-GAAP measures to the most comparable GAAP financial measures because certain information needed to reconcile those Non-GAAP measures to the most comparable GAAP financial measures is dependent on future events some of which are outside the control of Shell, such as oil and gas prices, interest rates and exchange rates. Moreover, estimating such GAAP measures with the required precision necessary to provide a meaningful reconciliation is extremely difficult and could not be accomplished without unreasonable effort. Non-GAAP measures in respect of future periods which cannot be reconciled to the most comparable GAAP financial measure are calculated in a manner which is consistent with the accounting policies applied in Shell plc's consolidated financial statements.

The contents of websites referred to in this presentation do not form part of this presentation.

We may have used certain terms, such as resources, in this presentation that the United States Securities and Exchange Commission (SEC) strictly prohibits us from including in our filings with the SEC. Investors are urged to consider closely the disclosure in our Form 20-F, File No 1-32575, available on the SEC website www.sec.gov.

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Shell in Australia

Shell's integrated energy solutions portfolio in Australia

PRELUDE

3.6 MTPA

LIQUIDS & CONDENSATE CAPACITY

QGC

8.5 MTPA

LIQUIDS & CONDENSATE CAPACITY

Non-Operated Ventures

2.8 MTPA
NORTH WEST SHELF

3.9 MTPA
GORGON

MORE THAN
8M TONNES
C02 INJECTED BY GORGON CCUS TO DATE

KONDININ ENERGY

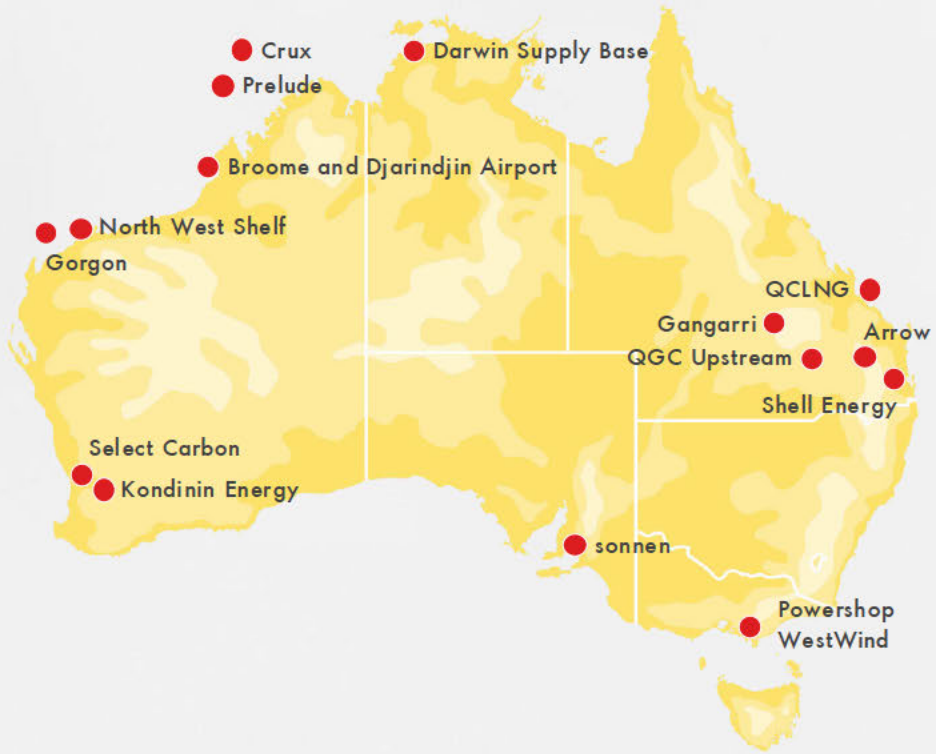
370 MW

OF DEVELOPMENT ACROSS WIND, SOLAR AND BATTERY ENERGY STORAGE SYSTEM ASSETS

SelectCarbon

MILLIONS OF HECTARES

OF CARBON SEQUESTRATION PROJECTS ACROSS AUSTRALIA



POWERSHOP

200K+

RESIDENTIAL AND SMALL BUSINESS GAS AND ELECTRICITY CUSTOMERS

WestWind ENERGY

670 MW

WIND PROJECTS DELIVERED

arrow energy go further

27 YEAR

GAS SUPPLY AGREEMENT WITH QCLNG

Shell ENERGY

2nd LARGEST*

ELECTRICITY PROVIDER TO C&I BUSINESSES

sonnen

80%

YEARLY HOME ENERGY NEEDS MET WITH PV + sonnenBATTARIE

GANGARRI

120 MW

SOLAR DEVELOPMENT IN COMMISSIONING

RESTRICTED

* By load, based on Shell Energy analysis of publicly available data
Prelude, QGC, Gorgon and North West Shelf MTPA values represent Shell share
Gorgon CCUS total from CCS system startup in August 2019 to May 2023

Prelude

- Prelude is a Floating Liquefied Natural Gas (FLNG) facility located 475km north-northeast of Broome, Western Australia, in the Browse Basin.
- The Prelude FLNG facility is moored over the Prelude gas field in 250m water depth and more than 200km from the coastline.
- Prelude produces LNG, LPG and condensate.
- Prelude has an onshore supply base in Darwin

Location:
WA-44-L, in Commonwealth marine waters, 475 km north-north east of Broome in Western Australia

Facility Type:
Floating liquefied natural gas (FLNG) facility

Number of wells:
Seven

Production capacity:
3.6 million tonnes per annum (mtpa) LNG, 1.3 mtpa LPG, 1.3mtpa condensate

Water depths:
250m

Status:
In operation

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Update on Social Investment

- Some of the longer-term larger programs we support provide sustained benefits to both our business and communities.
- When we talk to communities where we operate, these areas came up regularly and directed our investment in areas that align with our business:

SUPPORTING STRONGER FIRST NATIONS

We respect Indigenous people's deep connection to the land where we work.

We want to support them in rebuilding their identity and shaping their future.

JOBS FOR THE FUTURE

Local communities want young people to have meaningful jobs.

To access jobs with Prelude FLNG and many other employers in the future, young people will need strong science skills, and foundational skills and support to learn.

REGIONAL ECONOMIC DEVELOPMENT

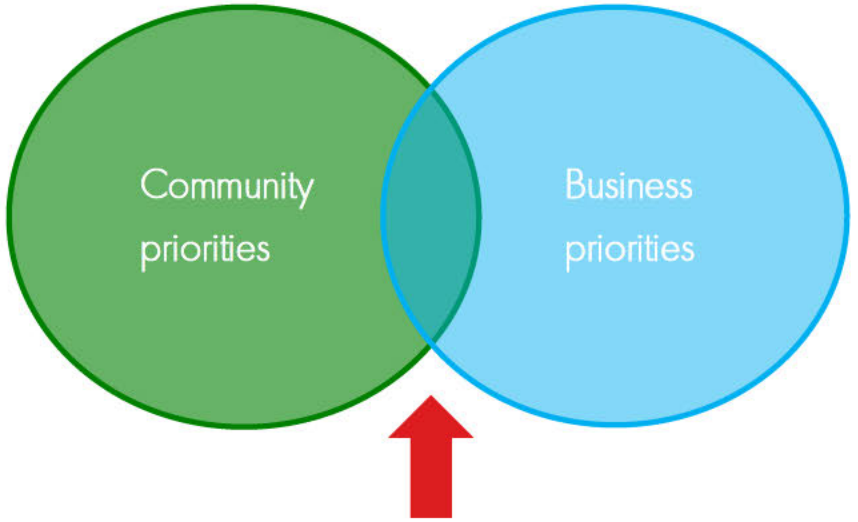
A diverse local economy benefits everyone.

Shell wants to be just one part of a thriving economy and support the growth of other sectors alongside our own.

- We're taking a fresh look at our social investment strategy for our programs being delivered from 2026-2028.
- Typically, we look at 3-year programs in the above areas to build long term social outcomes in above areas across a region, with smaller flexible funding pools which community and Indigenous groups can apply for to support local priorities.
- We want to understand where we can better align our social investment to bring greater benefits in our next programs.

How do we define Social Investment?

Social Investment is a voluntary contribution that Shell makes to communities of skills and/or resources that provide sustainable social outcomes for the community and for Shell.



Highest priority areas we focus on

What that includes

- Programs specific to the regional communities where Shell Australia operates – covering areas where highest community needs align with our business priorities to create shared value.
- Programs that can run over multiple years and deliver significant, lasting positive impact to the local communities – i.e., real social change.

What it doesn't include

- Stepping into the shoes of Government, or areas that are responsibilities of other organisations.
- Managing the impact of our operations, sponsorships and donations (e.g. for brand and publicity purposes), apprenticeships or traineeships – other areas of our business look after these areas.

Feedback on our Social Investment

- What are the main social issues in the region right now? Have these changed over the past three years?
- Do any of these align with our strategic areas? Are these areas where Shell can add the most value/ have shared value compared to other organisations?
- Of our existing programs, which do you think provide the most long-term value to the community? And if you'd like to elaborate, why?
- What's not working so well?

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Community Benefits

- Shell Community Benefits Fund is designed to provide funding for Communities to enhance liveability and ensure ongoing sustainability of the community

- Funding for projects is identified through collaboration with groups and organisations for both short term and long term benefits

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Community Grants Writer

- For the past 5 yrs Community Grants Writer has been funded by Shell's QGC Business in Western Downs region of QLD something that can be replicated in Broome
- Grant writers role is to research, identify and access funding opportunities
- It would be a shared resource in Broome and with Traditional owner groups with Shell's footprint
- Over $9.5 million dollars of approved successful grant applications since 2019 over 300 applications
- The grants writer works with community organisations and groups to build grant writing capability
- 18month pilot – potentially run 5 years total
- Commencing later this year

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Social Investment in the Kimberley

Shell is committed to working with local communities to deliver a better future

WARRMIJALA MURRGURLAYI (RISE UP TO WORK) NYAMBA BURU YAWURU

Rangelands Conference at Gumaranganyjal Station

Provides cultural, social, training and placement support for Indigenous people to gain employment.

BARDI JAWI OORANY RANGERS KIMBERLEY LAND COUNCIL

Rangers Natasha George And Viv Hunter-Orchid Propagating

Shell supports the Bardi Jawi Oorany Rangers to protect the environment and culture on the Dampier Peninsula.

Provides pathways to sustainable employment for women rangers and protects the environment and culture through traditional caring for country practices.

WAALITJ FOUNDATION DEADLY SISTA GIRLZ

Provides support to female students to continue their education.

Deadly Sista Girlz supports high school attainment for Indigenous young people.

KIMBERLEY BUSINESS NETWORK – BROOME CHAMBER

Provides business advisory, coaching training and support services to local and Indigenous businesses across Broome and the Kimberley to help them grow and create jobs.

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Prelude Communities Fund

The Prelude Communities Fund was made available to support community projects in the Shire of Broome up to the value of $15,000 in alignment with our priorities of; education & training, regional liveability and supporting stronger first nations.

2023 Communities Fund Recipients:

- **Djarindjin Aboriginal Corporation**-Community Garden
- **Burrguk Aboriginal Corporation**-Cultural History Display Board
- **Roebuck Primary School**- Microphone Hear and Learn System
- **Broome Senior Highschool**- STEM workshop and ICT classroom
- **Feed the Little Children**- Emergency Food relief

- Communities Fund will open in Q3 2024 expected July . Keep an eye on the SmartyGrants website

Prelude Communities Fund

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Supply Opportunities

- Shell is committed to giving Australian suppliers, local, regional and Indigenous businesses genuine opportunities to participate in our supply chain.

- To view opportunities and register your interest please visit Shell Australia's website www.shell.com.au **'becoming a supplier'** section. Or scan the QR code

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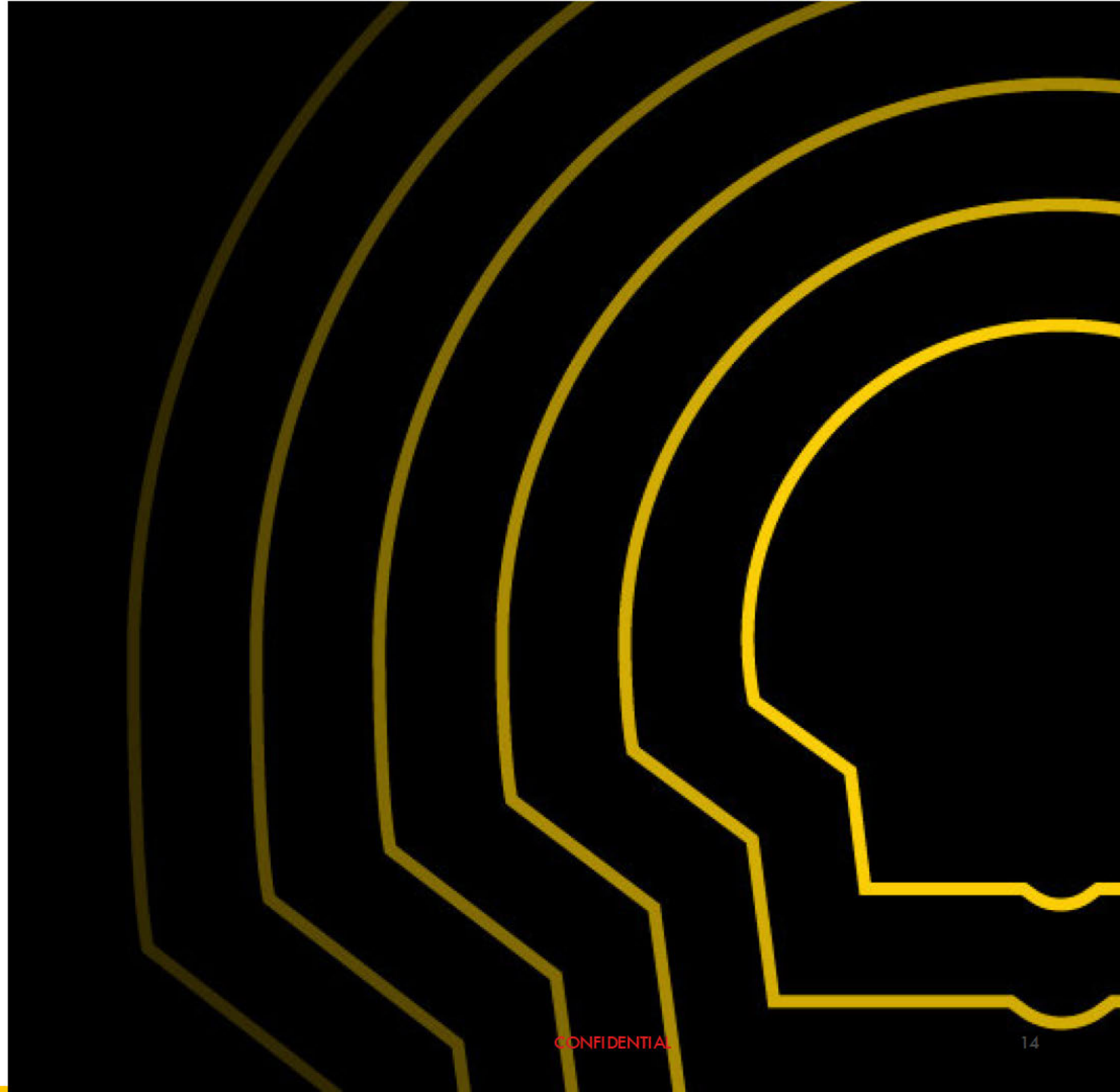
Q&A



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Crux Animation

https://creativehub.shell.com/m/61f586aae5cb405e/original/Crux-Stakeholder-Engagement-2023-05-10.mp4

The Crux Project is located 190km off the north-west coast of Western Australia, in waters of around 165m deep. It will provide continued supply of gas to the existing Prelude Floating Liquefied Natural Gas (FLNG) facility, approximately 160km southwest of the Crux field. The Crux Project forms an important part of Shell Australia's natural gas portfolio, and is being progressed with our joint venture partner, SGH Energy.

The project features a Not Normally Manned platform with five production wells, minimal processing facilities and utility systems. The platform will be operated remotely from the existing Prelude FLNG facility, requiring only periodic maintenance visits, significantly reducing the operational safety exposure to staff. A 26" export pipeline will connect the Crux Project to Prelude along the seabed approximately 160km long away. The pipeline route is relatively straight, and there are no seabed obstructions. The Prelude Floating LNG facility is 488mm long and 74m wide and is designed to remain moored in the field for at least 25 years. The facility extracts, liquefies, and stores natural gas at sea, before it is transferred and shipped to customers.

Development of Crux begins with drilling of the five wells. A subsea template structure provides a guide for the drill bit, with eight slots to allow for contingency. The wells will be drilled by a Mobile Offshore Drilling Unit, then suspended ready for completion after the platform and substructure have been installed.

The 26" rigid, concrete-clad export pipeline will be laid by a specialised pipelay vessel along a seabed corridor in water depths from 170m - 280m. A pipeline termination structure will be installed at each end, allowing for tie-in operations to be completed afterwards. The substructure will be brought to site, then landed over the guideposts on the drilling template. 12 anchor piles will be driven through the foundation to hold it in place. The topside facility will then be brought in and lowered onto the substructure. Subsea tie-in activities will then connect the platform to the export pipeline and to Prelude FLNG.

All systems will then be commissioned and safety-tested before production begins. At peak capacity the Crux Project is expected to provide approximately 2.9 million tonnes per annum of natural gas.

Before Shell commences substantial work on major projects or existing facilities, the regulatory, environmental, and social impacts are assessed, alongside commercial and technical considerations. As part of the Crux development, Shell will be preparing environmental approvals for submission to NOPSEMA. These Environmental plans outline the potential impacts and risks of an activity and how they will be managed.

Shell is consulting with relevant community members who have functions, interests or activities that may be affected, which is an important part of these approvals.

For more information on these plans please visit shell.com.au/crux

Shell has been operating in Australia since 1901. In this time, the needs of our customers and the nation have changed. Today, Shell Australia has an integrated energy solutions portfolio which includes gas production and liquefaction businesses, and Shell has been investing in renewable power and energy solutions to create a low- and zero-carbon energy business in Australia.

The Crux Project is a key part of Shell's current and future energy goals, helping to meet the growing demand for LNG. It aligns with Shell's "Powering Progress" strategy by helping customers switch to liquefied natural gas (LNG) as an alternative to more carbon intensive forms of fuel such as coal. Natural gas emits around half the greenhouse gas than coal does when used to generate electricity and less than one-tenth of the air pollutants.

Indigenous RPs – standard template

Shell Australia

2024

Shell Australia respectfully acknowledges the many Traditional Owner groups of the lands and waters on which we operate and pay our respect to the Elders past, present and emerging.

Agenda

1. Welcome to Country
2. Introductions
3. Shell Overview
4. Crux Project
5. Crux Environmental Impacts
6. Protecting Land and Sea Country
7. Social Investment and Other Opportunities
8. Prelude FLNG

- ask questions at any time

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Why are we here today?

- We have a floating Liquified Natural Gas facility off the Kimberley coast
- We are currently developing a platform to connect a new gas reservoir to our existing facility
- To do this safely we need to make sure we:
  1. Understand the environment we are developing in; and
  2. Minimize any impact to the environment, including cultural heritage
- We've done a lot of research to understand the environment and our potential impact however we want to hear from Traditional Owners who know your country best
- This information gets written in an Environmental Plan and submitted to a regulator called NOPSEMA

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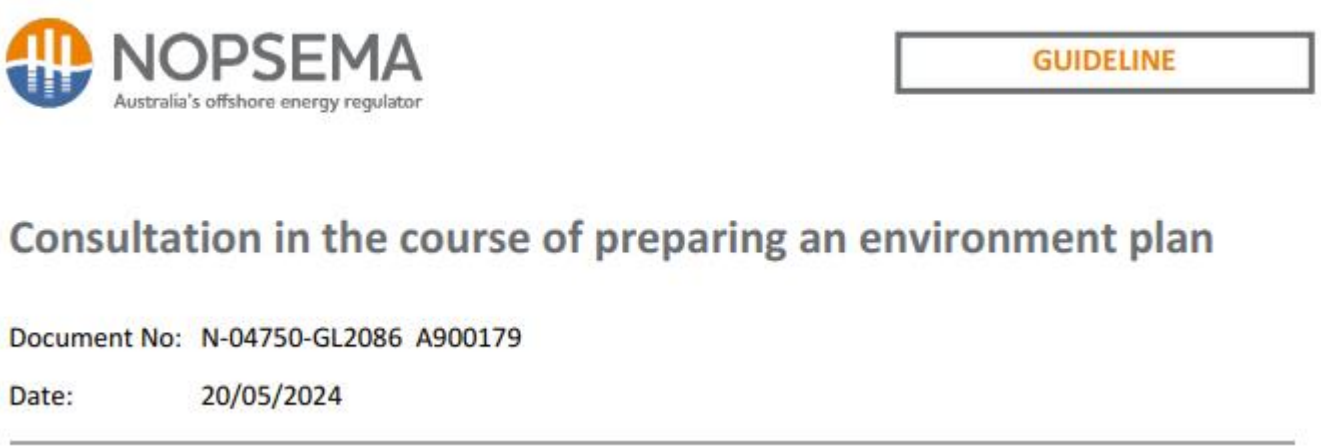
Offshore Petroleum Activities - Regulatory Context

- Regulator: NOPSEMA – National Offshore Petroleum Safety and Environment Management Authority
- Offshore Petroleum Greenhouse Gas Storage (OPGGS) Act
- OPGGS (Environment) Regulations
  - Require Environment Plan (EP) accepted prior to commencing activities
  - Consultation with relevant persons required in preparation of EPs



[Guideline: Consultation in the course of preparing an environment plan (nopsema.gov.au)]

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Shell in Australia

Shell's integrated energy solutions portfolio in Australia

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3.6 MTPA
LNG
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QGC

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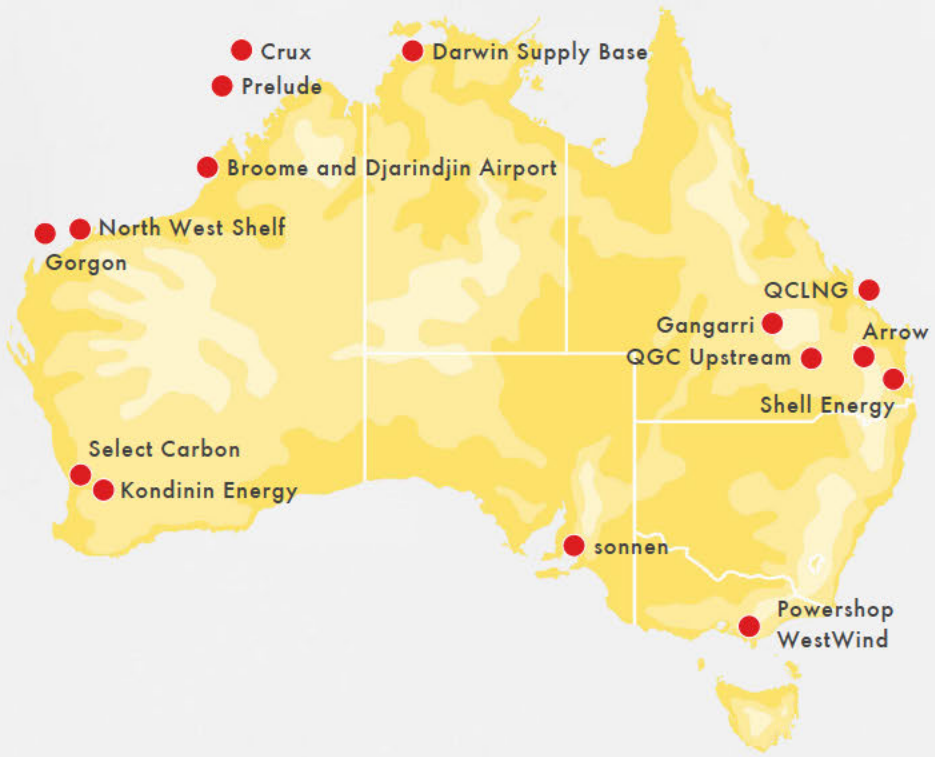

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27 YEAR
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sonnen

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- Prelude produces LNG, LPG and condensate.
- Prelude has an onshore supply base in Darwin

Location:
WA-44-L, in Commonwealth marine waters, 475 km north-north east of Broome in Western Australia

Facility Type:
Floating liquefied natural gas (FLNG) facility

Number of wells:
Seven

Production capacity:
3.6 million tonnes per annum (mtpa) LNG, 1.3 mtpa LPG, 1.3mtpa condensate

Water depths:
250m

Status:
In operation

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Crux

- In May 2022, Shell Australia and SGH decided to go ahead with Crux.
- The project is a long-term extension to the existing Prelude FLNG facilities.
- Crux consists of a platform (which is not normally manned), above 5 gas wells. The gas is delivered via a pipeline to Shell's Prelude project, which is moored some 165km away, and processed onboard.
- The project is part of Shell's strategy to help meet the needs of gas users as the energy market moves to a lower carbon future.

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Completions, Commissioning, Start up & Operations Activities

Activities include:

- **Completions**: the process of cleaning up and making the five wells ready for production after drilling operations.
- **Hot commissioning and startup**: the process of testing systems with gas to ensure they work as planned.
- **Operations**: the process of operating the wells to meet production requirements.
- **Remote operations**: the transition to remote operations (not normally manned) is expected to take approximately 12 months from start-up. Until then, there will be varying requirements for personnel on the platform:
  - Well completions, commissioning, and start-up activities
  - Early operations phase
  - Interim operations model
  - Not normally manned

Timing:
Activities are planned to commence in 2026.

Duration:
Well completions and clean-up of the five production wells, hot commissioning and startup are planned for 2026 to 2027. Production operations will be ongoing from 2027.

*Dates for the commencement of activities and duration are subject to schedule change.

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The 26" rigid, concrete-clad export pipeline will be laid by a specialised pipelay vessel along a seabed corridor in water depths from 170m - 280m.

The purpose of consultation

To give **relevant persons** an opportunity to provide input into:

- Shell's understanding of the existing environment which may be affected by proposed activities, including the cultural features of that environment;
- how Shell's activities might impact the existing environment including its cultural features; and
- how controls and mitigation measures may be adopted to protect what is important to you.

We want to hear from you if:

- your functions, interests, or activities, may be affected by the activities, risks and impacts described in the Environment Plan
- if you have cultural heritage interests or
- if you know someone else who may be affected.

We would like to know of other people or organisations who you think may be relevant for these activities too.

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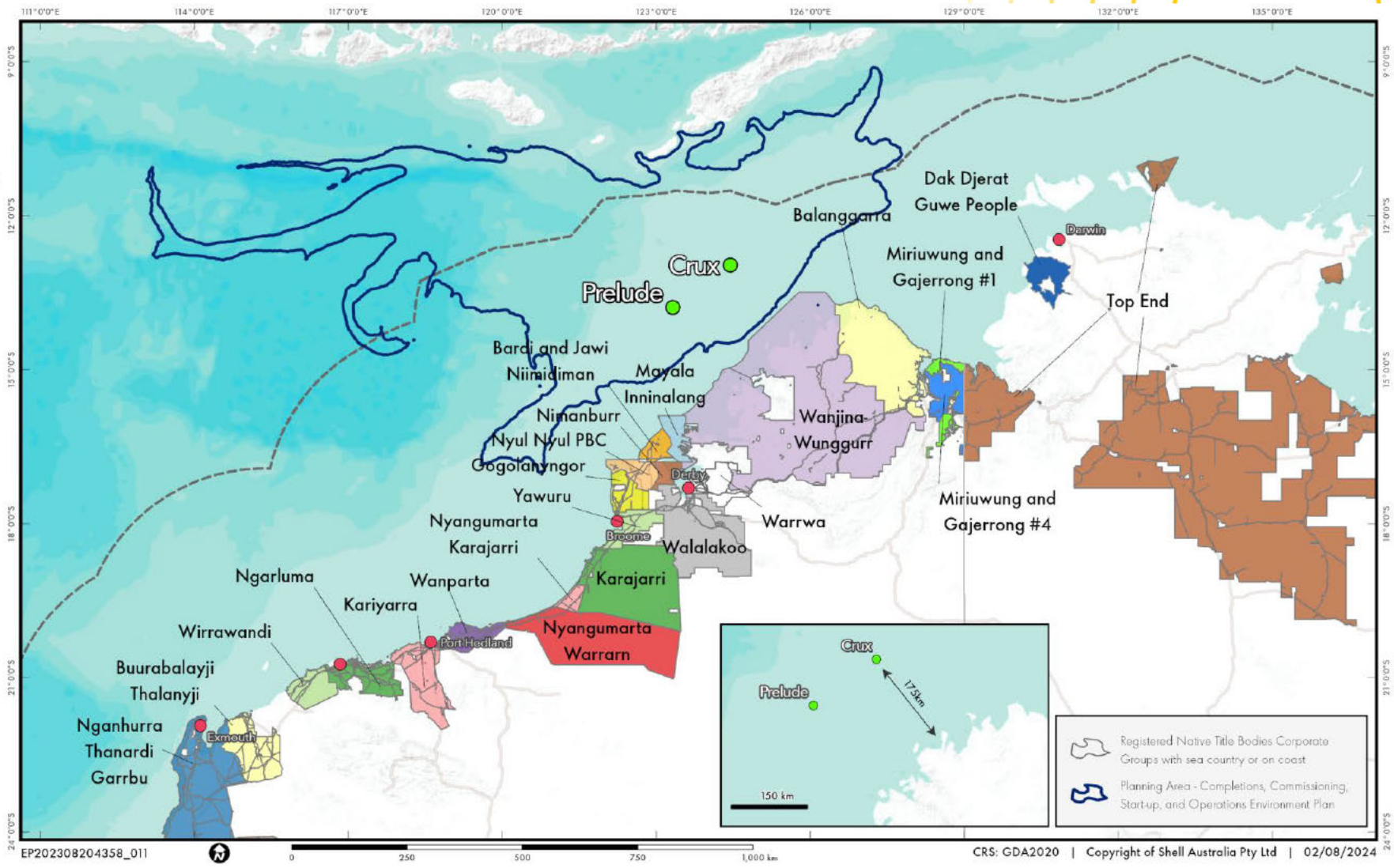
The Planning Area

- For each key stage of Crux, Shell develops an Environment Plan which looks at the key risks of that stage, and the size and scale of any impacts
- This is represented using a Planning Area.
- It shows the maximum outside limit of hundreds of individual, possible spill incidents.
- This takes into account weather, waves, currents, and other conditions.



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Expected vs unexpected activities

Expected Activities

Known activities that result in physical impact to the environment and occur within close proximity to the activity area. Shell has processes to control the impact of these such as:

- Physical presence of infrastructure and vessels
- Seabed disturbance
- Artificial light emissions
- Underwater sound emissions
- Atmospheric emissions (including GHG emissions)
- Utility discharges
- Produced water discharge

Unexpected Activities

Unexpected events are very rare. Shell has to be prepared for them, to ensure adequate controls such as:

- Fauna interactions
- Accidental release of waste overboard
- Introduction of invasive marine species
- Vessel collision resulting in diesel spill
- Pipeline Rupture
- Loss of Well Control resulting in oil spill

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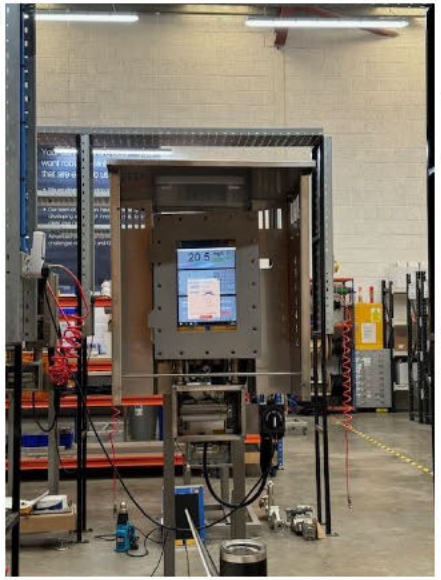
Crux Produced Water Management

- Crux uses standard offshore treatment technology in order to meet global and local standards for produced water discharge.
- Oil in water will be treated to level not exceeding 30mg/l prior to discharge (daily average).
- Estimated discharge rates 235-3029 m3/day. Increase as wells produce more water later in production.
- Oil in water will be monitored using an online analyser to assist in operating the process remotely.
- Periodic infield monitoring.
- Well understood discharge. Residual impacts from produced water are predicted to be slight (localised).



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Discharges: Drains, Greywater, Sewage, Wells, Subsea and Marine vessels

- All inherently low volume and risk discharges
- Drains system due to water source being rainwater and first flush captured.
- Crux and Prelude use a standard offshore treatment vessel in order to meet global and local standards for drains design discharge standards.
- All chemicals are risk assessed if planned for discharge.
- Subsea discharges: all small - MEG, hydraulic valves
- Standard marine vessel discharges.
- All of Slight consequence

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Browse Regional Oil Pollution Emergency Plan (BROPEP)

- BROPEP is Shell's regional spill contingency plan or OPEP.
- It documents Shell's Browse Basin regional spill response preparedness and first strike measures.
- Accepted by NOPSEMA under Drilling EP, and will be referred to for both the Prelude and Crux EPs.
- Shell has comprehensive capabilities and annual testing arrangements for BROPEP arrangements.
- Regional exercise occurred Sept 2024with over 200 personnel and regulators participating.

Response strategies included are;

1. source control, including subsea dispersant application
2. monitoring (including operational and scientific monitoring (OSMP) arrangements)
3. Protection of sensitive receptors
4. shoreline clean-up and SCAT
5. containment and recovery
6. surface chemical dispersants
7. Oiled wildlife response

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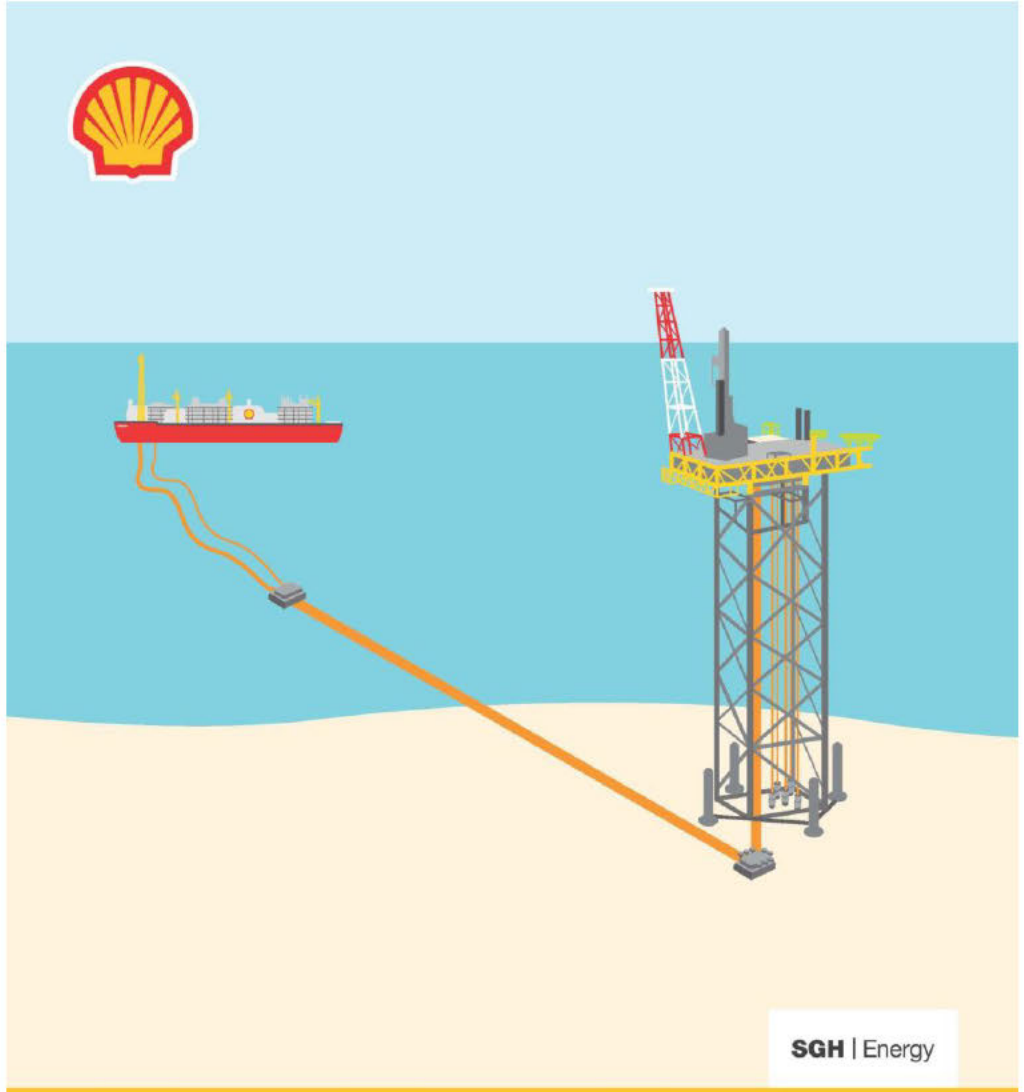
Ongoing Consultation

Existing Crux Environment Plans

- Crux Seabed Survey Environment Plan
- Crux Drilling Template Installation Environment Plan
- Crux Development Drilling Environment Plan
- Crux Installation and Cold Commissioning Environment Plan

Consultation in preparation of these plans was conducted throughout 2023 and early 2024.

- Shell is committed to ongoing consultation throughout the life of all Environment Plans.
- Any new information regarding environment impacts, risks and/or the existing environment will be used to update these plans
- This is driven by dedicated management of change process.



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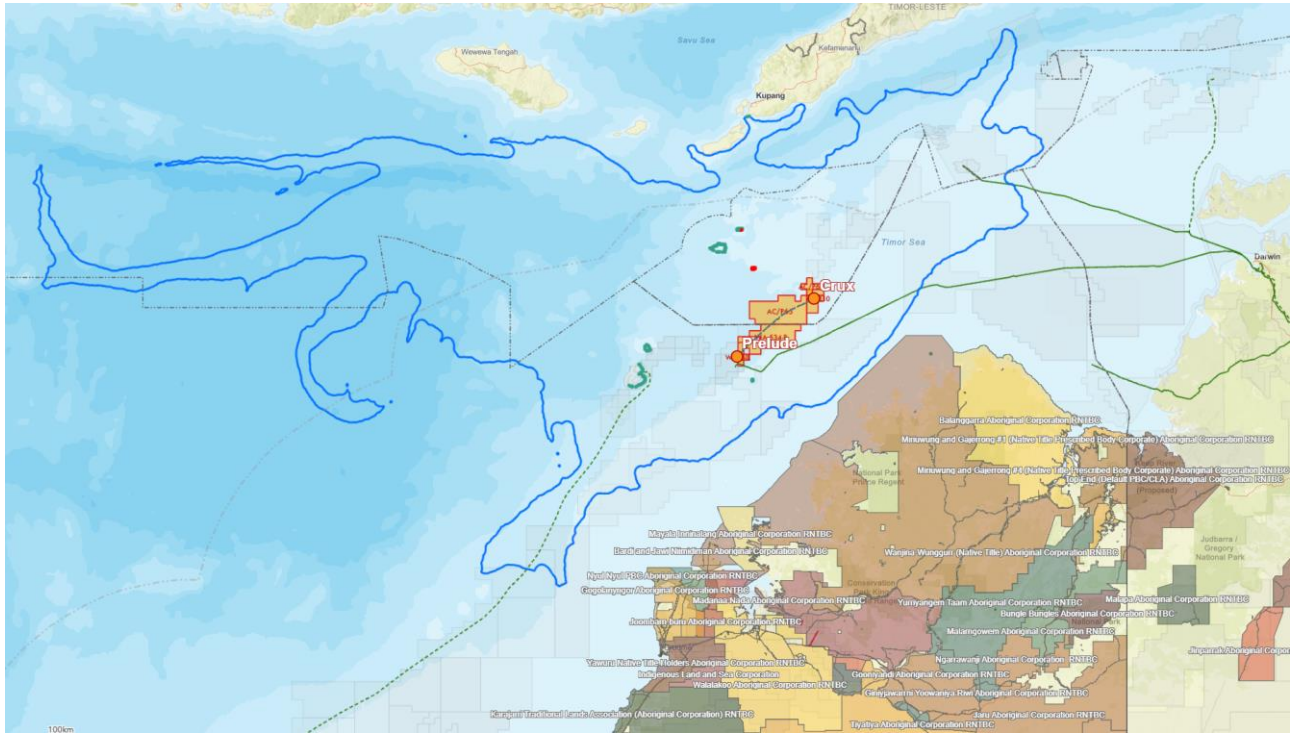
Protecting and respecting land and sea country

Shell has done research to improve our understanding about what is important to Aboriginal people in the Crux planning area.

We used Healthy Country plans, Native Title Determinations, Indigenous Land Use Agreements, Indigenous Protected Areas, Cultural Heritage Surveys and Assessments, heritage site registration and talking directly with Aboriginal groups.



Underwater Cultural Heritage

- We've looked at WA and NT databases for registered sites - there are no sites currently registered within the activity area.
- The Crux operating area is below the historical seabed levels (below 130m sea level). It's very unlikely there is any cultural heritage that far out to sea – the area was never above sea levels when human occupation existed.
- Further work mapping is being done on what tangible underwater cultural heritage could remain in the larger planning area

What we don't know

- Specific cultural features and values of your country?
- Any concerns for particular areas and sites that may exist for each different Traditional Owner groups?
- What you think of our current management methods?

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Environment Panel

- A panel of subject matter experts has been established, who you can go to with questions or concerns.
- You have access to the panel, with the costs incurred by Shell.
- It is anonymous - you can ask whatever you like from the panel.
- Shell will not see any of the information shared and any conversation is between you and the panel member.
- You are welcome to engage another environmental consultant for this purpose and Shell will pay for these services to support you during the consultation process.

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Social Investment in Shell Australia

- Some of the longer-term larger programs we support provide sustained benefits to both our business and communities.
- When we talk to communities where we operate, these areas came up regularly and directed our investment in areas that align with our business:

SUPPORTING STRONGER FIRST NATIONS

We respect Indigenous people's deep connection to the land where we work.

We want to support them in rebuilding their identity and shaping their future.

REGIONAL ECONOMIC DEVELOPMENT

A diverse local economy benefits everyone.

Shell wants to be just one part of a thriving economy and support the growth of other sectors alongside our own.

JOBS FOR THE FUTURE

Local communities want young people to have meaningful jobs.

To access jobs with Shell and many other employers in the future, young people will need strong science skills, and foundational skills and support to learn.

- We're taking a fresh look at our social investment strategy for our programs being delivered from 2026-2028.
- Typically, we look at 3-year programs in the above areas to build long term social outcomes in above areas across a region or community.

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Social Investment Overview

Bardi Jawi Oorany Rangers, Kimberley Land Council

Assists sustainable employment for women rangers and protects the environment and culture through traditional caring for country practices on the Dampier Peninsula

Warrmijala Murrgurlayi 'Rise up to Work', Nyamba Buru Yawuru

Provides cultural, social, training and placement support for Indigenous people to gain employment in Broome.

Deadly Sista Girlz, Waalitj Foundation

Deadly Sista Girlz supports high school attainment for Indigenous young people in Broome.

P242, Waalitj Foundation

P242 provides training and employment services for Indigenous people in Perth metro and Peel.

Kimberley Business Network, Broome Community, Commerce & Industry

Provides business advisory, coaching and support services to local and Indigenous businesses in Broome and Djarindjin to help them grow and create jobs.

Indigenous Business Support, Northern Territory Indigenous Business Network

Provides coaching and support to Indigenous businesses to help them grow in Darwin.

Prelude to the Future, Group Training Northern Territory

Provides accredited traineeships and apprenticeships, placing Territorians into employment in areas of skills shortage in Darwin.

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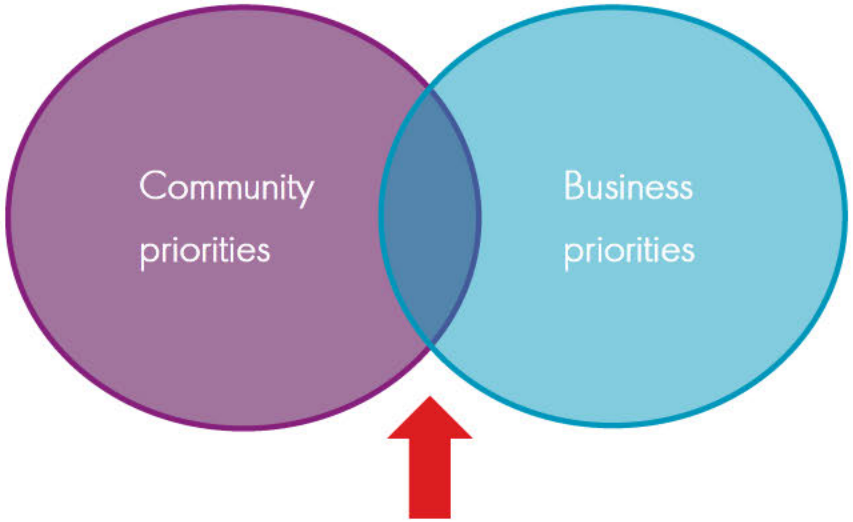
Our approach to Social Investment

Social Investment is a voluntary contribution that Shell makes to communities of skills and/or resources that provide sustainable social outcomes for the community and for Shell.



Highest priority areas we focus on

What that includes

- Programs specific to the regional communities where Shell Australia operates – covering areas where highest community needs are, aligning with our business priorities to create shared value.
- Programs that can run over multiple years and deliver significant, lasting positive impact to the local communities – i.e., real social change.

What it doesn't include

- Stepping into the shoes of Government, or areas that are responsibilities of other organisations.
- Managing the impact of our operations, sponsorships and donations (e.g. for brand and publicity purposes), apprenticeships or traineeships within our organisation – other areas of our business look after these areas.

National Energy Technician Training Scheme (NETTS)

Our NETTS Apprenticeship program opens annually for entry-level intake to the Prelude offshore facility, this is a 4-year program with FIFO opportunities from the second year and very competitive salaries. Applications are now open to all ages across the below three trade intakes:

- Mechanical Technicians
- Instrumentation Electricians
- Process Plant Technicians

Please visit https://info.programmed.com.au/nettswa for advice on how to apply.

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Supply Opportunities

- Shell is committed to giving Australian suppliers, local, regional and Indigenous businesses genuine opportunities to participate in our supply chain.

- To view opportunities and register your interest please visit Shell Australia's website www.shell.com.au **'becoming a supplier'** section. Or scan the QR code

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Prelude EP 5-Yearly Revision

- Prelude has been operating since 2018, with the first Prelude Operations Environment Plan (EP) accepted by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) in 2016.
- The first 5-yearly revision (the current Prelude Operations EP) was accepted by NOPSEMA in 2021.
- Shell plans to submit the next 5-yearly revision of the Prelude EP to NOPSEMA in late 2025.
- This revision will cover the receipt and processing of Crux gas on Prelude.

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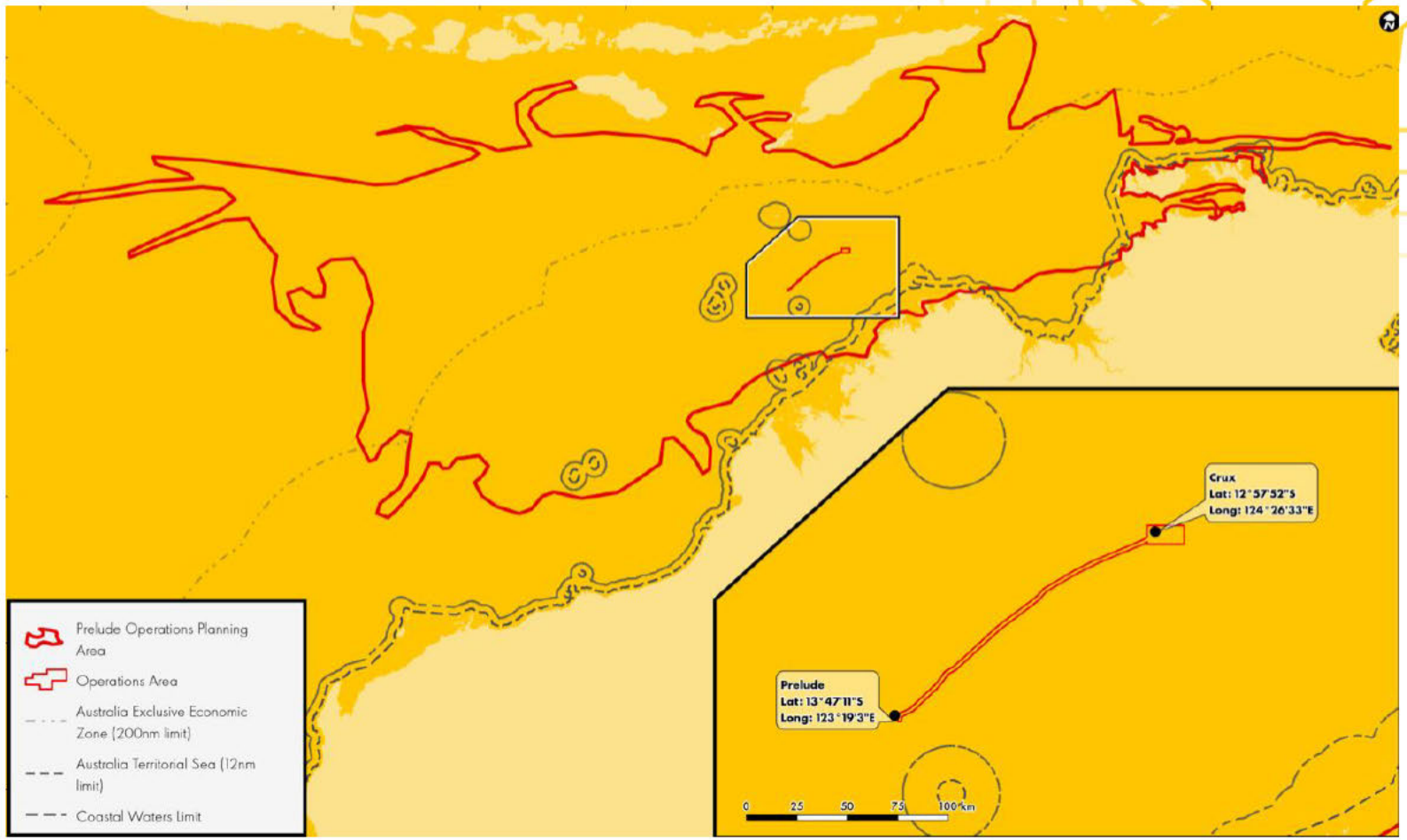
The Planning Area

- For each key stage of Crux, and for Prelude Operations, Shell develops an Environment Plan which looks at the key risks of that stage, and the size and scale of any impacts
- This is represented using a Planning Area.
- It shows the maximum outside limit of hundreds of individual, possible spill incidents.
- This takes into account weather, waves, currents, and other conditions.

Prelude Planning Area



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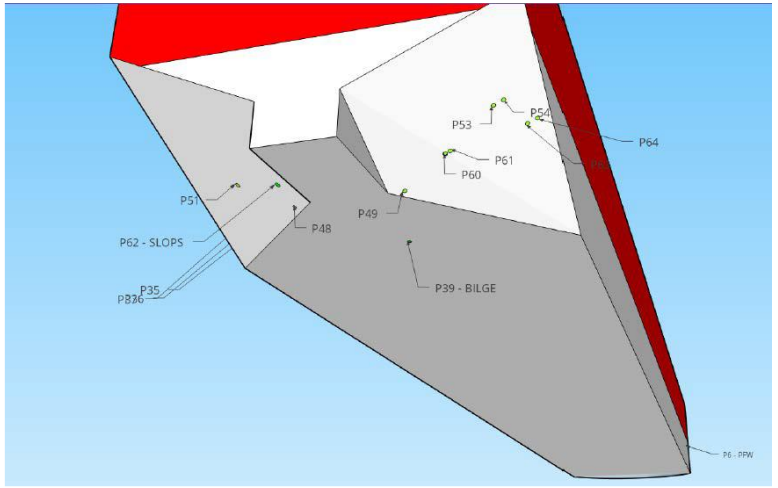
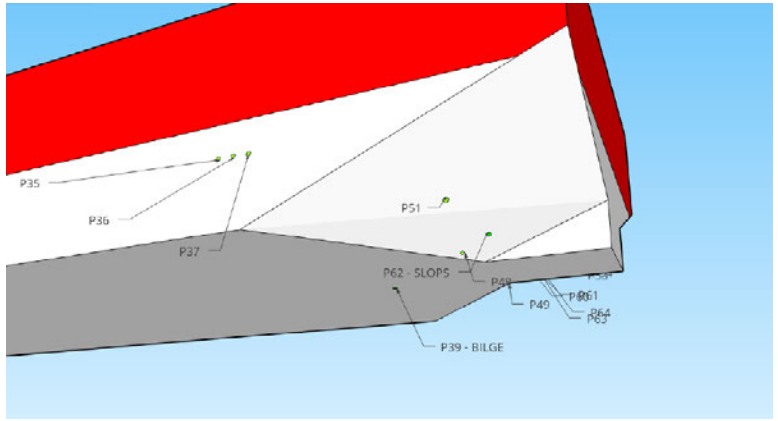
Liquid Discharges

There are several activities on Prelude that result in the discharge of liquid waste streams to the marine environment. These include:

- Drainage and bilge effluent
- Food waste, greywater and sewage
- Cooling Water (CW)
- Desalination brine, boiler blowdown and Mixed Bed Polisher (MBP) Effluent
- Produced Water (PW)
- Use and release of chemicals in ad-hoc discharges.





Note: unplanned spills, e.g. of chemicals or hydrocarbons, are considered separately

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Prelude Produced Water Management

- Prelude uses best available technology for offshore treatment (Macro Porous Polymer Extraction (MPPE) Package) in order to meet global and local standards for produced water discharge.
- The discharge limit for dispersed oil is a 24-hour average of 30 mg/L. Should this limit be exceeded, the water is manually diverted inboard for reprocessing.
- The PW treatment system of the FLNG facility is designed for a maximum 165 m3/hr discharge capacity.
- Oil in water is monitored using an online analyser.
- Produced water sample testing includes:
  - chemical characterisation
  - whole effluent ecotoxicological testing.
- Well understood discharge. Residual impacts from produced water are predicted to be slight (localised).

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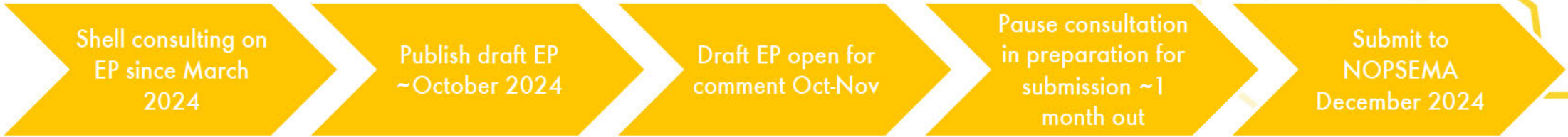
Where to from here?

- We want to stay in touch and develop stronger relationships
- Talk to your communities
- Ask questions of the Environment Panel
- Ask questions of us, Shell
- Are there others we should consult?

Information received during EP consultation is required to be documented in the EP when submitted to NOPSEMA. Following acceptance, the EP will be published online.

Let us know if anything you've told us is sensitive and we will ensure it's not published



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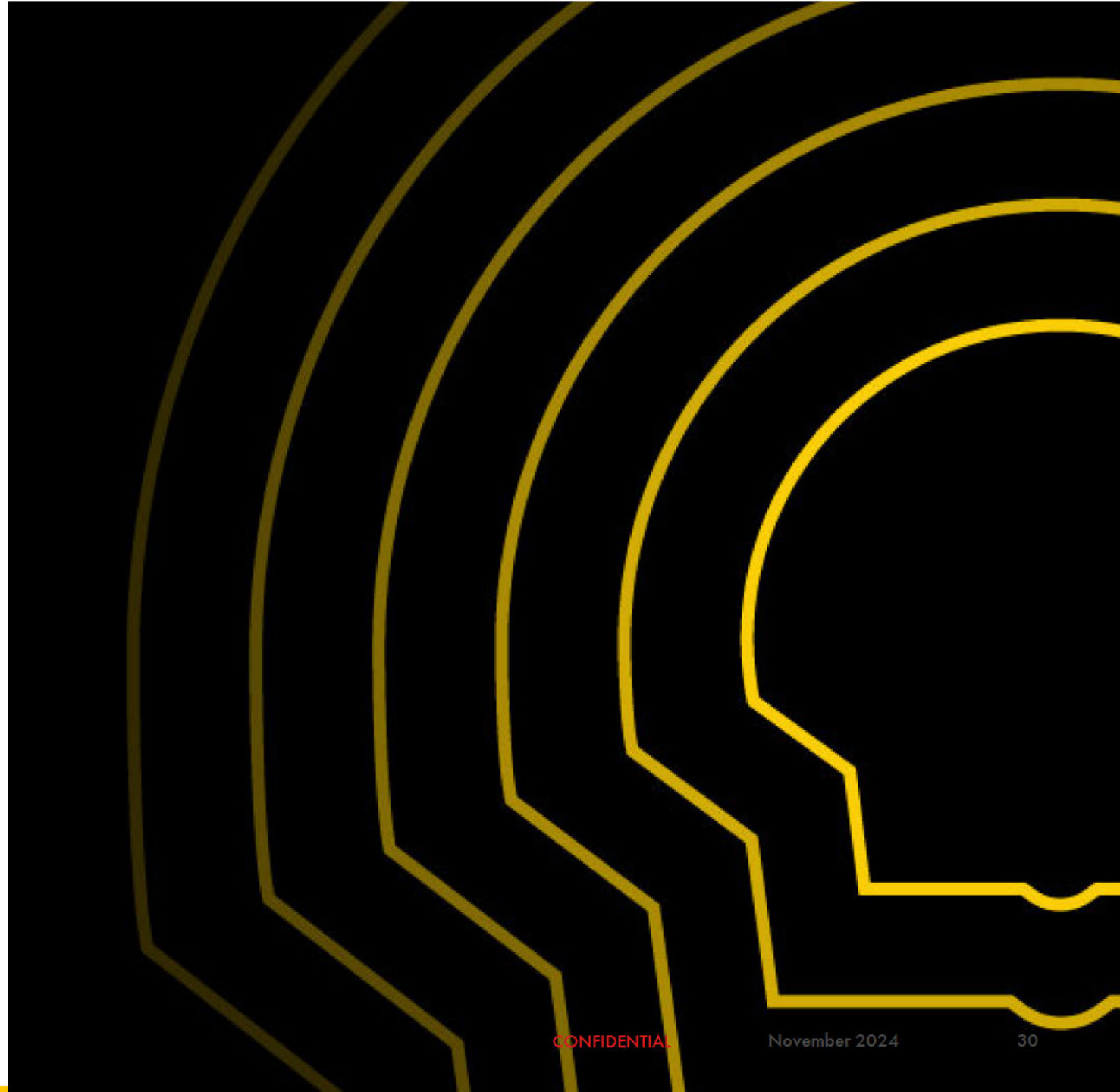
Q&A



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[redacted]

From: SDA CRUX-PROJECT SDA-ITPT/PI
Sent: Thursday, November 21, 2024 9:40 AM
Subject: Consultation on Shell Australia's Crux Completions, Commissioning, Start-up, and Operations Environment Plan/s
Attachments: 15870 SHELL - Crux Completions, Commissioning, Startup and Operations.pdf; 15947 SHELL EP General Information Sheet - Feb 2024.pdf; 15948 SHELL Cultural and Social Values Factsheet - Feb 2024 - P2 (1).pdf

Shell is commencing consultation on its *Completions, Commissioning, Start-up, and Operations Environment Plan*/s for the Crux project, as outlined in the attached Information Sheet. We want to give you an opportunity to consult with us on our proposed activities in this Environment Plan/s (EP).

Over the past 12 months Shell has spoken to many Traditional Owners, RNTBC's and PBC's, businesses and Aboriginal Corporations who are relevant persons for our Crux activities. We exchanged emails with you last year when we were consulting on four earlier EPs for the Crux Project. Three of those EPs have been accepted by NOPSEMA: the Seabed Survey, Drilling Template and Development Drilling EPs. The Installation and Cold Commissioning EP was submitted to NOPSEMA last month.

The purpose of this consultation is to give you an opportunity to provide input into:

- our understanding of the existing environment (including its cultural features), which may be affected by Shell's proposed activities, and the potential impact of our activities; and
- how controls and mitigation measures may be adopted to reduce the environmental impacts and risks associated with the proposed activities.

Further details on the purposes of consultation can be found in the NOPSEMA Consultation on Offshore Petroleum Environment Plans Brochure.

Feedback we receive from you will be included in the EP, when submitted to NOPSEMA for assessment. Once accepted, the EP will be published online however you may request that sensitive information you provide is not published.

An independent environmental panel of people has been established who are not employed by Shell and can answer any questions you have. Please contact any of the people listed below at no cost to yourself noting anything you ask or say will be kept confidential.

Independent Panel Members

[redacted]

If you wish to consult on our Completions, Commissioning, Start-up, and Operations Environment Plan please contact us by replying to this email or call on 0410 810 340 by 30 June 2024.

Kind Regards,

[redacted]

From: SDA CRUX-PROJECT SDA-ITPT/PI
Sent: Thursday, November 21, 2024 11:05 AM
Subject: Reminder: Consultation on Shell Australia's Crux Completions, Commissioning, Start-up, and Operations Environment Plan/s.
Attachments: 15947 SHELL EP General Information Sheet - Feb 2024.pdf; 16085 SHELL Crux Completions, Commissioning, Start up & Operations Information Sheet - May 2024 - P2.pdf

To whom it may concern,

This is a reminder that Shell Australia is seeking to consult with relevant persons in preparation of the *Completions, Commissioning, Start-up, and Operations Environment Plan/s* for the Crux project.

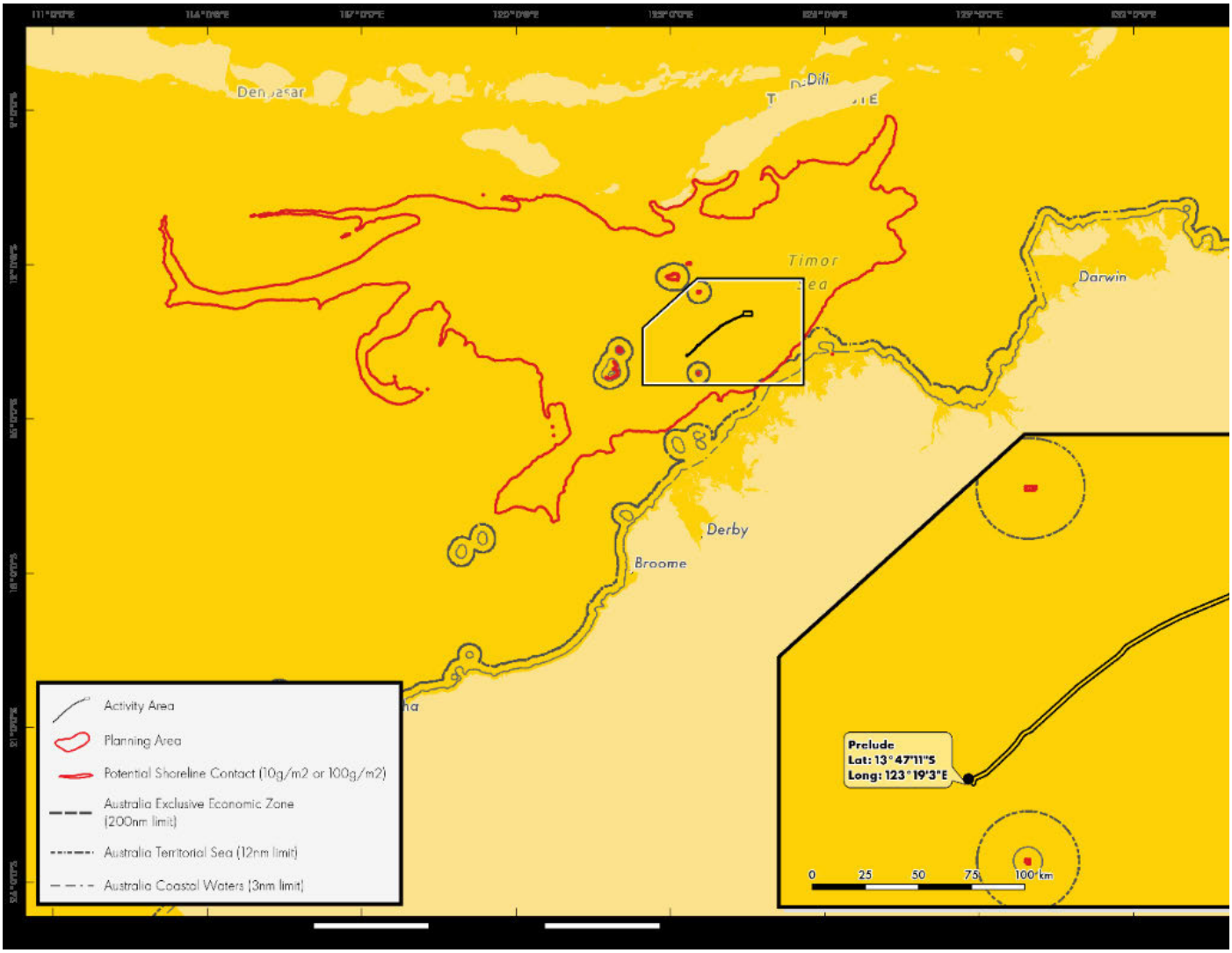
We want to hear from you if your functions, interests, or activities, may be affected by the activities, risks and impacts described in this Environment Plan, or if you have cultural heritage interests, or if you know someone else who may be affected.
The purpose of this consultation is to give you an opportunity to provide input into:

- our understanding of the existing environment including its cultural features which may be affected by Shell's proposed activities.
- how our activities might impact the existing environment including its cultural features; and
- how controls and mitigation measures may be adopted to reduce the environmental impacts and risks associated with the proposed activities.

About Crux

Shell is planning to extend its offshore gas production operations at the Prelude Floating Liquefied Natural Gas Facility. This extension requires new infrastructure to be installed offshore. This project is called Crux. At its closest point, Crux is about 190km off the coast of the Kimberley. When built, it will supply gas to Shell's existing gas operations, at Prelude, which is also offshore. There are no onshore activities.

Information about the project is available on our website: www.shell.com.au/crux. An information sheet describing the activities we are consulting on is also attached and you can watch an animation about Crux here.



Information received will be documented in the *Completions, Commissioning, Start-up, and Operations Environment Plan*, which will be submitted to Australia's offshore energy regulator, NOPSEMA, for assessment, and following acceptance, published online. You may request that sensitive information you provide not be published.

The purpose of this consultation is further detailed in the NOPSEMA Consultation on Offshore Petroleum Environment Plans Brochure.

We want to give you an opportunity to consult with us on this Environment Plan/s.

Please call our Community Hotline on 1800 059 152 if you wish to discuss further or reply to this email.

Should you or your organisation have any further questions, claims or objections or need more information, please advise us no later than 30 July 2024.

We look forward to hearing from you.

Kind regards,
The Crux Team.

[redacted]

From: SDA CRUX-PROJECT SDA-ITPT/PI
Sent: Thursday, November 21, 2024 11:00 AM
Subject: Update on Crux Environment Plans.
Attachments: 15947 SHELL EP General Information Sheet - Feb 2024.pdf; 16085 SHELL Crux Completions, Commissioning, Start up & Operations Information Sheet - May 2024 - P2.pdf

As previously advised, Shell Australia is currently consulting with relevant persons in preparation of the *Completions, Commissioning, Start-up, and Operations Environment Plan/s* for the Crux project.

We intend to publish a full draft of the Environment Plan on our website in October 2024, with submission to NOPSEMA planned for December 2024.

If you would like to be consulted or have information to share that you haven't yet provided, please let us know, so it can be included within our submission.

We want to hear from you if your functions, interests, or activities, may be affected by the activities, risks and impacts described in this Environment Plan, or if you have cultural heritage interests, or if you know someone else who may be affected.

The purpose of this consultation is to give you an opportunity to provide input into:

- our understanding of the existing environment which may be affected by Shell's proposed activities, including the cultural features of that environment.
- how our activities might impact the existing environment (including its cultural features); and
- appropriate controls and mitigation measures that may be adopted to reduce the environmental impact associated with the proposed activities.

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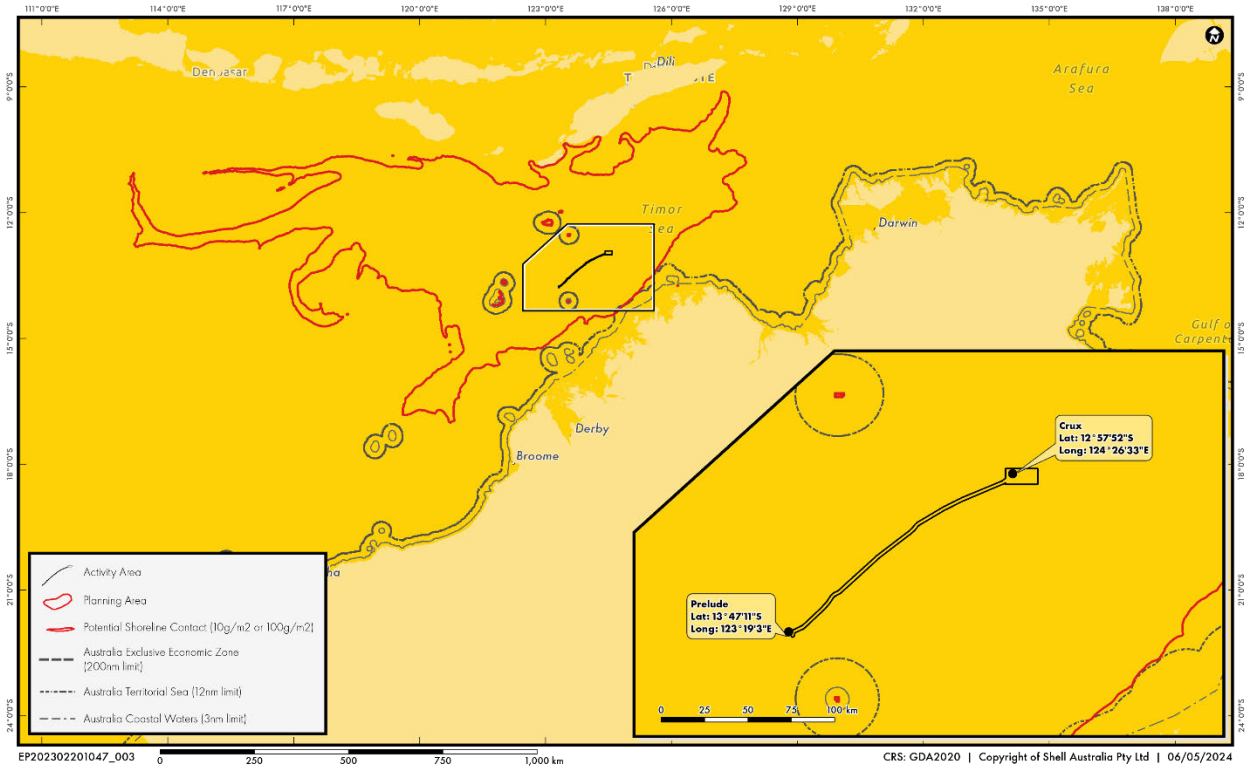

Information received will be documented in the *Completions, Commissioning, Start-up, and Operations Environment Plan*, which will be submitted to Australia's offshore energy regulator, NOPSEMA, for assessment, and following acceptance, published online. You may request that particular information you provide not be published. Any information that is the subject of such request will not be published.

The purpose of this consultation is further detailed in the NOPSEMA Consultation on Offshore Petroleum Environment Plans Brochure.

We want to give you an opportunity to consult with us on this Environment Plan.

If you would like to be consulted directly, please call our Community Hotline on 1800 059 152 or reply to this email.

Alternatively, if you would like to opt out from email updates, please reply to this email.

Kind regards,

The Crux Team.

[redacted]

From: SDA CRUX-PROJECT SDA-ITPT/PI
Sent: Thursday, November 21, 2024 9:44 AM
Subject: Final Call for Consultation on Crux Environment Plan Prior to Submission
Attachments: 16271 SHELL - Crux Completions, Commissioning, Start up & Operations Information Sheet - Web Accessible - P3-2.pdf; 15947 SHELL EP General Information Sheet - Feb 2024.pdf

Further to our previous emails and phone calls, regarding our consultation commitment to relevant persons, we are in the final stages of preparing our Completions, Commissioning, Start-up, and Operations Environment Plan for the Crux project, and have now published the full draft of the Environment Plan here: Draft Environment Plan

Submission to NOPSEMA is planned for December 2024. Should you have any comments or information to provide, please respond by **Friday 8 November 2024** so this information can be considered prior to submission.

If you would still like to be consulted or have information to share that you haven't yet provided, please let us know, so it can be included within our submission. We are happy to meet with you on-country or at a location that is convenient for you and can contribute to reasonable costs associated with you meeting with us.

We want to hear from you if your functions, interests, or activities, may be affected by the activities, risks and impacts described in this Environment Plan, or if you have cultural heritage interests, or if you know someone else who may be affected.

The purpose of this consultation is to give you an opportunity to provide input into:

- our understanding of the existing environment which may be affected by Shell's proposed activities, including the cultural features of that environment.
- how our activities might impact the existing environment (including its cultural features); and
- appropriate controls and mitigation measures that may be adopted to reduce the environmental impact associated with the proposed activities.

About Crux

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Information about the project is available on our website, www.shell.com.au/crux An information sheet describing the activities we are consulting on is also attached.

Happy to chat through on mobile below as needed.

Kind Regards,

NOPSEMA | Australia's offshore energy regulator

Consultation on offshore petroleum environment plans

Information for the community

The National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) is Australia's independent expert regulator for health and safety, structural and well integrity, and environmental management for offshore petroleum and greenhouse gas storage activities in Commonwealth waters.

The protection and preservation of the marine environment is best achieved when there are opportunities for the community to participate in the environmental approvals process through consultation.

Who can participate?

Under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (the regulations) there are several ways the community can participate in the environmental approvals process for offshore petroleum activities in Commonwealth waters.

Public comment for new projects and exploration activities

Offshore project proposals (OPPs) for new offshore petroleum projects and environment plans for offshore petroleum exploration activities are subject to a mandatory public comment period. Public comment must be done before the OPP or environment plan is submitted to NOPSEMA for assessment. Further information about public comment can be found at nopsema.gov.au.

Relevant persons consultation

Titleholders must consult with a specific category of people or organisations referred to as 'relevant persons' while preparing an environment plan for any offshore petroleum activity. This consultation must be done before the environment plan is submitted to NOPSEMA.

Some categories of relevant persons are specified in the regulations, such as government departments, however the information in this brochure is for the category of relevant persons who are not specified but who have 'functions, interests or activities' that may be affected by the offshore activity.

Correspondence directly to the regulator (NOPSEMA)

You can send correspondence directly to NOPSEMA; however, this generally cannot be considered until after the environment plan has been submitted. It is always better to use the public comment and relevant persons consultation processes in the first instance.

What is 'relevant persons' consultation?

Consultation on offshore petroleum activities is a two-way process where information is shared between titleholders and relevant persons. It is a requirement for titleholders when preparing an environment plan and is an important part of good environmental management.

Consultation provides an opportunity for people or organisations who may be affected by an offshore petroleum activity to raise concerns, including objections or claims, about the potential impacts of the activity, to seek information about how they may be affected, and how the titleholder intends to manage the activity to ensure the associated impacts are as low as reasonably practicable and are acceptable.

Information provided by relevant persons in consultation may also help titleholders better understand the values and sensitivities of the environment and inform the evaluation of the potential impacts and risks associated with the activity and how to manage them appropriately.

Am I a relevant person?

You may be a relevant person if you or your organisation have functions, interests, or activities that may be affected by an offshore petroleum activity proposed under an environment plan being prepared or already underway under an environment plan being revised.

The terms 'functions' 'interests' and 'activities' should be read broadly. You do not have to have a legal or financial interest that may be affected by an offshore petroleum activity to be a relevant person.

Interests that may be affected can include things like cultural and spiritual connections to the sea or interests in the protection of specific marine species. However, to be a relevant person your interests should be more than a general interest in the environment and/or offshore petroleum activities.

If I am a representative body, can I consult on behalf of all my members?

The law recognises that interests may be held communally. In some cases, all members of a community may agree that their representative body can consult on their behalf. However, this may not always be the case. Representative bodies should inform titleholders whether or not they have the authority to consult with titleholders on behalf of all their members.

Representative bodies, such as peak bodies and prescribed body corporates, may be relevant persons in their own right. They may also be an initial point of contact for titleholders to seek information about who else they should approach for consultation.

It is the titleholder's responsibility to provide all members of a community who have a shared interest opportunities to participate in consultation. In some circumstances, representative bodies may offer to assist titleholders with this.

Do I have to participate?

If you are a relevant person, you have the right to be consulted by titleholders of offshore petroleum activities when they are preparing an environment plan to submit to NOPSEMA.

Titleholders have a duty to provide you an opportunity to be consulted, however there is no obligation on you to participate in consultation. If you do not wish to be consulted, you should advise titleholders of this when they first contact you.

Titleholders must make reasonable efforts to consult with relevant persons, but the regulations do not require them to get a response to their requests. If you want to participate in consultation but need more information or time then it is best to communicate this to titleholders when they contact you. If you do not respond, they might assume you do not wish to be consulted.

If you are an organisation or representative body that is regularly approached for consultation you may consider developing guidance outlining how and when you want to be consulted. You could also consider documenting your functions, interests and activities. Both measures may help with managing regular requests for consultation.

In some instances, the likelihood of you being affected by an activity is very low and/or the impact on your functions, interests or activities may be minor. For example, if you are only going to be affected by the activity in the very unlikely event of an oil spill you may wish to inform titleholders you only want to be consulted if a spill occurs as part of the requirement for ongoing consultation set out in the regulations.

What if I want to be consulted but the titleholder hasn't contacted me?

Titleholders have a duty to identify who may be a relevant person and provide them opportunities to participate in consultation. However, even with best endeavors, titleholders may miss people or organisations who may be relevant.

If you believe you are a relevant person and you want to be consulted on offshore petroleum activities, then you should contact titleholders directly and identify yourself as a relevant person.

If a titleholder refuses to consult with you, and you believe you are a relevant person, you can write to NOPSEMA. Once an environment plan is submitted to NOPSEMA, this information can be considered in the assessment of whether or not the titleholder has met the requirements for consultation.

It is always better to attempt to resolve issues with the titleholder in the first instance. Relevant persons consultation is carried out before an environment plan is submitted, so NOPSEMA is limited in its ability to require titleholders to consult with a particular person or organisation.

What is the process for consultation?

There is no detailed process set out for how consultation should be carried out, however there are requirements that must be met under the regulations. These include:

- That you are given sufficient information to make an informed assessment about whether you are likely to be affected by the activity, how you may be affected, and to raise any concerns, including objections or claims, about the potential impacts of the activity.
- That you are given a reasonable period of time to consider the information provided to you and give feedback to the titleholder on the potential impacts of the activity on your functions, interests or activities.

What constitutes sufficient information and a reasonable period of time depends on several factors including the nature of your functions, interests and activities. You should communicate as early as possible in consultation with titleholders about what information and how much time you may need so that they can consider, respond and address these in their planning.

The information provided to you should be in a form that is appropriate and readily accessible to you. Consultation is generally a two-way process where information is shared between titleholders and relevant persons rather than a one-way process of seeking feedback to a fact sheet or high-level information.

What if I don't have the resources to participate?

If you are a relevant person and you believe you have information that is important to the understanding of the potential impacts of an offshore petroleum activity or you want to raise concerns, including objections or claims, then you should discuss with the titleholder how you can participate in consultation.

This might include requesting information in a different format, asking for more time to consider information or help to understand the information to provide an informed response.

There is no requirement in the law for titleholders to pay the costs incurred by relevant persons to be consulted, however they may choose to provide assistance to relevant persons to ensure consultation is carried out efficiently and is robust. This is a matter between the titleholder and relevant persons.

How do I make sure my views are considered?

It is important to communicate clearly when participating in consultation with titleholders. You may provide information to titleholders that helps them understand the environment and raise specific concerns, objections or claims about the potential impacts of the activity or the way the titleholder proposes to manage the activity to ensure the associated impacts are as low as reasonably practicable and are acceptable.

The information you provide to a titleholder during consultation must be considered by that titleholder and addressed in their environment plan for NOPSEMA to consider in its assessment and decision-making.

NOPSEMA publishes environment plans on its website when they are submitted for public comment, for assessment and when they are approved. Relevant persons have the right to request that the information they have provided in consultation is not published and titleholders must ensure they communicate this right to relevant persons.

Relevant persons should be aware that while you are free to respond on any matter and raise any concern, this may not be able to be considered if it is outside the scope or purpose of the environment plan and approval process. Examples of issues that may not be considered under the regulations include statements of fundamental objection to offshore petroleum activities or information containing personal threats or profanities.

Do titleholders need my consent?

Titleholders are not required by law to obtain agreement or consent from relevant persons for their offshore petroleum activities to proceed; however, they are required to demonstrate in their environment plan how the concerns, objections or claims raised by relevant persons were considered and demonstrate that their response to that information was appropriate.

NOPSEMA's assessment and decision-making will consider if titleholders have adequately demonstrated in the environment plan that genuine consultation has taken place with relevant persons in accordance with regulations.

Do I need to respond to a request for consultation?

There is no obligation for relevant persons to respond to a request for consultation from a titleholder. However, if you are provided an opportunity to participate in consultation and you do not want to be consulted, or you only want to be consulted on specific offshore petroleum activities or environmental matters, then it is best that you communicate this to titleholders as soon as they contact you. If you do not respond to requests for consultation, titleholders may make many repeated attempts to contact you.

NOPSEMA can help you understand the requirements for consultation and how to effectively participate in the process. Please contact communications@nopsema.gov.au for assistance.

NOPSEMA | Australia's offshore energy regulator

Further information

For further information visit nopsema.gov.au or contact communications@nopsema.gov.au.

Key legislation

Offshore Petroleum and Greenhouse Gas Storage Act 2006
Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
Environment Protection and Biodiversity Conservation Act 1999.

Contact details

p: +61 (08) 6188 8700
e: communications@nopsema.gov.au

Head office: Level 10, Alluvion Building
58 Mounts Bay Road, Perth WA 6000

Postal: GPO Box 2568 - Level 10 58 Mounts Bay Road, Perth WA 6000

nopsema.gov.au

National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA)

ABN 22 385 178 289

Published May 2023

[redacted]

From: SDA CRUX-PROJECT SDA-ITPT/PI
Sent: Thursday, November 21, 2024 9:20 AM
Subject: Consultation on Shell Australia's Crux Completions, Commissioning, Start-up, and Operations Environment Plan/s.
Attachments: 15870 SHELL - Crux Completions, Commissioning, Startup and Operations.pdf; 15947 SHELL EP General Information Sheet - Feb 2024.pdf

To whom it may concern,
Shell Australia is seeking to consult with relevant persons in preparation of the *Completions, Commissioning, Start-up, and Operations Environment Plan/s* for the Crux project.

We want to hear from you if your functions, interests, or activities, may be affected by the activities, risks and impacts described in this Environment Plan, or if you have cultural heritage interests, or if you know someone else who may be affected.

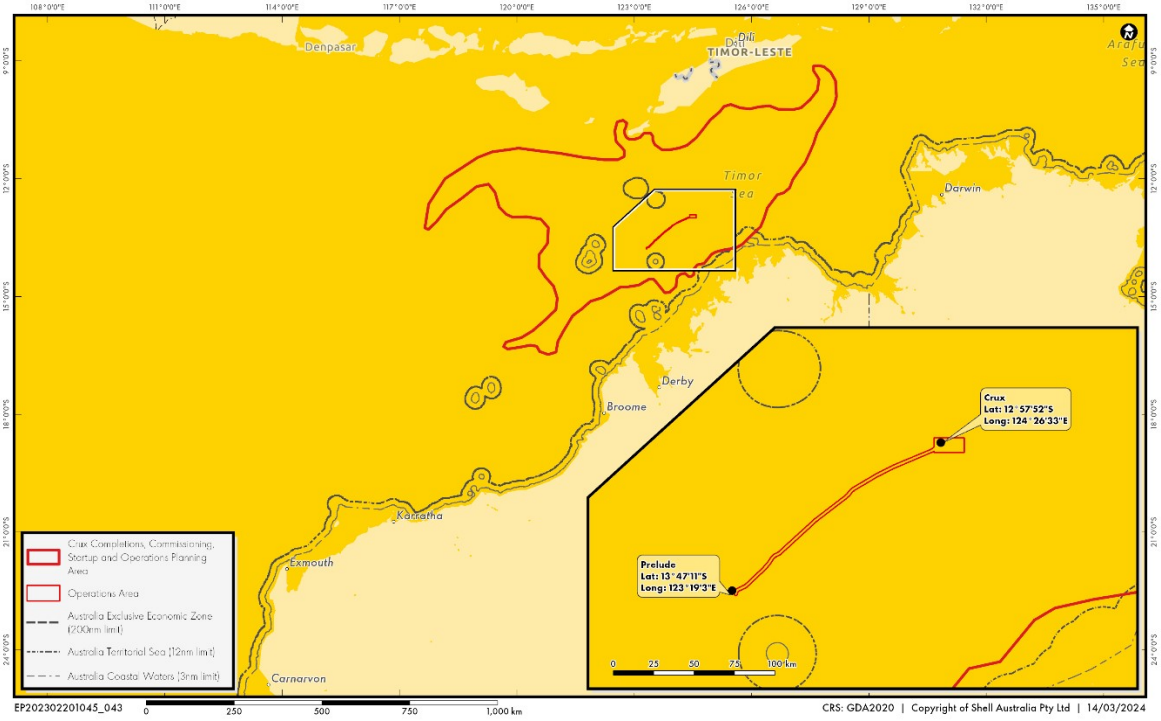
The purpose of this consultation is to give you an opportunity to provide input into:

- our understanding of the existing environment including its cultural features which may be affected by Shell's proposed activities.
- how our activities might impact the existing environment including its cultural features; and
- how controls and mitigation measures may be adopted to reduce the environmental impacts and risks associated with the proposed activities.

About Crux

Shell is planning to extend its offshore gas production operations at the Prelude Floating Liquefied Natural Gas Facility. This extension requires new infrastructure to be installed offshore. This project is called Crux. At its closest point, Crux is about 190km off the coast of the Kimberley. When built, it will supply gas to Shell's existing gas operations, at Prelude, which is also offshore. There are no onshore activities.

Information about the project is available on our website: www.shell.com.au/crux. An information sheet describing the activities we are consulting on is also attached and you can watch an animation about Crux here.



Information received will be documented in the *Completions, Commissioning, Start-up, and Operations Environment Plan*, which will be submitted to Australia's offshore energy regulator, NOPSEMA, for assessment, and following acceptance, published online. You may request that sensitive information you provide not be published.
The purpose of this consultation is further detailed in the NOPSEMA Consultation on Offshore Petroleum Environment Plans Brochure.

We want to give you an opportunity to consult with us on this Environment Plan/s.

We are undertaking some events as part of this consultation, and you are welcome to join us at the following:

Derby	**Date**: Tuesday 9 April 2024 **Time**: Between 12–6pm **Location**: Derby Professional Centre Conference Room - light lunch provided.
Broome	**Date**: Thursday 16 May 2024 **Time**: To be confirmed **Location**: To be confirmed

Alternatively, if you are unable to attend a session or would like to be consulted directly, please call our Community Hotline on 1800 059 152.
Please call our Community Hotline on 1800 059 152 if you wish to discuss further or reply to this email.

Should you or your organisation have any further questions, claims or objections or need more information, please advise us no later than 30 June 2024.
We look forward to hearing from you.

Kind regards,

The Crux Team.

[redacted]

From: SDA CRUX-PROJECT SDA-ITPT/PI <SDA-CRUX-PROJECT@shell.com>
Sent: Tuesday, June 11, 2024 10:09 AM
To: [redacted]
Subject: Reminder: Consultation on Shell Australia's Crux Completions, Commissioning, Start-up, and Operations Environment Plan/s.
Attachments: 15947 SHELL EP General Information Sheet - Feb 2024.pdf; 16085 SHELL Crux Completions, Commissioning, Start up & Operations Information Sheet - May 2024 - P2.pdf

Categories: Email saved

To whom it may concern,

This is a reminder that Shell Australia is seeking to consult with relevant persons in preparation of the *Completions, Commissioning, Start-up, and Operations Environment Plan/s* for the Crux project.

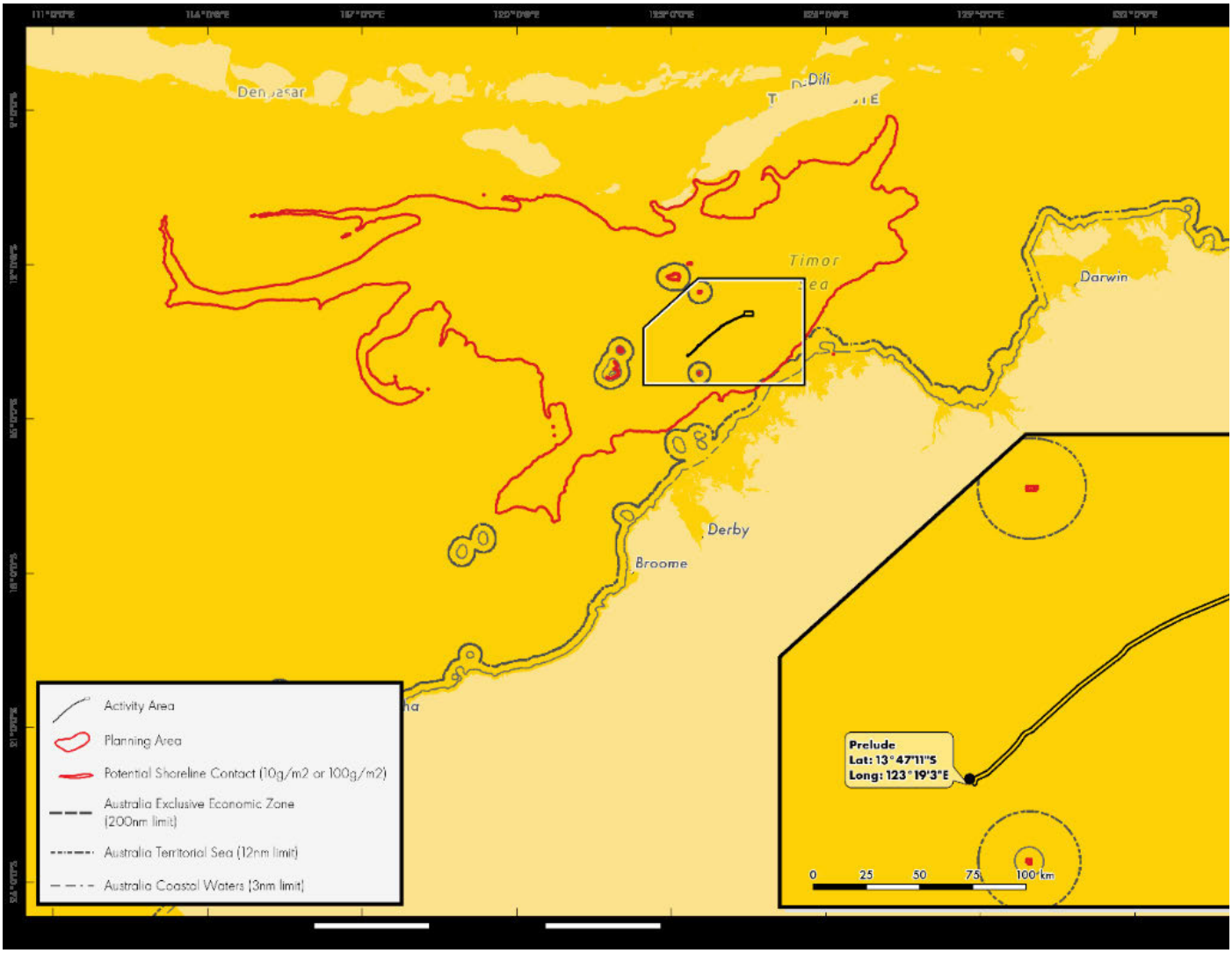
We want to hear from you if your functions, interests, or activities, may be affected by the activities, risks and impacts described in this Environment Plan, or if you have cultural heritage interests, or if you know someone else who may be affected.
The purpose of this consultation is to give you an opportunity to provide input into:

- our understanding of the existing environment including its cultural features which may be affected by Shell's proposed activities.
- how our activities might impact the existing environment including its cultural features; and
- how controls and mitigation measures may be adopted to reduce the environmental impacts and risks associated with the proposed activities.

About Crux

Shell is planning to extend its offshore gas production operations at the Prelude Floating Liquefied Natural Gas Facility. This extension requires new infrastructure to be installed offshore. This project is called Crux. At its closest point, Crux is about 190km off the coast of the Kimberley. When built, it will supply gas to Shell's existing gas operations, at Prelude, which is also offshore. There are no onshore activities.

Information about the project is available on our website: www.shell.com.au/crux. An information sheet describing the activities we are consulting on is also attached and you can watch an animation about Crux here.



Information received will be documented in the *Completions, Commissioning, Start-up, and Operations Environment Plan*, which will be submitted to Australia's offshore energy regulator, NOPSEMA, for assessment, and following acceptance, published online. You may request that sensitive information you provide not be published.

The purpose of this consultation is further detailed in the NOPSEMA Consultation on Offshore Petroleum Environment Plans Brochure.

We want to give you an opportunity to consult with us on this Environment Plan/s.

Please call our Community Hotline on 1800 059 152 if you wish to discuss further or reply to this email.

Should you or your organisation have any further questions, claims or objections or need more information, please advise us no later than 30 July 2024.

We look forward to hearing from you.

Kind regards,
The Crux Team.

[redacted]

From: SDA CRUX-PROJECT SDA-ITPT/PI
Sent: Thursday, November 21, 2024 9:28 AM
Subject: Update on Crux Environment Plans.
Attachments: 15947 SHELL EP General Information Sheet - Feb 2024.pdf; 16085 SHELL Crux Completions, Commissioning, Start up & Operations Information Sheet - May 2024 - P2.pdf

As previously advised, Shell Australia is currently consulting with relevant persons in preparation of the *Completions, Commissioning, Start-up, and Operations Environment Plan/s* for the Crux project.

We intend to publish a full draft of the Environment Plan on our website in October 2024, with submission to NOPSEMA planned for December 2024.

If you would like to be consulted or have information to share that you haven't yet provided, please let us know, so it can be included within our submission.

We want to hear from you if your functions, interests, or activities, may be affected by the activities, risks and impacts described in this Environment Plan, or if you have cultural heritage interests, or if you know someone else who may be affected.

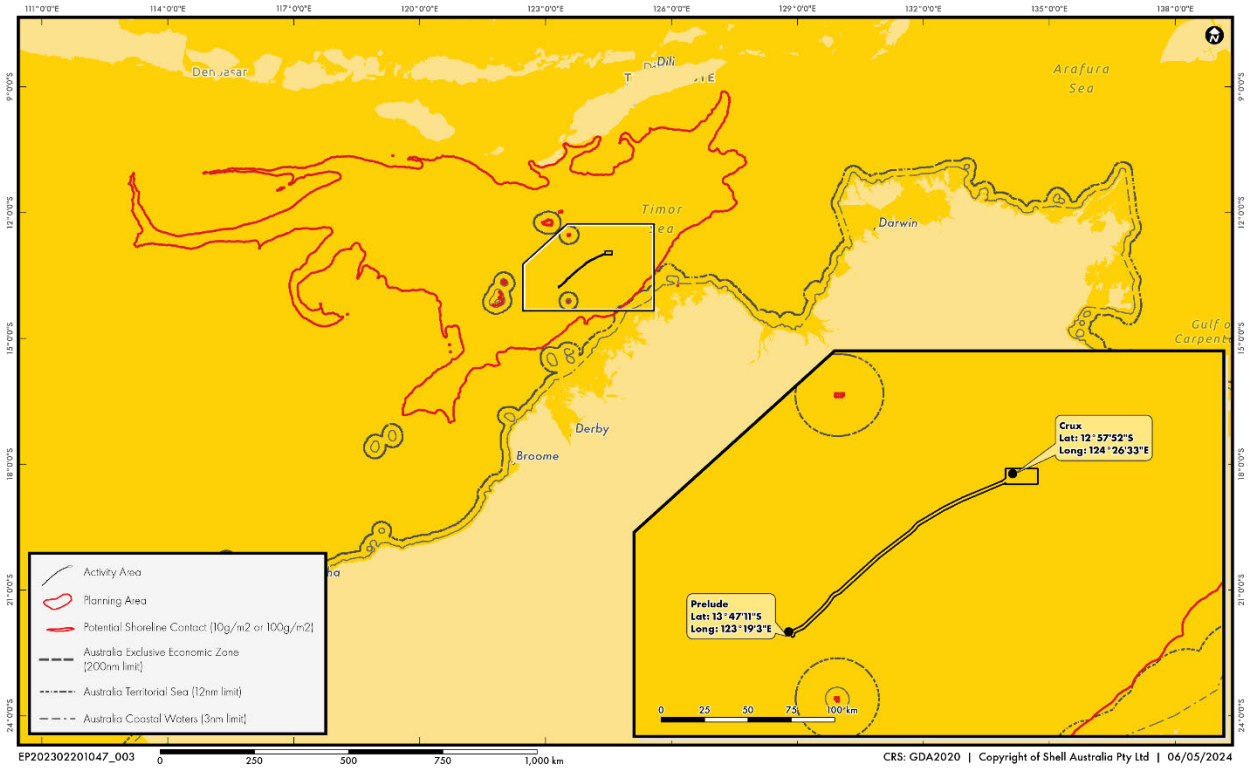
The purpose of this consultation is to give you an opportunity to provide input into:

- our understanding of the existing environment which may be affected by Shell's proposed activities, including the cultural features of that environment.
- how our activities might impact the existing environment (including its cultural features); and
- appropriate controls and mitigation measures that may be adopted to reduce the environmental impact associated with the proposed activities.

About Crux

Shell is planning to extend its offshore gas production operations at the Prelude Floating Liquefied Natural Gas Facility. This extension requires new infrastructure to be installed offshore. This project is called Crux. At its closest point, Crux is about 190km off the coast of the Kimberley. When built, it will supply gas to Shell's existing gas operations, at Prelude, which is also offshore. There are no onshore activities.

Information about the project is available on our website: www.shell.com.au/crux. An information sheet describing the activities we are consulting on is also attached and you can watch an animation about Crux here.



Information received will be documented in the *Completions, Commissioning, Start-up, and Operations Environment Plan*, which will be submitted to Australia's offshore energy regulator, NOPSEMA, for assessment, and following acceptance, published online. You may request that particular information you provide not be published. Any information that is the subject of such request will not be published.

The purpose of this consultation is further detailed in the NOPSEMA Consultation on Offshore Petroleum Environment Plans Brochure.

We want to give you an opportunity to consult with us on this Environment Plan.

If you would like to be consulted directly, please call our Community Hotline on 1800 059 152 or reply to this email.

Alternatively, if you would like to opt out from email updates, please reply to this email.

Kind regards,

The Crux Team.

[redacted]

From: SDA CRUX-PROJECT SDA-ITPT/PI
Sent: Thursday, November 21, 2024 9:33 AM
Subject: Final call for consultation on Crux Environment Plan prior to submission.
Attachments: 16271 SHELL - Crux Completions, Commissioning, Start up & Operations Information Sheet - Web Accessible - P3-2.pdf; 15947 SHELL EP General Information Sheet - Feb 2024.pdf

Further to our previous emails, regarding our consultation commitment to relevant persons, we are in the final stages of preparing our Completions, Commissioning, Start-up, and Operations Environment Plan for the Crux project, and have now published the full draft of the Environment Plan here: Draft Environment Plan

Submission to NOPSEMA is planned for December 2024. Should you have any comments or information to provide, please respond by **Friday 8 November 2024** so this information can be considered prior to submission.

Thank you to those of you we have already spoken to or who have provided information. If you would still like to be consulted or have information to share that you haven't yet provided, please let us know, so it can be included within our submission.
We want to hear from you if your functions, interests, or activities, may be affected by the activities, risks and impacts described in this Environment Plan, or if you have cultural heritage interests, or if you know someone else who may be affected.

The purpose of this consultation is to give you an opportunity to provide input into:

- our understanding of the existing environment which may be affected by Shell's proposed activities, including the cultural features of that environment.
- how our activities might impact the existing environment (including its cultural features); and
- appropriate controls and mitigation measures that may be adopted to reduce the environmental impact associated with the proposed activities.

About Crux

Shell is planning to extend its offshore gas production operations at the Prelude Floating Liquefied Natural Gas Facility. This extension requires new infrastructure to be installed offshore. This project is called Crux. At its closest point, Crux is about 190km off the coast of the Kimberley. When built, it will supply gas to Shell's existing gas operations, at Prelude, which is also offshore. There are no onshore activities.

Information about the project is available on our website, www.shell.com.au/crux An information sheet describing the activities we are consulting on is also attached.

The Crux Team

Appendix B Summary of Consultation

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
	Commonwealth and State Government Departments or Agencies					
	Section 25(1) (a) of the OPGGS(E) Regulations					
8.	**Australian Border Force** (Maritime Border Command)	**Email from Shell** 26 March 2024 *(initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 *(final call)*	Shell emailed Australian Border Force several times, with no response.	No objections or claims received.	No applicable.	*See footnote
4.	**Australian Communications and Media Authority (ACMA)**	**Email from Shell** 26 March 2024 *(initial email)* **Email to Shell** 23 April 2024	**Email on 26 March 2024 from Shell** Initial email with sufficient information. **Email on 23 April 2024 from ACMA** ACMA advised Shell that there would be no further consultation required.	No objections or claims received.	No applicable.	ACMA have confirmed that no further consultation on this EP is required. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
5.	**Australian Fisheries Management Authority (AFMA)**	**Email from Shell** 26 March 2024 *(initial email)* 03 April 2024 11 June 2024 *(reminder email)* 25 July 2024 11 October 2024 *(final call)* **Email to Shell** 25 July 2024 **Phone call** 22 July 2024	**Email on 26 March 2024 from Shell** Initial email with sufficient information. **Email on 03 April 2024 from Shell** Requesting assistance with updated contact details of Commonwealth Fishers. **Email 11 June 2024 from Shell** Reminder email sent. **Phone call 22 July 2024** Discussed request for updated contact details. AFMA requested information on the Crux project. **Email 25 July 2024 from Shell** Email provided with requested information on Crux. **Email 25 July 2024 from AFMA** Thanking Shell for the information. **Email 11 October 2024 from Shell** Final call out email. No response received	No objections or claims received.	Shell requested assistance from AFMA with obtaining contact details from Commonwealth Fishers. AFMA requested information on the Crux project, which Shell provided and received no further requests.	AFMA requested information on this EP, which Shell provided. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
2.	**Australian Hydrographic Office (AHO) – Department of Defence Operations Branch**	**Email from Shell** 18 April 2024 *(initial email)* **Email from AHO** 19 April 2024 22 April 2024	**Email on 18 April 2024 from Shell** Initial email with sufficient information. **19 April 2024 from AHO** Confirming information had been received. **22 April 2024 from AHO** Advising AHO has no concerns with activities set out in this EP.	No objections or claims received.	Not applicable.	AHO confirmed they have no concerns with activities set out in this EP. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
3	**Australian Maritime Safety Authority (AMSA)**	**Email from Shell** 26 March 2024 *(Initial email)* 11 October 2024 *(final call)* **Email from AMSA** 27 March 2024	**Email on 26 March 2024 from Shell** Initial email with sufficient information **Email on 27 March 2024 from AMSA** Advising Shell to contact relevant Government departments. **Email on 11 October 2024 from Shell** Final call out email. No response received	No objections or claims received.	AMSA requested that relevant Maritime Safety Information (MSI) is shared for the area and nature of the operations, including recommending other Government agencies AHO and JRCC. Shell adopted measures as a result of this relevant matter.	Notification requirements are included in Table 10-21 of this EP, which includes AMSA/JRCC and AHO notification requirements, consistent with the advice provided by AMSA. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
10.	**Clean Energy Regulator (CER)**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 *(final call)* **In person** 11 August 2021	**In person on 11 August 2021** Meeting covered: • Crux development overview and GHG emissions • Considerations for defining the Crux Facility (i.e. stepped through the checklist of NGER facility definition document) • Communicated the recommended Crux / Prelude facility description. **Email on 26 March 2024 from Shell** Initial email with sufficient information. **Email on 11 June 2024 from Shell** Reminder email. **Email on 07 August 2024 from Shell** Update email. **Email on 11 October 2024 from Shell** Final call out email. No response received	No objections or claims received.	CER confirmed the reasoning presented having the Crux and Prelude FLNG as separate facilities (for NGER and SGM purposes) was logical. CER also confirmed Shell had referred to the relevant guidance available and was aware of record keeping requirements for future audit purposes. No further measures were adopted relevant to preparation of this EP.	No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
13.	**Department of Climate Change, Energy, the Environment and Water (DCCEEW)**	**Email from Shell** 28 March 2024 *(Initial email)* 17 October 2024 *(final call)*	Shell emailed DCCEEW twice, with no response.	No objections or claims received.	Not applicable.	*See footnote
9.	**Department of Foreign Affairs (DFAT)**	**Email from Shell** 28 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 *(final call)*	Shell emailed DFAT several times with information on this EP. The only response received has been an automated response.	No objections or claims received.	Not applicable.	*See footnote
14.	**Department of Industry, Science, and Resources (DISR); including NOPTA**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 *(final call)*	Shell emailed DISR several times with information on this EP. The only response received has been an automated response.	No objections or claims received.	Not applicable.	*See footnote

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
6.	**Director of National Parks (DNP)**	**Email from DNP** 21 April 2023	**Email on 21 April 2023 from DNP** Advising no further consultation on this project is required.	No objections or claims received.	DNP advised that no further consultation on the Crux Project is required when Shell consulted on a previous EP. Shell has carried this advice forward to this EP.	DNP have confirmed that no further consultation on the Crux Project is required. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
22.	**Indigenous Land and Sea Corporation (ILSC)**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 *(final call)*	Shell emailed ILSC several times with information on this EP with no response.	No objections or claims received.	Not applicable.	*See footnote
7.	**National Native Title Tribunal (NNTT)**	**Email from Shell** 26 March 2024 *(Initial email)* 17 October 2024 *(final call)* **Email from NNTT** 27 March 2024 17 October 2024	**Email on 26 March 2024 from Shell** Initial email with sufficient information. **Email on 27 March 2024 from NNTT** Standard response received. **Email on 17 October 2024 from Shell** Final call out email. No formal response received. **Email on 17 October 2024 from NNTT** Email will be forwarded to appropriate team.	No objections or claims received.	Not applicable.	*See footnote
15.	**The Department of Agriculture Fisheries and Forestry's (DAFF)**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 *(final call)*	Shell emailed DAFF several times with information on this EP with no response.	No objections or claims received.	Not applicable.	*See footnote
	Section 25(1)(b) of the OPGGS(E) Regulations					
24.	**Aboriginal Areas Protection Authority NT (AAPA)**	**Email from Shell** 28 March 2024 *(Initial email)* 17 October 2024 *(final call)*	Shell emailed AAPA twice with information on this EP with no response.	No objections or claims received.	Not applicable.	*See footnote
26.	**Department of Biodiversity, Conservation and Attractions (DBCA)**	**Email from Shell** 28 March 2024 *(Initial email)* 24 April 2024 11 October 2024 *(final call)*	**Email on 28 March 2024 from Shell** Initial email with sufficient information. **Email on 04 April 2024 from DBCA** Requested Shell to provide additional information related to monitoring or oil spill response preparedness for this EP.	No objections or claims received.	DBCA requested Shell to provide additional information related to monitoring or oil spill response preparedness for this EP, which Shell provided. There have been no further requests for information.	DBCA requested additional information, which Shell provided. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		Email from DBCA 04 April 2024	**Email on 24 April 2024 from Shell** Directing DBCA to the Browse Regional Oil Pollution Emergency Plan (BROPEP) and OSMP BIP which outlines relevant notifications to DoT and DBCA to enable access to reserves and relevant oiled wildlife response activities as required in the event of a response. **Email on 11 October 2024 from Shell** Final call out email. No response received			
21.	**Department of Environment, Parks and Water Security (DEPWS)**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 11 October 2024 *(final call)* **Email from DEPWS** 11 June 2024	**Email on 26 March 2024 from Shell** Initial email with sufficient information. **Email on 11 June 2024 from Shell** Reminder email. **Email on 11 June 2024 from DEPWS** Noted that they would be in touch if they had any concerns or queries. **Email on 11 October 2024 from Shell** Final call out email. No response received	No objections or claims received.	Not applicable.	No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
11.	**Department of Jobs, Tourism, Science and Innovation (JTSI)**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 *(final call)* **Email from JTSI** 14 October 2024	**Email on 26 March 2024 from Shell** Initial email with sufficient information. **Email on 11 June 2024 from Shell** Reminder email. **Email on 07 August 2024 from Shell** Reminder email. **Email on 11 October 2024 from Shell** Final call out email. **Email on 14 October 2024** JTSI advised they have no comments.	No objections or claims received.	Not applicable.	JTSI advised they have no comments on this EP. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
23.	**Department of Planning Lands and Heritage (DPLH)** including Heritage Council of WA and Aboriginal Cultural Heritage Committee	**Email from Shell** 26 March 2024 *(Initial email)* 07 August 2024 *(update email)* 11 October 2024 *(final call)* **Email from DPLH** 26 April 2024	**Email on 26 March 2024 from Shell** Initial email with sufficient information. **Email on 26 April 2024 from DPLH** DPLH advised that as the subject area is outside of the 3 mile coastal waters limit the Aboriginal Heritage Act 1972 does not apply. **Email on 07 August 2024 from Shell** Reminder email. **Email on 11 October 2024** Final call out email. No response received	No objections or claims received.	DPCH advised that the Aboriginal Heritage Act 1972 does not apply. Shell considered that it does for potential spill impacts to WA territory so left it in the EP.	Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
12.	**Department of Primary Industries and Region Development (DPIRD) – Fisheries Division**	**Email from Shell** 26 March 2024 *(Initial email)* 18 June 2024 17 October 2024 *(final call)* 21 November 2024 **Email from DPIRD** 27 March 2024 08 November 2024	**Email on 26 March 2024 from Shell** Initial email with sufficient information. **Email on 27 March 2024 from DPIRD** Advised to contact WAFIC for consultation with fishers. **Email on 18 June 2024 from Shell** Confirming we are working with WAFIC. **Email on 17 October 2024 from Shell** Final call out email. **Email on 08 November 2024 from DPIRD** DPIRD outlined the fishing activities in the area. They also outlined 3 key peak fishing bodies that Shell should consult with: WAFIC, Recfishwest and Aquaculture Council of WA. They recommended Shell obtain contact information of individual commercial fisheries through the Departments public register. **Email on 21 November 2024 from Shell** Closing out comments from DPIRDs letter on 08 November 2024.	DPIRD raised that activities may have an effect on fish resources and the aquatic environment managed under the WA fisheries legislation, including the North-West Australian Marine Parks. Shell recognised this. Spawning grounds and aggregation periods for key fish species are particularly vulnerable to the impacts of spills. DPIRD requested that specific strategies are developed in the Environment Plan and/or OSCPs to mitigate these risks. DPIRD listed specific fish species that may be spawning within the region. DPIRD requested that all potential impacts to fisheries, fish resources and the aquatic environment are acknowledged in the final EPs and the OSCPs with strategies undertaken to mitigate or minimise these impacts are defined. Shell confirmed that the OPEP, supporting the EP, addresses specific strategies to mitigate risks to key fish species including considerations during a spill event using the SIMA process to consider their spawning locations and aggregation periods. DPIRD requested that in the event of an oil spill or discharge of any pollutant to the environment that it be reported promptly to the WA Department of Transport and to DPIRD within 24 hours. Table 10-22 lists DPIRD as a notification point in the event of an oil spill or discharge of any pollutant which may impact WA managed fish breeding or fish stocks. DPIRD advocates for best practice biofouling management, where biofouling is kept to a minimum to mitigate the risk of harbouring marine pest and disease., including reporting suspected or confirmed presence of any marine pest or disease within 24 hours. DPIRD requested this information is forwarded to vessel operators associated with the project. Shell confirmed that Shell and its Contractors use Vessel-Check which is an industry best practice system to manage biosecurity. Shell will ensure all EP requirements are communicated to contractors.	DPIRD noted commercial fisheries and peak fishing sector bodies in WA that Shell should consult with. Shell confirmed that it has consulted with relevant peak fishing sector bodies in WA who were identified as relevant persons. Additionally, Shell confirmed that it had obtained contact information for individual commercial fishers through DPIRD's public register and consulted with them. Shell confirmed that it had reviewed the Aquaculture Council of Western Australia, Kimberley Gillnet and Barramundi Fishery WA Sea Cucumber Fishery and Aquaculture and determined they are not a relevant person for this EP as they do not have functions, interests or activities potentially affected by the activities covered by this EP nor do they operate within the planning area for this EP. DPIRD recommended consultation with relevant Traditional Owners. Shell confirmed consultation has taken place with Traditional Owners who are identified as relevant persons. DPIRD gave details required to be included in consultation material, such as start and end dates for the activity and the spatial extent of the activity. Shell has been consulting with commercial fishers and including the information required. DPIRD advised that customary, recreational, and charter fishing resources may also occur within the area. Shell confirmed that it had identified relevant persons within recreational and charter fishing and consulted them as required by the regulations. DPIRD shared a link to the State of the Fisheries report. Shell confirmed the State of the Fisheries Report had been used as appropriate to inform understanding of the existing environment for the Activity and Planning Areas of this EP. DPIRD requested that Shell collects baseline marine data to compare against any post-spill monitoring and that this data should be made available to the Department upon request. Shell confirmed it has collected baseline marine data and will continue to suited to the activities. Shell's assessment of baseline monitoring for spill preparedness is outlined within the Operational and Scientific Monitoring arrangements for the EP. Shell confirmed it would provide baseline data, where available and subject to meeting Shell's disclosure requirements, to DPIRD on request. Shell considered most the above relevant matters. However, no new measures were adopted as a result of the matters raised.	Table 10-22 lists DPIRD as a notification point in the event of an oil spill or discharge of any pollutant which may impact WA managed fish breeding or fish stocks. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
16.	**Department of Transport (DoT)**	**Email from Shell** 30 April 2024 *(Initial email)* 10 October 2024	**Email on 30 April 2024 from Shell** Initial email with sufficient information. **Email on 15 May 2024 from DoT**	No objections or claims received.	Not applicable.	Shell provided DOT an EP specific consultation report with all the information required by the Department of Transport Offshore Petroleum Industry Guidance Note, Marine Oil Pollution: Response and Consultation Arrangements.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		Email from DoT 15 May 2024	Confirmed information had been received. **Email on 10 October 2024 from Shell** Shell provided DOT with activity specific consultation report and link to draft EP.			Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
17.	**Department of Water & Environmental Regulation (DWER)**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 *(final call)*	Shell emailed DWER several times with information on this EP. The only response received has been an automated response.	No objections or claims received.	Not applicable.	*See footnote
20.	**Environment Protection Authority (EPA)**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 *(final call)*	Shell emailed EPA several times with information on this EP with no response.	No objections or claims received.	Not applicable.	*See footnote
18.	**Federal Member for Kimberley – Melissa Price**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 *(final call)*	Shell emailed the Federal Member for the Kimberley several times with information on this EP. The only response received has been an automated response.	No objections or claims received.	Not applicable.	*See footnote
19.	**State Member for Kimberley – Divina Grace D'Anna**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 *(final call)*	Shell emailed the State Member for Kimberley several times with information on this EP with no response.	No objections or claims received.	Not applicable.	*See footnote
	Section 25(1)(c) of the OPGGS(E) Regulations					
28.	**Department of Industry Tourism and Trade (DITT)**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 *(final call)*	Shell emailed DITT several times with information on this EP with no response.	No objections or claims received.	Not applicable.	*See footnote
27.	**Department of Energy, Mines, Industry Regulation and Safety (DEMIRS)**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)*	**Email on 26 March 2024 from Shell** Initial email with sufficient information. **Face to face on 16 May 2024**	No objections or claims received.	Not applicable.	DEMIRS have confirmed they do not require any further information on this EP. No additional measures have been adopted.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		07 August 2024 *(update email)* **Email from DEMIRS** 29 August 2024 **Face to face** 16 May 2024	A representative from DEMIRS attended a Broome Information Session. **Email on 11 June 2024 from Shell** Reminder email. **Email on 07 August 2024 from Shell** Update email. **Email on 29 August 2024 from DEMIRS** Advised Shell that no further information was required at this stage.			Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
	Section 25(1)(d) of the OPGGS(E) Regulations					
	Commercial Fisheries					
139.	**Abalone Managed Fishery Licence**	**Letter from Shell** 03 April 2024 *(Letter)*	Shell sent a letter to the Abalone Managed Fishery Licence with information on this EP with no response.	No objections or claims received.	Not applicable.	In accordance with Shell's approach to consultation, WAFIC carried out consultation with Fishers in the Activity Area. Shell also sent a letter to this fishery identified outside of the activity area but within the planning area as a courtesy. This aligned with WAFIC's advice that the activities set out in this EP are routine for the industry, and therefore Shell deemed this sufficient. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
166.	**Australian Northern Prawn Fishery**	**Email from Shell** 04 April 2024 *(initial email)* 11 June 2024 *(reminder email)* **Australian Northern Prawn Fishery** 11 June 2024	**Email on 04 April 2024 from Shell** Initial email with sufficient information. **Email on 11 June 2024 from Shell** Reminder email. **Email on 11 June 2024 from Australian Northern Prawn Fishery** There is no conflict with any fisheries that this particular licence holder operates in.	No objections or claims received.	One licence holder confirmed there is no conflict for them.	One licence holder confirmed there is no conflict for them. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
179.	**Australian Southern Bluefin Tuna Industry Association (ASBTIA)**	**Email from Shell** 09 April 2024 *(initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 20 September 2024 27 September 2024 04 October 2024 11 October 2024 *(final call)* **Email from Australian Southern Bluefin Tuna Industry Association** 20 September 2024 26 September 2024 03 October 2024	**Email on 09 April 2024 from Shell** Initial email with sufficient information. **Email on 11 June 2024 from Shell** Reminder email. **Email on 07 August 2024 from Shell** Update email. **Email on 20 September 2024 from ASBTIA** Requesting engagement on this EP. **Email on 20 September 2024 from Shell** Shell advised that it would set up a call for next week. **Phone call on 26 September 2024**	The spawning ground for Australian Southern Bluefin Tuna is in the region, and this is potentially the sole breeding ground globally. ASBTIA would like this reflected in the EP. Shell updated the EP to reflect the information provided.	ASBTIA advised that planned impacts at the Crux location were unlikely to have an effect on the Southern Bluefin Tuna. ASBTIA confirmed it is good that there is compensation should it be required through the NERA protocol. ASBTIA committed to providing research papers on the Tuna spawning grounds.	Shell has incorporated the Australian Southern Bluefin Tuna spawning ground in the EP. ASBTIA will remain a relevant person given the location of the spawning ground of Tuna. ASBTIA had no material concerns for the project, their main concern is around Seismic. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		Phone call 26 September 2024 02 October 2024	Phone call to set up a suitable time for the meeting. **Email on 26 and 27 September 2024 from Shell and ASBTIA** Meeting arrangements. **Teams meeting on 02 October 2024** Consultation as there are nearby spawning grounds. Shell presented on this EP, including detailed information on environmental impacts and risks, and associated management measures in place as well as the worst credible case scenarios and modelling results. Agreed that planned impacts at the Crux location were unlikely to have an effect on the Southern Bluefin Tuna. **Email on 03 October 2024 from ASBTIA** Providing further information on research on spawning grounds as discussed in the meeting. **Email on 04 October 2024 from Shell** Acknowledging receipt of information. **Email on 11 October 2024 from Shell** Final call out email. No response received			
141.	**Broome Prawn Managed Fishery**	**Letter from Shell** 03 April 2024 *(Letter)*	Shell sent a letter to the Broome Prawn Managed Fishery with information on this EP with no response.	No objections or claims received.	Not applicable.	In accordance with Shell's approach to consultation, WAFIC carried out consultation with Fishers in the Activity Area. Shell also sent a letter to this fishery identified outside of the activity area but within the planning area as a courtesy. This aligned with WAFIC's advice that the activities set out in this EP are routine for the industry, and therefore Shell deemed this sufficient. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
142.	**Commonwealth Fisheries Association**	**Email from Shell** 09 April 2024 *(Initial email)* 06 June 2024 *(reminder email)* 07 August 2024 *(update email)* 15 October 2024 (*final call)*	Shell emailed the Commonwealth Fisheries Association several times with information on this EP, with no response.	No objections or claims received.	Not applicable.	*See footnote
160.	**Cygnet Bay Pearl Farm**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 (*reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed the Cygnet Bay Pearl Farm several times with information on this EP, with no response.	No objections or claims received.	Not applicable.	*See footnote
144.	**Kimberley Crab Managed Fishery Licence**	**Letter from Shell** 03 April 2024 *(Letter)*	Shell sent a letter to the Kimberley Crab Managed Fishery Licence with information on this EP with no response.	No objections or claims received.	Not applicable.	In accordance with Shell's approach to consultation, WAFIC carried out consultation with Fishers in the Activity Area. Shell also sent a letter to this fishery identified outside of the activity area but within the

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
						planning area as a courtesy. This aligned with WAFIC's advice that the activities set out in this EP are routine for the industry, and therefore Shell deemed this sufficient. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
145.	**Kimberley Prawn Managed Fishery Licence**	**Letter from Shell** 03 April 2024 *(Letter)*	Shell sent a letter to the Kimberley Prawn Managed Fishery Licence with information on this EP with no response.	No objections or claims received.	Not applicable.	In accordance with Shell's approach to consultation, WAFIC carried out consultation with Fishers in the Activity Area. Shell also sent a letter to this fishery identified outside of the activity area but within the planning area as a courtesy. This aligned with WAFIC's advice that the activities set out in this EP are routine for the industry, and therefore Shell deemed this sufficient. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
146.	**Mackerel Managed Fishery Licence**	**Letter from Shell** 03 April 2024 *(Letter)* Also consulted through 155 WAFIC.	Shell sent a letter to the Mackerel Managed Fishery Licence with information on this EP as well as consulting with them via WAFIC. No response has been received. They were also consulted through 155 WAFIC.	No objections or claims received.	Not applicable.	*See footnote
147.	**Marine Aquarium Fish Managed Fishery Licence**	**Letter from Shell** 03 April 2024 *(Letter)*	Shell sent a letter to the Marine Aquarium Fish Managed Fishery Licence with information on this EP with no response. They were also consulted through 155 WAFIC.	No objections or claims received.	Not applicable.	In accordance with Shell's approach to consultation, WAFIC carried out consultation with Fishers in the Activity Area. Shell also sent a letter to this fishery identified outside of the activity area but within the planning area as a courtesy. This aligned with WAFIC's advice that the activities set out in this EP are routine for the industry, and therefore Shell deemed this sufficient. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
149.	**North West Slope Trawl Fishery**	**Email from Shell** 04 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* **Email from North West Slope Trawl Fishery** 11 June 2024	Shell sent two emails to the North West Slope Trawl Fishery with information on this EP with no response. **Email on 11 June 2024 from North West Slope Trawl Fishery** There is no conflict with any fisheries that this particular licence holder operates in.	No objections or claims received.	One licence holder confirmed there is no conflict for them.	One licence holder confirmed there is no conflict for them. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
148.	**Northern Demersal Scalefish Managed Fishery Licence**	**Letter from Shell** 03 April 2024 *(Letter)* Also consulted via WAFIC. **Email from Northern Demersal Scalefish Managed Fishery** 11 June 2024	**Letter on 03 April 2024 from Shell** Letter sent with sufficient information. **Email on 11 June 2024 from Northern Demersal Scalefish Managed Fishery** There is no conflict with any fisheries that this particular licence holder operates in.	No objections or claims received.	One licence holder confirmed there is no conflict for them.	One licence holder confirmed there is no conflict for them. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
163.	**Northern Prawn Fishery Industry Pty Ltd**	**Email from Shell** 09 April 2024 *(Initial email)*	Shell emailed the Northern Prawn Fishery Industry Pty Ltd several times with information on this EP, with no response.	No objections or claims received.	Not applicable.	*See footnote

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		11 June 2024 *(reminder email)* 08 August 2024 *(update email)* 11 October 2024 (*final call)*				
150.	**Pearl Oyster Fishery**	Consultation occurred through 115 WAFIC only.	See 115 WAFIC	No objections or claims received.	Not applicable.	*See footnote
172.	**Pilbara Crab Managed Fishery Licence**	**Letter from Shell** 03 April 2024 *(Letter)*	Shell sent a letter to Pilbara Crab Managed Fishery Licence with information on this EP with no response.	No objections or claims received.	Not applicable.	In accordance with Shell's approach to consultation, WAFIC carried out consultation with Fishers in the Activity Area. Shell also sent a letter to this fishery identified outside of the activity area but within the planning area as a courtesy. This aligned with WAFIC's advice that the activities set out in this EP are routine for the industry, and therefore Shell deemed this sufficient. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
157.	**Seafarms Group Ltd**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Seafarms Group Ltd several times with information on this EP, with no response.	No objections or claims received.	Not applicable.	*See footnote
151.	**Seafood Industry Association**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 11 October 2024 (*final call)*	Shell emailed Seafood Industry Association several times with information on this EP, with no response.	No objections or claims received.	Not applicable.	*See footnote
152.	**South West Coast Salmon Fishery**	**Letter from Shell** 03 April 2024 *(Letter)*	Shell sent a letter to South West Coast Salmon Fishery with information on this EP with no response.	No objections or claims received.	Not applicable.	In accordance with Shell's approach to consultation, WAFIC carried out consultation with Fishers in the Activity Area. Shell also sent a letter to this fishery identified outside of the activity area but within the planning area as a courtesy. This aligned with WAFIC's advice that the activities set out in this EP are routine for the industry, and therefore Shell deemed this sufficient. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
613.	**Southern Bluefin Tuna Fishery**	**Email from Shell** 03 April 2024 *(Initial email)* 11 June 2024 *(reminder email)*	Shell sent two emails to the Southern Bluefin Tuna Fishery with information on this EP with no response.	No objections or claims received.	Not applicable.	*See footnote
180.	**Southern Bluefin Tuna Management Advisory Committee (SBTMAC)**	**Email from Shell** 09 April 2024 *(Initial email)* 11 June 2024 *(reminder email)*	Shell sent several emails to the Southern Bluefin Tuna Management Advisory Committee with information on this EP with no response.	No objections or claims received.	Not applicable.	*See footnote

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		11 October 2024 *(final call)*				
153.	**Specimen Shell Managed Fishery License**	**Letter from Shell** 03 April 2024 *(Letter)*	Shell sent a letter to Specimen Shell Managed Fishery License with information on this EP with no response.	No objections or claims received.	Not applicable.	In accordance with Shell's approach to consultation, WAFIC carried out consultation with Fishers in the Activity Area. Shell also sent a letter to this fishery identified outside of the activity area but within the planning area as a courtesy. This aligned with WAFICs advice that the activities set out in this EP are routine for the industry, and therefore Shell deemed this sufficient. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
181.	**Tropical Tuna Management Advisory Committee**	**Email from Shell** 09 April 2024 *(Initial email)* 11 June 2024 *(reminder email)* 11 October 2024 (*final call)*	Shell emailed Tropical Tuna management Advisory Committee several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
182.	**Tuna Australia**	**Email from Shell** 04 April 2024 *(Initial email)* 05 April 2024 18 April 2024 11 June 2024 *(reminder email)* 26 June 2024 12 July 2024 12 August 2024 28 August 2024 24 September 2024 11 October 2024 21 November 2024 04 December 2024 **Email from Tuna Australia** 05 April 2024 18 April 2024 22 April 2024 08 July 2024 22 July 2024 22 August 2024 29 August 2024 25 September 2024 17 October 2024 21 October 2024 08 November 2024 05 December 2024 **Phone call** 18 June 2024 **Teams meeting** 24 June 2024	**Email on 04 April 2024 from Shell** Initial email with sufficient information. **Email on 05 April 2024 from Tuna Australia** Sharing their industry position statement. **Email on 05 April 2024 from Shell** Requesting TUNA Australia share the draft agreement prior to scheduling a call with TUNA Australia. **Email on 05 April 2024 from Tuna Australia** Sharing their industry position statement. **Email on 18 - 22 April 2024 from Shell and Tuna Australia** Exchange of emails to schedule a call. **Phone call on 18 June 2024** Introductory call to discuss options for Tuna Australia to disseminate information for Shell in relation to this EP. **Teams meeting on 24 June 2024** Discussion of options to enable Tuna Australia's consultation with its members. **Email on 26 June 2024 from Shell** Follow up email arranging to use Tuna Australia to consult with its members. **Email on 08 July 2024 from Tuna Australia** Tuna Australia detail further the agreement they propose. **Email on 12 July 2024 from Shell** Shell confirming the activities outlined are appropriate, and seeking an alternative solution to the services agreement. Shell is committed to enabling additional consultation.	Tuna Australia raised concerns of its members over the cumulative impacts of oil and gas activity in Northwest waters. Regarding a much broader strategic assessment, this has not occurred to date. These types of strategic assessments take many years and Shell doesn't currently have plans to carry this out. However, Shell offered to further discuss the matter with Tuna Australia. Tuna Australia notes the temporary presence of support vessels and drilling infrastructure, and the 500 m petroleum safety zones that will be in place for the duration of the project. Whilst it is unlikely that proposed operations will impact active fishing operations, Tuna Australia request notice about potentially conflicting marine operations through coastal waters. Tuna Australia would pass these on to their members.	Shell signed a consultation agreement with Tuna Australia to consult with its members. Tuna Australia engaged license holders in The Western Tuna and Billfish Fishery (WTBF) and permits holders in the Skipjack Tuna Fishery West. Tuna Australia recommended Shell consult with ABSTIA. Tuna Australia recommends Shell consult with other Fishing Industry Associations, such as the Commonwealth Fisheries Association.	Tuna Australia have provided a completion statement to confirm consultation has occurred with Tuna Australia and its members. Tuna Australia's assessment is that the proposal is viewed as noncontroversial. Shell confirmed it has addressed the matter of cumulative impacts in various respects through the draft EP which is published on the Shell website. Shell has given Tuna Australia background on cumulative impacts and reasoning why a strategic assessment is not possible at this time. Shell confirmed it has been consulting with ASBTIA. Shell will continue to issue relevant notices via the AHO and JRCC, for promulgation across vessel information platforms. Shell confirms it has consulted with other Fishing Industry Associations. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			Email on 22 July 2024 from Tuna Australia Reinforcing preference to formalise industry consultation agreement and would consider changes proposed by Shell. **Email on 12 August 2024 from Shell** Advising Shell cannot enter into a formal agreement. **Email on 22 August 2024 from Tuna Australia** Reinforcing preference to formalise industry consultation agreement. **Email on 28 August 2024 from Shell** Shell shared a marked up agreement for review. **Email on 29 August 2024 from Tuna Australia** Tuna Australia will review the amendments to find a workable solution. **Email on 24 September 2024 from Shell** Follow up on status of review. **Email on 25 September 2024 from Tuna Australia** Confirming Tuna Australia are happy with the changes, with one final amendment related to time of agreement. **Email on 11 October 2024 from Shell** Attaching the signed agreement and sharing the draft EP published on Shell's website. **Email on 17 October 2024 from Tuna Australia** Confirming Tuna Australia will return their signed agreement tomorrow and that they have drafted up consultation with members, scheduled to go out next week. They will provide their consultation report prior to 8 November. **Email on 21 October 2024 from Tuna Australia** Attached the executed agreement. **Email on 08 November 2024 from Tuna Australia** Confirming Tuna Australia finalised the consultation process with its members, and attaching their report. **Email on 21 November 2024 from Shell** Closing out comments from previous email. **Email on 04 December 2024 from Shell** Email sent to clarify notifications. **Email on 05 December 2024 from Tuna Australia**			

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			Thanks for clarification.			
154.	**West Coast Deep Sea Crustacean Managed Fishery Licence**	**Letter from Shell** 03 April 2024 *(Letter)* Also consulted via WAFIC.	Shell sent a letter to West Coast Deep Sea Crustacean Managed Fishery Licence with information on this EP as well as consulting with them via WAFIC. No response has been received.	No objections or claims received.	Not applicable.	*See footnote
155.	**Western Australian Fishing Industry Council (WAFIC)**	**Email from Shell** 27 February 2024 15 March 2024 18 March 2024 03 April 2024 11 April 2024 12 April 2024 15 April 2024 24 April 2024 27 June 2024 03 July 2024 25 July 2024 10 October 2024 **Email from WAFIC** 29 February 2024 18 March 2024 27 March 2024 10 April 2024 12 April 2024 15 April 2024 24 April 2024 28 June 2024 16 July 2024 26 July 2024 **Phone call** 15 April 2024	**Email on 27 February 2024 from Shell** Giving WAFIC a heads up that Shell is preparing to start consultation for this EP and requesting their assistance in consulting with WA Fishers. **Email on 29 February 2024 from WAFIC** Confirming the fee-for-service conditions available for consultation. **Email on 15 March 2024 from Shell** Confirming Shell would like to proceed. **Email on 18 March 2024 from WAFIC** Requesting details on the activity and timeframes. **Email on 18 March 2024 from Shell** Provided a summary of activities and confirming timeframes for consultation. **Email on 27 March 2024 from WAFIC** Given the activities are routine for the industry, WAFIC recommended to scale back the consultation approach. It would not be recommended to hold a briefing session for licence holders. **Email on 03 April 2024 from Shell** Confirming that Shell would like to continue to offer the briefing in the spirit of genuine consultation. Provided email content and attachments for WAFIC to use in the consultation. **Email on 10 April 2024 from WAFIC** Suggestion from WAFIC to amend the wording in the consultation content to offer a briefing to licence holders who request it. Advice that the level of consultation is proportional to the type and scape of proposed activity. **Email on 11 April 2024 from Shell** Agreement with WAFIC proposal of amended wording and level of consultation. **Email on 12 April 2024 from WAFIC** Confirming distribution of materials will occur on Monday 15 April. **Email on 12 April 2024 from Shell** Thanking WAFIC.	WAFIC has some minor concerns surrounding the impact of noise on the marine environment and valuable commercial species that are sensitive to noise. Shell considered this within the draft EP which was shared with WAFIC.	**Relevant matters to this EP** WAFIC provided feedback on the best consultation method for communicating with WA Licensed Fishers. WAFIC requested to be included in any vessel operation look ahead associated with this EP. WAFIC requested to be listed as a contact within the Oil spill response planning documents to ensure contact is made within 24 hours of the event notification. WAFIC can also assist Shell with communication with the fishing industry if required. This was adopted. WAFIC requested that Shell retains a current list of WA commercial fisheries that could potentially be impacted by unplanned spill scenarios. WAFIC noted that Shell will have a suitable Operational and Scientific Monitoring Program (OSMP), for the purposes of determining impacts and monitoring the recovery of the marine environment. WAFIC has developed a position regarding consultation with the WA fishing industry for unplanned events. **Not relevant matters to this EP** WAFIC raised queries related to a previous EP. Shell directed WAFIC to the relevant sections of that EP.	Shell's Browse Regional Oil Pollution Emergency Plan has been updated to reflect the notification requirements for WAFIC to ensure WAFIC is contacted within 24 hours of an event. Shell notes that WAFIC can assist with communication with the fishing industry. Shell shared section 9.5 of the Crux Installation and Cold Commissioning EP which includes a thorough assessment of noise impacts due to the EP activity including a piling campaign. This section establishes the controls that Shell will adopt to management noise impacts to ALARP and acceptable levels. Shell adopted WAFIC feedback on the best way to consult with Commercial Fishers. Shell could not fulfil the request for a vessel operation look ahead as it would require the development of a bespoke vessel-based look ahead and associated resources to manage throughout the project. Shell will continue to issue relevant notices via the AHO and JRCC, for promulgation across vessel information platforms. Shell confirmed it will continue to maintain its contact list for commercial fishers as they relate to the spill scenarios. Shell acknowledged the requirement for an OSMP and referred WAFIC to Shell's Browse Regional Operational and Scientific Monitoring Plan which will be maintained and implemented. Shell acknowledged WAFICs position on consultation related to unplanned events. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			Email on 15 April 2024 from WAFIC Suggesting some slight amendments to consultation materials. **Phone call on 15 April 2024** Discussed revision of consultation material to tailor it further for the fishing industry. **Email on 15 April 2024 from Shell** Confirming slight amendments made to the consultation material following phone call. **Email on 15 April 2024 from WAFIC** Confirmation that consultation material shared with: • Mackerel Fishery – Area 1 • Northern Demersal Scalefish • West Coast Deep Sea Crustacean • Pearl Oyster Fishery **Email on 15 April 2024 from Shell** Thanking WAFIC. **Emails on 24 April 2024 from Shell & WAFIC** To finalise distribution and payment. **Email on 27 June 2024 from Shell** Requesting a copy of the NERA Commercial Fishing Industry Adjustment Protocol. **Email on 28 June 2024 from WAFIC** Shared the NERA protocol. Confirming WAFIC did not receive any feedback or concerns from our industry regarding this EP. WAFIC asked a number of questions in this email, which have been assessed in the following columns. **Email on 03 July 2024 from Shell** Shell confirmed intent is to commit to implementing the adjustment protocols for unplanned activities limited to an unplanned spill event and/or the accidental introduction of Invasive Marine Species (IMS) and will be made within the implementation statement of this EP. The protocol will be directly referenced within the implementation statement and provided to NOPSEMA as sensitive information. Confirmed Shell would come back to WAFIC on their questions. **Email on 16 July 2024 from WAFIC** WAFIC appreciates Shells commitment to implementing the NERA Commercial Fishing Industry Adjustment Protocol.			

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			Email on 25 July 2024 from Shell Shell responded to WAFIC's questions. **Email on 26 July 2024 from WAFIC** WAFIC had no further comments on the proposed activity. **Email on 10 October 2024 from Shell** Final call out email. No response received			
156.	**Western Tuna and Billfish Fishery (WTBF)**	**Email from Shell** 03 April 2024 *(Initial email)* 11 June 2024 *(reminder email)* Also consulted via Tuna Australia. **Email from WTBF** 03 April 2024 11 June 2024	**Email on 03 April 2024 from Shell** Initial email with sufficient information. **Email on 03 April 2024 from WTBF License Holder** Requesting that Shell contact the peak fishing industry body, Tuna Australia. **Email on 11 June 2024 from Shell** Reminder email. **Email on 11 June 2024 from WTBC License Holder** Requesting that Shell contact the peak fishing industry body, Tuna Australia.	No objections or claims received.	Received two separate requests to consult using Tuna Australia,	Shell signed an agreement with Tuna Australia to enable consultation with its members and this consultation occurred with Tuna Australia and its members. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
	Titleholders and Operators					
608.	**Bengal Energy Ltd**	**Email from Shell** 10 June 2024 *(initial email)* 09 August 2024 *(update email)* 11 October 2024 *(final call)*	Shell emailed Bengal Energy several times with information on this EP. The only response received has been an automated response.	No objections or claims received.	Not applicable.	*See footnote
184.	**Carnarvon Energy Ltd**	**Email from Shell** 06 August 2024 *(Initial email)* 11 October 2024 *(final call)* **Email from Carnarvon Energy Ltd** 06 August 2024	**Email on 06 August 2024 from Shell** Initial email with sufficient information. **Email on 06 August 2024 from Carnarvon Energy Ltd** Advising that they have no feedback. Attachments were corrupted. **Email on 06 August 2024 from Shell** Sent correct attachments. **Email on 11 October 2024 from Shell** Final call out email. No response received	No objections or claims received.	Not applicable.	Canarvon Energy Ltd confirmed they do not have any feedback on this EP. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
201.	**Eni Australia Ltd**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 *(final call)*	**Email on 26 March 2024 from Shell** Initial email with sufficient information **Email on 11 June 2024 from Shell** Reminder email. **Email on 07 August 2024 from Shell** Reminder email.	No objections or claims received.	Not applicable.	ENI Australia Ltd confirmed they do not have any feedback on this EP. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		Email from Eni Australia Ltd 12 August 2024	**Email on 12 August 2024 from Eni Australia** Advising that they have no feedback. Requested an update if any material changes. **Email on 11 October 2024 from Shell** Final call out email. No response received			
185.	**Finder Energy**	**Email from Shell** 26 March 2024 *(Initial email)* 06 June 2024 *(reminder email)* 11 October 2024 *(final call)* **Email from Finder Energy** 13 June 2024	**Email on 26 March 2024 from Shell** Initial email with sufficient information **Email on 06 June 2024 from Shell** Reminder email. **Email on 13 June 2024 from Finder Energy** Advising that they have no feedback. **Email on 11 October 2024 from Shell** Final call out email. No response received	No objections or claims received.	Not applicable.	Finder No1 confirmed they do not have any feedback on this EP. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
191.	**INPEX**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 *(final call)*	Shell emailed INPEX several times with information on this EP. The only response received has been an automated response.	No objections or claims received.	Not applicable.	*See footnote
208.	**IPB-WA**	**Email from Shell** 10 June 2024 *(Initial email)* 09 August 2024 *(update email)* 11 October 2024 *(final call)*	Shell emailed IPB-WA several times with information on this EP. The only response received has been an automated response.	No objections or claims received.	Not applicable.	*See footnote
186.	**Jadestone Energy**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 *(final call)*	Shell emailed Jadestone Energy several times with information on this EP with no response.	No objections or claims received.	Not applicable.	*See footnote
187.	**Melbana Energy**	**Email from Shell** 26 March 2024 *(Initial email)* 11 October 2024 **Email from Melbana Energy** 27 March 2024	**Email on 26 March 2024 from Shell** Initial email with sufficient information **Email on 27 March 2024 from Melbana Energy** Advising that they have no feedback. **Email on 11 October 2024 from Shell** Final call out email. No response received	No objections or claims received.	Not applicable.	Melbana Energy AC/P70 confirmed they do not have any feedback on this EP. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
216.	**Pathfinder Energy**	**Email from Shell** 10 June 2024 *(Initial email)* 09 August 2024 *(update email)*	Shell emailed Pathfinder several times with information on this EP with only automated responses received.	No objections or claims received.	Not applicable.	*See footnote

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		11 October 2024 (*final call)*				
189.	**Santos Ltd**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 12 August 2024 11 October 2024 (*final call)*	Shell emailed Santos several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
221.	**Timor Resources**	**Email from Shell** 06 August 2024 *(Initial email)* 11 October 2024 (*final call)*	Shell emailed Timor Resources several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
220.	**Timor Gap**	**Email from Shell** 06 August 2024 *(Initial email)* 11 October 2024 (*final call)* **Email from Timor Gap** 12 August 2024	**Email on 06 August 2024 from Shell** Initial email with sufficient information. **Email on 12 August 2024 from Timor Gap** Confirming information has been received. **Email on 11 October 2024 from Shell** Final call out email. No response received	No objections or claims received.	Not applicable.	Timor Gap confirmed information has been received on this EP, but have not provided any feedback. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
190.	**Vulcan Energy Resources**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Vulcan Energy Resources several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
225.	**Woodside Energy Ltd**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Woodside several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
	Commercial Operators					
235.	**Absolute Ocean Charters**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Absolute Ocean Charters several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
240.	**Auriga Marine**	**Email from Shell** 27 March 2024 *(Initial email)*	Shell emailed Auriga Marine several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*				
239.	**Aurora Expeditions**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Aurora Expeditions several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
270.	**Coral Expeditions**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Coral Expeditions several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
372.	**Eco Abrolhos**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Eco Abrolhos several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
288.	**Fly Broome**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Fly Broome several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
296.	**Kimberley Air Tours**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Kimberley Air Tours several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
297.	**Kimberley Boat Cruises**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024*(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Kimberley Boat Cruises several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
298.	**Kimberley Coastal Camp**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Kimberley Coastal Camp several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
302.	**Kimberley Ports Authority** This includes Kimberley Marine Supply Base.	**Email from Shell** 11 June 2024 *(Initial email)* 09 August 2024 *(update email)* 11 October 2024 *(final call)* **In person** 16 May 2024	**In person on 16 May 2024** Representative from Kimberley Ports Authority attended a community consultation session. **Email on 11 June 2024 from Shell** Initial email with sufficient information. **Email on 09 August 2024 from Shell** Reminder email. **Email on 11 October 2024 from Shell** Final call out email. No response received	No objections or claims received.	Not applicable.	*See footnote
303.	**Kimberley Quest – Beyond Adventure**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Kimberley Quest several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
308.	**Kuri Bay Sport Fishing Tours**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Kuri Bay Sport Fishing Tours several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
309.	**Lady M Cruising**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Lady M Cruising several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
329.	**Odyssey Expeditions**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Odyssey Expeditions several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
330.	**One Tide Charters**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed One Tide Charters several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
228.	**Oolin Sunday Island Cultural Tours**	**Email from Shell** 04 April 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Oolin Sunday Island Cultural Tours several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
340.	**Reel Teaser**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Reel Teaser several times with information on this EP with only automated responses received.	No objections or claims received.	Not applicable.	*See footnote
349.	**Slick Fishing Charters Broome**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024*(update email)* 11 October 2024 (*final call)*	Shell emailed Slick Fishing Charters Broome several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
229.	**The Great Escape Charter Company**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed The Great Escape Charter Company several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
358.	**The Travelling Naturalist**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed The Travelling Naturalist several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
230.	**True North Kimberley Cruises**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)*	Shell emailed True North Kimberley Cruises several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		09 August 2024*(update email)* 11 October 2024 (*final call)*				
374.	**Unreel Adventure Safaris**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Unreel Adventure Safaris several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
	Interest Groups					
376.	**10,000 Birds**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed 10,000 Birds several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
377.	**Australasian Seabird Group**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Australasian Seabird Group several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
381.	**Australasian Wader Studies Group (AWSG)**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* **Email from AWSG** 07 August 2024	**Email on 26 March 2024 from Shell** Initial email with sufficient information. **Email on 11 June 2024 from Shell** Reminder email. **Email on 07 August 2024 from Shell** Reminder email. **Email on 07 August 2024 from AWSG** Requesting to opt out of further consultation.	No objections or claims received.	Not applicable.	AWSG have opted out of further consultation.
375.	**Australian Wildlife Conservancy**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Australian Wildlife Conservancy several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
382.	**Birding in Kimberley**	**Email from Shell** 26 March 2024 *(Initial email)*	Shell emailed Birding in Kimberley several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*				
383.	**Birdlife Top End**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Birdlife Top End several times with information on this EP with only automated responses received.	No objections or claims received.	Not applicable.	*See footnote
385.	**Broome Fishing Club**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Broome Fishing Club several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
390.	**Kimberley Birdwatching**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Kimberley Birdwatching several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
394.	**Recfishwest**	**Email from Shell** 26 March 2024 *(Initial email)* 13 June 2024 *(reminder email)* 11 October 2024 (*final call)* **Email from Recfishwest** 10 April 2024	**Email on 26 March 2024 from Shell** Initial email with sufficient information. **Email on 10 April 2024 from Recfishwest** Advised that they don't have concerns but want to be kept informed. **Email on 13 June 2024** Shell confirmed they would continue to keep Recfishwest informed. **Email on 11 October 2024 from Shell** Final call out email. No response received	No objections or claims received.	Not applicable.	RecfishWest do not have any concerns related to this EP and have requested to be kept updated. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
378.	**BirdLife WA**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed BirdLife WA several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
	Non-Government Organisations					

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
418.	**AIATSIS (Australian Institute of Aboriginal and Torres Strait Islander Studies)**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed AIATSIS several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
399.	**Australian Conservation Foundation**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Australian Conservation Foundation several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
400.	**Australian Marine Conservation Society**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Australian Marine Conservation Society several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
401.	**Australian Marine Oil Spill Centre (AMOSC)**	**Email from Shell** 26 March 2024 *(Initial email)* 25 July 2024 17 September 2024 18 September 2024 23 October 2024 01 November 2024 **Email from AMOSC** 03 April 2024 28 August 2024 18 September 2024 23 October 2024 **Phone call** 05 April 2024	**Email on 26 March 2024 from Shell** Initial email with sufficient information. **Email on 03 April 2024 from AMOSC** AMOSC requested a copy of the Environment Plan (EP) (specifically the risk scenario) and the Oil Pollution Emergency Plan (OPEP) for review prior to submission to NOPSEMA. In return, AMOSC will provide a letter of consultation confirming their service capability. On acceptance of the EP/OPEP, AMOSC requests a copy of the final plans to be provided to support response readiness. **Phone call on 05 April 2024** Shell to provide the BROPEP in the coming weeks. Shell to also provide the spill risk section once available. AMOSC can only provide a letter of consultation once these had been provided. **Email on 25 July 2024 from Shell** Shell shared the content related to AMOSC's request – including attached information. Shell confirmed that it would be referring to the accepted OPEP on NOPSEMA's website. **Email on 28 August 2024 from AMOSC** AMOSC confirmed details relating to AMOSC response capability/timeframes is accurate. AMOSC requested access to the full OPEP for review if Shell require an official letter of consultation.	No objections or claims received.	AMOSC requested a copy of the EP and the OPEP for review prior to submission to NOPSEMA. Shell provided the EP and OPEP for review. AMOSC requested a copy of the final plans to be provided to support response readiness. Shell will provide this once final. AMOSC provided some feedback on the OPEP. Feedback from AMOSC will be incorporated into the BROPEP in the next revision.	No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			Email on 17 September 2024 from Shell Confirmed link to the OPEP document for AMOSC to complete a review. **Email on 18 September 2024 from AMOSC** Confirming if there is a request from Shell to review the OPEP content. **Email on 18 September 2024 from Shell** Shell confirmed it would like AMSOC to complete a review of the OPEP. **Email on 23 October 2024 from AMOSC** AMOSC sent through the completed review of the OPEP with some suggested updates. **Email on 1 November 2024 from Shell** Thanking AMOSC for their review and confirmed Shell will incorporate the minor changes in the next revision of the BROPEP.			
395.	**Ben and Jerry's**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Ben and Jerry's several times with information on this EP with only automated responses received.	No objections or claims received.	Not applicable.	*See footnote
402.	**Conservation Council of WA**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 17 September 2024 17 October 2024 (*final call)* **Email from Conservation Council of WA** 13 September 2024	**Email on 26 March 2024 from Shell** Initial email with sufficient information. **Email on 11 June 2024 from Shell** Reminder email. **Email on 07 August 2024 from Shell** Reminder email. **Email on 13 September 2024 from Conservation Council of WA** Confirming that CCWA would like to be consulted. **Email on 17 September 2024 from Shell** Shell confirmed that CCWA had been identified as a relevant person for the purpose of consultation on this EP. Shell attached consultation materials related to the EP. Shell confirmed plans to publish the full draft EP in October and committed to sharing the link once available. Shell requested CCWA to advise if they needed any further information and come back to Shell with any objections or claims related to how their interests may be affected by the activities, within 30 calendar days. Shell confirmed planned submission of the EP to NOPSEMA by	No objections or claims received.	CCWA confirmed with Shell that they would like to be consulted for this EP.	Shell confirmed they were identified as a relevant person and re-attached consultation material. Shell also shared the draft EP with CCWA in the final call email. CCWA were given sufficient information on several occasions and over 6 months of time to consult with Shell. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			December 2024 and offered CCWA to meet with Shell prior to this date. **Email on 17 October 2024 from Shell** Final call out email. No response received			
421.	**Conservation Volunteers Australia**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Conservation Volunteers Australia several times with information on this EP with only automated responses received.	No objections or claims received.	Not applicable.	*See footnote
403.	**Environmental Defenders Office WA (EDO WA)**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed EDO WA several times with information on this EP with only automated responses received.	No objections or claims received.	Not applicable.	*See footnote
404.	**Environs Kimberley**	**Email from Shell** 09 April 2024 *(Initial email)* 30 May 2024 09 October 2024 **Email from Environs Kimberley** 12 June 2024 08 October 2024 **In person** 16 May 2024	**Email on 09 April 2024 from Shell** Initial email with sufficient information. **In person 16 May 2024 at Broome Community Session** Environs Kimberley attended the Broome Community session and raised some questions which were later emailed through and responded to. **Email on 30 May 2024 from Shell** In follow up from Broome Community Session, Shell provided Environs Kimberley with response to questions raised: • how many helicopters where currently flying to Prelude from Broome: we currently run two flights a day, Monday to Friday. • Is there a supply base in Broome: we are planning to support Crux drilling and Completions work through a Broome supply base from 2024 to 2026. Shell committed to coming back to Environs Kimberley with modelling data on questions related to greenhouse gases, oil spills and produced formation waste and utility discharges. **Email on 12 June 2024 from Environs Kimberley** Environs Kimberley responded with follow up questions • how many extra helicopters will be flying from Broome if Crux goes ahead? • Where would the supply base be, how many personnel and what size would it be • Would the supply base be operating 24/7 Reinforced interest in questions related to greenhouse gases and oil spill modelling.	No objections or claims received.	**Relevant matter to this EP** Environs Kimberley highlighted an interest in greenhouse gas and oil spill modelling. Shell provided Environs Kimberley with a link to the draft EP available on Shell's website and attached relevant sections related to previous query: • Section 9.9 Produce Water Discharge. • Section 9.10 Activity Discharges. • Section 9.12 Green House Gas **Not a relevant matter to this EP** Environs Kimberley raised a number of questions related to general Shell Operations, which Shell responded to.	Environs Kimberley were given sufficient information with full sections of the draft EP being shared, and over 6 months of time to consult with Shell. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			Email on 08 October 2024 from Environs Kimberely Following up on questions raised in June. **Email on 09 October 2024 from Shell** Shell responded to questions from Environs Kimberley and requested a response within 30 days. No response was received.			
405.	**Greenpeace**	**Email from Shell** 23 June 2023 24 September 2024	**Email on 23 June 2023 from Shell** Shell received correspondence from Greenpeace in relation to previous Crux EPs. A commitment was made in our response to share draft sections of this EP related to their matters of interest. **Email on 24 September 2024 from Shell** Shell attached a letter referring Greenpeace to information relating to previous request for information on GHG emissions management and spill preparedness, including sections of the draft EP published on Shell's website. Shell requested Greenpeace raise any objections or claims related to how their interests may be affected by the activities within 30 days and shared planned submission date for the EP to NOPSEMA in December 2024. Shell also let Greenpeace know that they would be available to meet prior to this. No response was received to this.	No objections or claims received.	**Relevant matters to this EP** Greenpeace requested information relating to Greenhouse Gas for previous EPs and Shell advised Greenpeace that it would consider indirect consequences, such as associated scope 3 GHG emissions, in this EP and committed to responding when information was available. Greenpeace asked Shell to advise which scenario the Crux gas project is most consistent with. Shell shared the draft GHG content from this EP and that the Crux project is consistent with Shell Group's Energy Transition strategy 2024. Greenpeace requested analysis of GHG environmental impacts. Shell shared GHG content of this EP and directed Greenpeace to section 8.4.5.3 of the Crux OPP. Greenpeace requested information on how the Crux project and the activities within the Environment Plans fit within the remaining global, national and state carbon budget to limit the average global temperature increase to 1.5°C by 2100. Shell directed Greenpeace to the draft GHG content of this EP. Greenpeace requested information showing how the inputs to the worst-case scenario hydrocarbon spill modelling were calculated. Shell referred Greenpeace to section 8.4.9.1 of the Crux OPP. **Not relevant matters to this EP** Greenpeace requested detailed information on how Shell determines who is a relevant person. Shell directed Greenpeace to section 5 of the Crux Development Drilling EP for more information on this.	Greenpeace were given sufficient information with full sections of the draft EP being shared. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
406.	**High Seas Alliance**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed High Seas Alliance several times with information on this EP with only automated responses received.	No objections or claims received.	Not applicable.	*See footnote

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
407.	**Martuwarra Fitzroy River Council**	**Email from Shell** 04 April 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)* 15 October 2024 **Email from Martuwarra Fitzroy River Council** 11 October 2024	**Email on 04 April 2024 from Shell** Initial email with sufficient information. **Email on 11 June 2024 from Shell** Reminder email. **Email on 09 August 2024 from Shell** Reminder email. **Email on 11 October 2024 from Martuwarra Fitzroy River Council** Advising of new email address for incoming CEO. **Email on 15 October 2024 from Shell** Resending final call out email to new email address. No response received.	No objections or claims received.	Not applicable.	Shell received advice from Martuwarra Fitzroy River Council on 11 October 2024 that there was a new CEO. Shell redirected further correspondence to this address. Since there was no delivery failure for the previous two emails, Shell deems them to have been received. *See footnote
410.	**Save the Kimberley**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Save the Kimberley several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
411.	**Sea Turtle.org**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Sea Turtle.org several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
397.	**Surfrider Foundation Australia**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Surfrider Foundation Australia several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
416.	**Wilderness Society**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)* **Email From Wilderness Society**	**Email on 26 March 2024 from Shell** Initial email with sufficient information. **Email on 11 June and 09 August 2024** Reminder emails. **Email on 11 October 2024 from Shell** Final call out email. **Email on 4 November 2024 from Wilderness Society**	No objections or claims received.	Not applicable.	Wilderness Society have confirmed they will not be providing feedback on this EP but requested to be kept updated. Shell will continue to do so. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		04 November 2024	Thanked Shell for contacting them and confirmed they would not be providing feedback on this activity. Requested to be kept updated as the activity progresses and confirmed email address.			
413.	**United Nations**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed United Nations several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
414.	**WA Marine Science Institute (WAMSI)**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed WAMSI several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
415.	**WA Parks Foundation**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed WA Parks Foundation several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
427.	**WWF**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed WWF several times with information on this EP with only automated responses received.	No objections or claims received.	Not applicable.	*See footnote
423.	**Regional Development Australia Kimberley**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Regional Development Australia Kimberley several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
	Academic and Research					
432.	**Australian National University (ANU)**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)*	Shell emailed ANU several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		07 August 2024 *(update email)* 11 October 2024 (*final call)*				
428.	**Deep History of Sea Country Research Project**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 21 August 2024 *(update email)* 11 October 2024 (*final call)* **Email from Deep History of Sea Country Research Project** 07 August 2024	**Email on 26 March 2024 from Shell** Initial email with sufficient information. **Email on 11 June 2024 from Shell** Reminder email. **Email on 07 August 2024 from Shell** Reminder email. **Email on 07 August 2024 from Deep History of Sea Country Research Project** Suggested a specialist heritage team. **Email on 21 August 2024 from Shell** Shell confirmed we have completed an Underwater Cultural Heritage assessment independently which is being peer reviewed for assurance. Shell has also provided Underwater Cultural Heritage training to relevant staff. **Email on 11 October 2024 from Shell** Final call out email. No response received	No objections or claims received.	The Deep History of Sea Country Research Project suggested a specialist heritage team. Shell responded to this with details on approach taken.	Shell confirmed that an Underwater Cultural Heritage Assessment had been carried out and was being peer reviewed for assurance. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
528.	**Fisheries Research and Development Corporation (FRDC)**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed FRDC several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
429.	**Kimberley Marine Research Station**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Kimberley Marine Research Station several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
433.	**The Ecology Centre**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed the Ecology Centre several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
	Industry Representative Bodies					

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
440.	**Kimberley Marine Tourism Association**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Kimberley Marine Tourism Association several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
442.	**Western Australian Game Fishing Association (WAGFA)**	**Email from Shell** 26 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed WAGFA several times with information on this EP with no response received.	No objections or claims received.	Not applicable.	*See footnote
	Service Providers					
443.	**Broome Sea Rescue**	**Email from Shell** 27 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Broome Sea Rescue several times with information on this EP with no response received.	No objections or claims received.	No applicable.	*See footnote
604.	**Territory Emergency Management Council (TEMC)**	**Email from Shell** 13 June 2024 *(Initial email)* 17 October 2024 (*final call)* **Email from TEMC** 13 June 2024 16 July 2024	**Email on 13 June 2024 from Shell** Initial email with sufficient information. **Email on 13 June 2024 from TEMC** Acknowledged receipt of information and advised a response would be forthcoming. **Email on 13 June 2024 from Shell** Extending the deadline. **Email on 16 July 2024 from TEMC** Remote location is outside of the NTFES emergency response area, which limits response to an emergency in a timely manner. Not in a position to provide comment to environmental impacts. Recommends consultation with community and emergency management stakeholders in Western Australia. **Email on 17 October 2024 from Shell** Final call out email. No response received	No objections or claims received.	TEMC advised that the location of the Crux project is outside of the NTFES emergency response area and they are not in a position to comment on this EP.	TEMC advised that the location of the Crux project is outside of the NTFES emergency response area and they are not in a position to comment on this EP. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.
	Indigenous Organisations and People					
	Tier 1					

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
29.	**Bardi and Jawi Niimidiman Aboriginal Corporation (BJNAC)** *Tier 1*	**Email from Shell** 17 April 2024 *(initial email)* 15 May 2024 06 June 2024 07 June 2024 20 June 2024 24 June 2024 10 July 2024 21 July 2024 12 September 2024 18 September 2024 08 October 2024 16 October 2024 *(final call)* 22 October 2024 24 October 2024 25 October 2024 07 November 2024 08 November 2024 22 November 2024 29 November 2024 04 December 2024 05 December 2024 06 December 2024 11 December 2024 13 December 2024 24 March 202520 May 2025 06 June 2025 **Email from BJNAC** 13 May 2024 22 May 2024 27 May 2024 07 June 2024 22 July 2024 12 September 2024 08 October 2024 18 October 2024 22 October 2024 23 October 2024 25 October 2024 06 November 2024 26 November 2024 02 December 2024 05 December 2024 (x3) 12 December 2024 04 March 2025 letter via NOPSEMA 01 May 2025	**In person on 12 April 2024** Informal catch up and notification that EP5 consultation had commenced, prior to sending out sufficient information. **Email on 17 April 2024 from Shell** Sufficient information provided on this EP. **Email on 13 May 2024 from BJNAC** Letter received outlining consultation requirements. **Email on 15 May 2024 from Shell** Response to letter received on 13 May 2024. **Phone call on 16 May 2024 from Shell** Calling to discuss letter received on 13 May 2024. **Email on 22 May 2024 from BJNAC** Confirming meeting on Friday 24 May. **In person on 24 May 2024** • Consultation expectations discussed - general relationship catch up. • Discussed project opportunities. **Email on 27 May 2024 from BJNAC** Sharing a redrafted resourcing protocol. **Phone call on 31 May 2024 from Shell** Progressing the resourcing protocol and opportunity to discuss this in person. **Emails and text messages on 06, 07, 10 and 11 June 2024 from BJNAC and Shell** Meeting logistics **Email on 20 June 2024 from Shell** High level points shared to discuss at the meeting. **In person meeting on 20 June 2024** Meeting discussed the consultation protocol. **Email on 24 June 2024 from Shell** Sharing draft table setting out issues and solutions discussed related to a consultation protocol. **Email on 10 July 2024 from Shell** Seeking a number to call on. **Phone call on 18 July 2024 from Shell**	No objections or claims.	**Relevant matter to this EP** Shell received a letter on behalf of BJNAC and an individual person who is a member of BJNAC in relation to a previous EP. Shell's response offered to consult with BJNAC and the individual. The individual has not come forward and to identified as relevant for this EP. Advice received from BJNAC, has directed Shell that the culturally appropriate way to consult with BJNAC members is through BJNAC as opposed to individual members., and follow their culturally appropriate method of consultation. Shell has respected that advice. **Not relevant matter to this EP** Shell and BJNAC have not been able to reach agreement on the consultation approach. Shell has offered to cover all reasonable costs related to consultation, to meet on country with culturally appropriate representatives, at an appropriate time as advised by BJNAC as well as offering access to an independent Environment Panel with costs covered by Shell.	Please see justification for consultation closed outlined in Table 5.11.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		Phone call 16 May 2024 31 May 2024 20 June 2024 11 July 2024 *(unanswered)* 15 July 2024 *(unanswered)* 17 July 2024 *(unanswered)* 18 July 2024 08 August 2024 05 September 2024 *(unanswered)* 13 September 2024 18 September 2024 11 October 2024 22 October 2024 25 October 2024 30 October 2024 *(unanswered)* 04 November 2024 *(unanswered)* 05 June 2025 *(unanswered)* **Text messages** 10 June 2024 11 June 2024 22 October 2024 **In Person** 12 April 2024 24 May 2024 20 June 2024	Shared re-submission timing for EP and provided BJNAC with the draft consultation summary section of the EP. BJNAC shared timing for next Board meeting. **Email on 21 July 2024 from Shell** Attaching relevant sections of EP for review by 2 August 2024. **Email on 22 July 2024 from BJNAC** Confirming receipt of email. Clarification required before they can respond. **Phone call on 08 August 2024 from Shell** Follow up on email related to draft consultation summary of EP and resourcing protocol discussion from 20 June 2024. **Email on 12 September 2024 from BJNAC** Confirmed BJNAC will be seeking Board instructions in September. **Email on 12 September 2024 from Shell** Proposing time for a call. **Phone call on 13 September 2024 from Shell** Follow up on previous phone calls from 08 August and 05 September 2024. **Phone call on 18 September 2024 from Shell** Actions discussed and followed up via email. **Email on 18 September 2024 from Shell** Shared information sheets for this EP along with status of project. Confirmed Shell would be happy to attend their Board meeting. **Email on 08 October 2024 from BJNAC** Confirming the BJNAC Board did not have space on their agenda for Shell. Feedback on summary table will be drafted over the course of the next week. Some available times were put forward to meet with the Board. **Email on 08 October 2024 from Shell** Shell looks forward to receiving feedback on the summary table. Shell confirmed commitment to consulting in a culturally appropriate and respectful way. **Phone call on 11 October 2024 from Shell** Follow up from email on 08 October and confirming Shel's attendance at Board meeting and Law Bosses meeting. **Email on 16 October 2024 from Shell**			

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			Shared draft link to the EP and confirmed submission timing. **Email on 18 October 2024 from BJNAC** Meeting cancellation. **Text message on 22 October 2024 from Shell** Confirming logistics for the meeting that week. **Phone call on 22 October 2024 from Shell** Follow up on text related to logistics for meeting on 24 October 2024. **Email on 22 October 2024 from BJNAC** Sharing discussion table with comments from the BJNAC Board and confirming meeting timing that week. **Email on 22 October 2024 from Shell** Shell confirmed receipt of discussion table and to consider proposed changes. **Text message on 22 October 2024 from Shell** Notifying that email had been sent and following up for confirmation on meeting on 24 October 2024. **Phone call on 22 October 2024 from Shell** Response to email received from BJNAC providing BJNAC response to discussion table and clarification of Law Boss meeting. **Phone call on 22 October 2024 from BJNAC** Provision of decision from BJNAC Chair whether to progress with Law Boss meeting. **Email on 23 October 2024 from BJNAC** BJNAC outlining position related to consultation protocol. **Email on 24 October 2024 from Shell** Requesting a call with BJNAC. **Email on 25 October 2024 from BJNAC** Revised consultation protocol. **Phone call on 25 October 2024 from Shell** Calling BJNAC regarding email on 25 October 2024. **Email on 25 October 2024 from Shell** Response to previous email related to consultation protocol. **Email on 06 November 2024 from BJNAC**			

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			Response to previous email related to consultation protocol. **Email on 7 November 2024 from Shell** Requesting Arma Legal return Shell's call. **Email on 08 November 2024 from Shell** Response to previous email related to consultation protocol. **Email on 22 November 2024 from Shell** Offer to meet. **Email on 26 November 2024 from BJNAC** Response related to consultation protocol. **Email on 29 November 2024 from Shell** Response related to consultation protocol. **Email on 02 December 2024 from BJNAC** Response related to consultation protocol. **Email on 04 December 2024 from Shell** Response related to consultation protocol. **Email on 05 December 2024 from BJNAC** Cancelling proposed meeting. **Email on 05 December 2024 from Shell** Confirming will cancel the meeting. **Email on 05 December 2024 from BJNAC** Requesting new proposed dates for the meeting. **Email on 06 December 2024 from Shell** Response related to consultation protocol. **Email on 11 December 2024 from Shell** Sharing extracts related to BJNAC consultation for review. **Email on 12 December 2024 from BJNAC** BJNAC do not feel that they have been consulted and remain open to meet in 2025. **Email on 13 December 2024 from Shell** Advising submission of EP5 and that Shell remain committed to ongoing engagement with BJNAC. **Letter on 04 March 2025 from BJNAC, via NOPSEMA** Outlining concerns related to consultation.			

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			Email on 24 March 2025 from Shell Update on the status of this EP. **Email on 01 May 2025 from BJNAC** Related to revised consultation protocol and Prelude EP. **Email on 20 May 2025 from Shell** Response to email related to revised consultation protocol and Prelude EP. **Email on 06 June 2025 from Shell** Advice on EP5 re-submission.			
31.	**Dambimangari Aboriginal Corporation (DAC)** *Tier 1*	**Email from Shell** 08 April 2024 *(initial email)* 19 April 2024 01 May 2024 10 May 2024 14 May 2024 23 May 2024 27 May 2024 17 June 2024 25 July 2024 29 July 2024 14 October 2024 16 October 2024 *(final call)* 17 October 2024 30 October 2024 07 November 2024 18 November 2024 19 November 2024 13 December 2024 16 December 2024 **Email from DAC** 16 April 2024 19 April 2024 08 May 2024 13 May 2024 14 May 2024 24 May 2024 29 July 2024 14 October 2024 17 October 2024 30 October 2024 05 November 2024 19 November 2024 13 December 2024 15 December 2024	**Email on 08 April 2024 from Shell** Sufficient information provided on this EP. **In person on 10 April 2024** Shell presented tailored presentation on this EP, including detailed information on environmental impacts and risks, and associated management measures in place as well as the worst credible case scenarios and modelling results for arriving at the planning area. **Email on 16 April 2024 from DAC** Follow up actions from the meeting held on 10 April 2024 and providing dates for a further meeting in the second half of the year. **Email on 19 April 2024 from Shell** Providing some follow up actions from the meeting held on 10 April 2024 as well as attaching a meeting summary for review. **Email on 19 April 2024 from DAC** DAC confirming they would come back with comments later next week. **Email on 19 April 2024 from Shell** Confirming no issues with the timeframe for response. **Email on 01 May 2024 from Shell** Follow up email on amendments to meeting summary. **Email on 08 May 2024 from DAC** Attaching minor comments and amendment to meeting summary. **Email on 10 May 2024 from Shell** Confirming receipt of meeting summary amendments. Comments have been addressed, seeking to finalise the notes. Attached the accepted OPP for the Crux Project from 2020.	No objections or claims received.	**Relevant matters to this EP** Shell encouraged to consult with Kimberley saltwater groups, as saltwater in sea country is interlinked across these groups, namely ISWAG. Shell confirmed that ISWAG are listed as a relevant person (37) for this EP. DAC confirmed they would like to see the underwater cultural heritage study as well as heritage modelling maps. Shell to share underwater cultural heritage study at a future meeting, once peer reviewed. **Not relevant matter to this EP** DAC requested a further meeting to discuss Social Investment. This will be progressed separately at a future meeting.	Please see justification for consultation closed outlined in Table 5.11.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		In person 10 April 2024 04 December 2024 **Phone call** 26 April 2024 *(unanswered)* 25 July 2024 27 September 2024	Reiterated Shell would be happy to attend the August Board meeting. **Email on 13 May 2024 from DAC** Accepted comments from the meeting summary. Raised a couple of queries related to the OPP. **Email on 14 May 2024 from Shell** Requesting dates for the next Board meeting. Shared a link to the OPP appendices and committed to responding on the other queries as would need to access archive records. **Email on 14 May 2024 from DAC** Confirming dates for the next Board meeting. **Email on 14 May 2024 from Shell** Confirming receipt of dates. **Email on 23 May 2024 from Shell** Responding to queries raised about the OPP. **Email on 24 May 2024 from DAC** Thanking Shell for response. **Email on 27 May 2024 from Shell** Closing loop on information raised at in person meeting. **Email on 17 June 2024 from Shell** Seeking clarification on dates to present to the Board. **Phone call on 25 July 2024** Seeking clarification on dates to present to the Board. **Email on 25 July 2024 from Shell** Seeking clarification on dates/times to present to the Board. **Email on 29 July 2024 from DAC** Request to reschedule presentation to October. **Email on 29 July 2024 from Shell** No issue with date change for Shell. **Phone call on 27 September 2024** Follow-up to email received re request for support of Dambimangari (DAC) TO's to travel to cultural artefact exhibition in Germany and upcoming EP Consult at DAC Board meeting. **Phone call on 30 September 2024** Upcoming consultation at Board Meeting in Derby.			

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			Phone call on 11 October 2024 Seeking clarification on dates/times to present to the Board. **Email on 14 October 2024 from DAC** Requesting delay to December Board meeting or 2025. **Email on 14 October 2024 from Shell** No issue with date change for Shell. **Email on 16 October 2024 from Shell** Sharing the draft EP link published on Shell's website. Shared the plan to submit the EP in December. Requested any comments or information from DAC by 8 November 2024. **Email on 17 October 2024 from DAC** Advising changes in structure at DAC. **Email on 17 October 2024 from Shell** Thanking DAC for advice. **Email on 30 October 2024 from DAC** Confirming receipt of last email and noted the due date. **Email on 30 October 2024 from Shell** Thanking DAC. **Email on 05 November 2024 from DAC** Invitation to Board meeting. **Email on 07 November 2024 from Shell** Confirming Shell will attend. **Emails on 18 and 19 November 2024 from Shell & DAC** Meeting logistics. **In person on 04 December 2024** Shell presented tailored presentation on this EP, including detailed information on environmental impacts and risks, and associated management measures in place as well as the worst credible case scenarios and modelling results for arriving at the planning area. **Email on 13 December 2024 from Shell** Sharing meeting notes and presentation post the meeting. **Email on 13 December 2024 from DAC** Distributing notes to Directors.			

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			Email on 13 December 2024 from Shell Thank you. **Email on 15 December 2024 from DAC** Minor corrections provided to meeting notes. **Email on 16 December 2024 from Shell** Amended records provided. **Email on 16 December 2024 from DAC** Amendments accepted. **Email on 16 December 2024 from Shell** Shared the final notes.			
38.	**Kimberley Land Council (KLC)** *Tier 1*	**Email from Shell** 19 February 2024 08 April 2024 *(initial email)* 17 April 2024 18 April 2024 13 August 2024 *(update email)* 15 October 2024 *(final call)* **Email from KLC** 08 April 2024 17 April 2024 **Further consultation with KLC has occurred through 39. Kimberley Ranger Network.*	**Email on 19 February 2024 from Shell** Attempting to organise a meeting with KLC. **Email on 20 February 2024 from KLC** Directing Shell to the right person. **Email on 08 April 2024 from Shell** Sufficient information provided on this EP. **Email on 17 April 2024 from Shell** Proposing dates for a meeting with the KLC. **Email on 17 April 2024 from KLC** KLC advised that they will check and come back to Shell. **Email on 18 April 2024 from Shell** Thanking KLC. **Email on 13 August 2024 from Shell** Update email. **Email on 15 October 2024 from Shell** Final call out email. Shell also shared the link to the draft EP. No response received	No objections or claims received.	No applicable.	Please see justification for consultation closed outlined in Table 5.11.
44.	**Mayala Inninalang Aboriginal Corporation (incl Mayala 2)** *Tier 1*	**Email from Shell** 08 April 2024 *(Initial email)* 08 August 2024 *(reminder email)* 16 October 2024 *(final call)* **Phone call** 19 April 2024 *(unanswered)* 22 August 2024	**Email on 08 April 2024 from Shell** Sufficient information provided on this EP. **Email on 08 August 2024 from Shell** Reminder email. **Phone call on 22 August 2024** Follow up to email sent on 08 August 2024. Phone call to discuss previous email offering on-country consultation. Mayala advised they had recently appointed	No objections or claims received.	No applicable.	Please see justification for consultation closed outlined in Table 5.11.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			new Executive Officer, confirmed had received previous correspondence from Shell and would discuss internally priority placed on consultation. Mayala to contact Shell if decision made to take offer to consult with Shell. Mayala discussing consulting with proponents to align on priority and method. Mayala would reach out if a decision was made to take up offer to consult. Shell available to meet at Mayala's convenience. **Email on 16 October 2024 from Shell** Final call out email. No response received.			
114.	**Northern Land Council (NLC)** *Tier 1*	**Email from Shell** 10 April 2024 *(Initial email)* 27 May 2024 29 May 2024 30 May 2024 15 July 2024 13 August 2024 *(update email)* 18 September 2024 15 October 2024 *(final call)* **Email from NLC** 30 May 2024 15 July 2024 13 August 2024 18 September 2024 **Phone call** 13 May 2024 29 May 2024 15 July 2024	**Email on 10 April 2024 from Shell** Sufficient information provided on this EP. **Phone call on 13 May 2024** Phone call seeking to organise an appropriate method of consultation with NLC as an identified RP for preparation of this EP. **Email on 27 May 2024 from Shell** Requesting information to be shared with Top End Aboriginal Corporation and Arnhem Land Aboriginal Land Trust. **Phone call 29 May 2024** NLC confirmed that information had been received. **Email on 30 May 2024 from Shell** Requesting NLC to pass on information to NLC groups. **Email on 30 May 2024 from NLC** Providing contact details for NLC groups and requesting to be copied on emails. **Phone call on 15 July 2024** Contact unavailable. **Email on 15 July 2024 from Shell** Reminder email with offer to meet in Darwin. **Email on 15 July 2024 from NLC** Out of office from NLC. **Email on 13 August 2024 from Shell** Update email. **Email on 13 August 2024 from NLC** Out of office from NLC. **Email on 18 September 2024 from Shell** Offer to meet in Darwin.	No objections or claims received.	No applicable.	Please see justification for consultation closed outlined in Table 5.11.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			Email on 18 September 2024 from NLC Out of office from NLC. **Email on 15 October 2024 from Shell** Final call out email. No response received			
51.	**Nyul Nyul PBC Corporation** *Tier 1*	**Email from Shell** 08 April 2024 *(Initial email)* 15 April 2024 29 April 2024 30 April 2024 06 May 2024 08 May 2024 20 May 2024 21 May 2024 06 June 2024 16 October 2024 *(final call)* **Email from Nyul Nyul** 12 April 2024 29 April 2024 06 May 2024 21 May 2024 **Email from KLC** 08 April 2024 06 May 2024 **In person** 22 February 2024 02 May 2024	**In person on 22 February 2024** Shell presented a tailored presentation on this EP, including detailed information on environmental impacts and risks, and associated management measures in place as well as the worst credible case scenarios and modelling results. **Email on 08 April 2024 from Shell** Sufficient information provided on this EP. **Email on 08 April 2024 from KLC** Directing Shell to the best contact at Nyul Nyul. **Email on 12 April 2024 from Nyul Nyul** Confirming Shell will be on the agenda at their Board meeting in May. **Email on 15 April 2024 from Shell** Meeting logistics. **Emails on 29 and 30 April 2029 from Shell & Nyul Nyul** Meeting logistics. **In person 02 May 2024** Shell presented a tailored presentation on this EP, including detailed information on environmental impacts and risks, and associated management measures in place as well as the worst credible case scenarios and modelling results. The oil spill preparedness training was also discussed. **Email on 06 May 2024 from Shell & Nyul Nyul** Confirming attendees at the meeting to be included in the meeting summary. **Email on 08 May 2024 from Shell** Follow up email to meeting, including meeting summary for review and sharing the presentation, recruitment flyer and animation video. Also following up the proposed oil spill training workshop with Nyul Nyul Rangers. **Email on 20 May 2024 from Shell** Follow up to email on 08 May 2024. Also flagged that Shell had not heard from the Land and Sea Management Unit and suggesting Shell could contact them to progress the workshop with the Nyul Nyul Rangers.	No objections or claims received	Nyul Nyul raised the migratory shore birds that passed through the planning area. Shell is aware of the migratory shore birds and information has been included in planning process. Nyul Nyul confirmed they would like to see the underwater cultural heritage study Shell has recently completed and highlighted the importance to protect any underwater cultural heritage that is found. Shell to share the underwater cultural heritage study at a future meeting. Information was provided by Nyul Nyul about two culturally sensitive sites. Shell confirmed that the two culturally sensitive sites are outside of the planning area and are not relevant to this EP Nyul Nyul directed Shell to organise through KLC a follow up workshop with Nyul Nyul Rangers, preferably coordinated with other Operators to discuss oil spill preparedness training and cultural monitoring opportunities. Shell has progressed the workshop through the Kimberley Ranger Network – see RP39. This matter forms part of Shells ongoing consultation commitment.	Please see justification for consultation carried out outlined in Table 5.11. .

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			Email on 21 May 2024 from Nyul Nyul Confirming meeting summary had been forwarded to the Board for consideration, and sharing the Land and Sea Management Units contact details. **Email on 21 May 2024 from Shell** Shell thanked Nyul Nyul for confirmation. **Email on 16 October 2024 from Shell** Final call out email. No response received			
54.	**Walalakoo Aboriginal Corporation** *Tier 1*	**Email from Shell** 15 May 2024 06 June 2024 *(initial email)* 22 August 2024 *(update email)* 15 October 2024 *(final call)* 12 November 2024 **Email from Walalakoo** 13 May 2024 25 October 2024 **Phone call** 17 May 2024 *(unanswered)* 05 June 2024 11 July 2024 22 August 2024 x2	**Email on 13 May 2024 from Walalakoo** Letter received outlining consultation requirements. **Email on 15 May 2024 from Shell** Response to letter received on 13 May 2024. **Phone call on 05 June 2024** Ascertaining contact details. **Email on 06 June 2024 from Shell** Follow up after having tried to call. Sufficient information provided on this EP. **Phone call on 22 August 2024** Trying to establish contact to discuss this EP. Spoke with office reception. Further call to GM unsuccessful – voicemail left. **Email on 22 August 2024 from Shell** Update email. **Email on 15 October 2024** Final call out email. **Email on 25 October 2024 from Walalakoo** Attaching the standard terms of engagement for the consultation. **Email on 12 November 2024 from Shell** Response to previous email.	No objections or claims received	Whilst this is not considered a relevant matter to this EP, Shell received a consultation protocol from Walalakoo on 25 October 2024. Shell first contacted Walalakoo in June 2024, Shell reviewed this and communicated to Walalakoo that it was unlikely Shell and Walalakoo would reach agreement prior to the submission of this EP. Shell offered to cover all reasonable costs related to consultation, to meet on country with culturally appropriate representatives, at an appropriate time as advised by Walalakoo as well as offering access to the Environment Panel for which Shell will cover the costs.	Please see justification for consultation closed outlined in Table 5.11.
55.	**Wanjina-Wunggurr (Native Title) Aboriginal Corporation** *Tier 1*	**Email from Shell** 08 April 2024 *(initial email)* 20 August 2024 21 August 2024 30 September 2024 16 October 2024 *(final call)* **Email from Wanjina-Wunggurr** 21 August 2024	**Email on 08 April 2024 from Shell** Sufficient information provided on this EP. **Email on 20 August 2024 from Shell** New contact identified and sent sufficient information on this EP. **Email on 21 August 2024 from Wanjina-Wunggurr** Confirming the Board would consider offer to meet from Shell before October at September Board meeting.	No objections or claims received.	No applicable.	Please see justification for consultation closed outlined in Table 5.11.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			Email on 21 August 2024 from Shell Confirming Shell would be happy to travel to meet on-country and contribute costs. **Email on 30 September 2024 from Shell** Follow up on meeting availability. **Email on 16 October 2024 from Shell** Final call out email. No response received.			
57.	**Wilinggin Aboriginal Corporation** *Tier 1*	**Email from Shell** 08 April 2024 *(initial email)* 16 July 2024 07 August 2024 14 August 2024 22 August 2024 30 September 2024 15 October 2024 *(final call)* **Email from Wilinggin** 06 August 2024 14 August 2024 **Phone call** 03 May 2024 *(unanswered)* 15 July 2024 **Text message** 03 May 2024	**Email on 08 April 2024 from Shell** Sufficient information provided on this EP **Text message 03 May 2024 from Wilinggin** Requesting to use text. **Text message on 03 May 2024 from Shell** Confirming receipt of email and opportunity to meet to consult on this EP. **Phone call on 15 July 2024** Wilinggin to share legal representative details. Wilinggin confirmed that the project wasn't impacting native title interests, so the position of the group was that given the distance of the project Wilinggin didn't feel like they needed to consult directly with Shell. However legal representative would confirm. **Email on 16 July 2024 from Shell** Shell followed up with legal representative details. **Email on 06 August 2024 from Wilinggin** Seeking more details about meeting with Wilinggin. **Email on 07 August 2024 from Shell** Shell confirmed happy to meet and outlined approach we have been taking. **Email on 14 August 2024 from Wilinggin** Advised will let Shell know. **Email on 14 August 2024 from Shell** Thanking Wilinggin. **Email on 22 August 2024 from Shell** Following up regarding meeting dates. **Email on 30 September 2024 from Shell** Further follow up. **Email on 15 October 2024 from Shell**	No objections or claims received.	No applicable.	Please see justification for consultation closed outlined in Table 5.11.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			Final call out email. No response received			
125.	**Wunambal Gaambera Aboriginal Corporation (WGAC) (including the Uunguu Rangers)** *Tier 1*	**Email from Shell** 08 April 2024 *(initial email)* 29 May 2024 20 August 2024 22 August 2024 26 August 2024 16 October 2024 *(final call)* 30 October 2024 08 November 2024 **Email from Wunambal Gaambera** 20 August 2024 22 August 2024 **Phone call** 26 April 2024 *(unanswered)* 03 May 2024 *(unanswered)* 30 October 2024 *(unanswered)* **In person** 23 August 2024	**Email on 08 April 2024 from Shell** Sufficient information provided on this EP **Email on 29 May 2024 from Shell** Following up on other business related matters but looping in our Indigenous Engagement Advisor. **Email on 20 August 2024 from WGAC** Seeking approval from Shell for an alternative business matter related to flights. **Email on 20 August 2024 from Shell** Confirming email passed onto Aviation Team in Shell. **Emails on 22 August 2024 from Shell and WGAC** Arrangements to meet in person at Shell House. **In person on 23 August 2024** Shell presented tailored presentation on this EP, including detailed information on environmental impacts and risks, and associated management measures in place as well as the worst credible case scenarios and modelling results for arriving at the planning area. **Email on 26 August 2024 from Shell** Follow up from meeting. **Email on 16 October 2024 from Shell** Final call out email. **Email on 30 October 2024 from Shell** Letting WGAC know about drop-in sessions in Wyndham and Kununurra. **Email on 08 November 2024 from Shell** Reaching out further to discussion with Kalumburu about aligning consultation.	No objections or claims received.	**Matters relevant to this EP** WGAC have interest in Shell's GIS data to build their database and better document understanding of WGAC country. Shell to discuss GIS data at a future meeting. WGAC expressed interest in accessing the Underwater Cultural Heritage research report. Shell plan to present the Underwater Cultural Heritage study at the next meeting. WGAC provided a current copy of Healthy Country Plan and IPA Management Plan to Shell. The Healthy Country Plan and IPA Management Plan has been reviewed against the previous version which was considered in the initial research work undertaken which supports this EP. No further measures adopted. **Matters not relevant to this EP** Discussion around other opportunities borne by the project including employment and procurement. This will be progressed as a separate mater.	Please see justification for consultation closed outlined in Table 5.11.
	Tier 2					
72.	**Anindilyakwa Land Council** *Tier 2*	**Email from Shell** 24 May 2024 *(Initial email)* 15 August 2024 *(update email)* 17 October 2024 (*final call)* **Phone call** 18 September 2024 *(unanswered)* 19 September 2024	**Email on 24 May 2024 from Shell** Sufficient information provided on this EP. **Email on 15 August 2024 from Shell** Update email. **Phone call on 19 September 2024** Will follow up with person responsible for the email account. **Email on 17 October 2024 from Shell**	No objections or claims received.	No applicable.	Please see justification for consultation closed outlined in Table 5.12.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			Final call out email. No response received			
122.	**Balanggarra Aboriginal Corporation** *Tier 2*	**Email from Shell** 08 April 2024 *(initial email)* 06 May 2024 13 August 2024 *(update email)* 16 October 2024 *(final call)* 30 October 2024 **Phone call** 13 May 2024 *(unanswered)* 05 September 2024 *(unanswered)* **Text message** 13 May 2024	**Email on 08 April 2024 from Shell** Sufficient information provided on this EP. **Email on 06 May 2024 from Shell** Forwarding on initial email following a bounce back. **Text messages on 13 May 2024** Shell seeking to consult. Balanggarra confirmed message shared with CEO. **Email on 13 August 2024 from Shell** Update email. **Email on 16 October 2024 from Shell** Final call out email. No response received. **Email on 30 October 2024 from Shell** Letting Balanggarra know about drop-in sessions in Wyndham and Kununurra.	No objections or claims received.	No applicable.	Please see justification for consultation closed outlined in Table 5.12.
33.	**Gogolanyngor Aboriginal Corporation** *Tier 2*	**Email from Shell** 08 April 2024 *(initial email)* 09 April 2024 16 October 2024 *(final call)* **Email from KLC** 09 April 2024 **Phone call** 13 May 2024 x 2 *(unanswered)* 23 May 2024 *(unanswered)* 05 September 2024 *(unanswered)*	**Email on 08 April 2024 from Shell** Sufficient information provided on this EP. **Email on 09 April 2024 from KLC** Updating on correct contact details for Gogolanyngor. **Email on 09 April 2024 from Shell** Resending to correct contact. **Email on 16 October 2024 from Shell** Final call out email. No response received.	No objections or claims received.	No applicable.	Please see justification for consultation closed outlined in Table 5.12.
93.	**Kalumburu Aboriginal Corporation** *Tier 2*	**Email from Shell** 08 April 2024 *(initial email)* 08 August 2024 *(update email)* 16 October 2024 *(final call)* 31 October 2024 08 November 2024 **Email from Kalumburu** 31 October 2024 **Phone call** 08 May 2024 *(unanswered)*	**Email on 08 April 2024 from Shell** Sufficient information provided on this EP. **Email on 08 August 2024 from Shell** Update email. **Email on 16 October 2024 from Shell** Final call out email. **Phone call on 30 October 2024 from Shell** Contact made with the local store. Provided with Accounts email address. **Email on 30 October 2024 from Shell**	No objections or claims received.	Kalumburu requested to align consultation with Wunambal Gaambera in 2025. Shell will endeavour to accommodate this request.	Please see justification for consultation closed outlined in Table 5.12.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		22 August 2024 *(unanswered)* 30 October 2024 *(unanswered)* 30 October 2024 01 November 2024	Letting Kalumburu know about drop-in sessions in Wyndham and Kununurra. **Email on 30 October 2024 from Shell** Reaching out to alternative Accounts email regarding consultation with Kalumburu. **Email on 31 October 2024 from Kalumburu** Accounts email address advising they are external and cannot talk on behalf of Kalumburu. **Email on 31 October 2024 from Shell** Acknowledged previous email. **Phone call on 01 November 2024 from Kalumburu** Interested but not able to meet until early 2025. Reference Wunumbal Gambera as a joint consultation. **Email on 08 November 2024 from Shell** Aligning on meeting with both Kalumburu and Wunumbal Gambera.			
123.	**Wanparta Aboriginal Corporation** *Tier 2*	**Email from Shell** 04 June 2024 *(initial email)* 13 June 2024 18 June 2024 02 August 2024 18 August 2024 21 August 2024 26 August 2024 27 August 2024 29 August 2024 30 August 2024 03 September 2024 06 September 2024 16 October 2024 *(final call)* 18 October 2024 **Email from Wanparta** 13 June 2024 17 June 2024 18 June 2024 02 August 2024 14 August 2024 20 August 2024 22 August 2024 27 August 2024 30 August 2024 06 September 2024 18 October 2024	**Email on 04 June 2024 from Shell** Sufficient information provided on this EP. **Email on 13 June 2024 from Wanparta** Invitation to Board meeting on 16 August 2024. **Email on 13 June 2024 from Shell** Confirming Shell would be happy to proceed and requesting further details for due diligence. **Email on 17 June 2024 from Wanparta** List of Directors for meeting. **Email on 18 June 2024 from Shell & Wanparta** Meeting logistics. **Email on 02, 14 18, 20, 21, 22, 26, 27 August 2024 from Shell & Wanparta** Meeting logistics. **In person on 28 August 2024** Shell presented tailored presentation on this EP, including detailed information on environmental impacts and risks, and associated management measures in place as well as the worst credible case scenarios and modelling results for arriving at the planning area. **Email on 29 August 2024 from Shell** Follow up from meeting and confirming Shell to share draft notes. Request for Wanparta to confirm attendees.	No objections or claims received.	**Matters relevant to this EP** Shell to engage with Wanparta on Underwater cultural heritage at a future meeting post peer review. Shell plan to present the Underwater Cultural Heritage study at the next meeting. Shell to continue to consult with Wanparta on an annual basis. **Matters not relevant to this EP** Shell to consider funding the Ngarla Ranger Program and Bedout Island birdlife research scope to establish baseline data. Shell will assess whether these two programs can be further progressed as a separate matter.	Please see justification for consultation closed outlined in Table 5.12.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		In person 28 August 2024	**Email on 30 August 2024 from Wanparta** Confirming attendees from meeting. **Email on 30 August 2024 from Shell** Shell thanked Wanparta. **Email on 03 September from Shell** Attaching draft meeting notes. **Email on 06 September from Wanparta** Confirmation of consultation letter, including meeting outcomes. **Email on 06 September 2024 from Shell** Thanking Wanparta for the letter. **Email on 06 September 2024 from Shell** Thanking Wanparta for the review of the meeting notes. **Email on 16 October 2024 from Shell** Final call out email. **Email on 18 October 2024 from Wanparta** Wanparta will revert if they have any final comments. **Email on 18 October 2024 from Shell** Thanking them. No further response received			
	Tier 3					
131.	**Ardyaloon Trochus Hatchery and Aquaculture Centre** *Tier 3*	**Email from Shell** 24 May 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Ardyaloon Trochus Hatchery and Aquaculture Centre several times with information on this EP with no response received.	No objections or claims received.	No applicable.	*See footnote
74.	**Arnhem Land Aboriginal Land Trust** *Tier 3*	Consulted through 114 NLC.	See 114 NLC.	No objections or claims received.	No applicable.	*See footnote
603.	**Cobourg Peninsula Sanctuary Land Trust**	Consulted through 114 NLC.	See 114 NLC.	No objections or claims received.	No applicable.	*See footnote
32.	**Djarindjin Aboriginal Corporation (DAC)** *Tier 3*	**In person** 27 March 2024 *(sufficient information)* **Email from Shell** 15 April 2024 16 October 2024 *(final call)*	**Email on 19 March 2024 from DAC** Confirming availability for meeting. **In person on 27 March 2024** Shell presented tailored presentation on this EP, including detailed information on environmental impacts and risks, and associated management measures in place as well as		**Relevant matters to this EP** Encouraged Shell to discuss with rangers in the area and suggested linking in with Kimberley Leadership Forums such as ISWAG and KRN. Shell confirmed it is consulting with these groups. DAC followed up a historic suggestion to use TO representatives to facilitate collective TO consultation for Shell. Shell responded that it had	Shell met with DAC on 27 March 2024 and shared the draft EP on 16 October, with no further response from DAC. No further measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		Email from DAC 19 March 2024 21 June 2024	the worst credible case scenarios and modelling results for arriving at the planning area. Shell also left hard copy information sheets with DAC. **Email on 15 April 2024 from Shell** Shared draft meeting summary notes and link to animation. **Email on 21 June 2024 from DAC** Confirming meeting notes and that no sensitive issues discussed or provided in the material. **Email on 16 October 2024** Final call out email, with link to draft EP. No response received		adapted its consultation approach to accommodate TO requests for consultation approaches and timing as far as was considered reasonable and possible, such as offers to consult 1:1 and on country. DAC provided feedback that the Environmental Panel shouldn't be positioned as independent if experts have worked with Shell previously. Shell reiterated the Independent Environmental Panel was anonymous and paid for by Shell. Shell also confirmed that an alternative expert preferred by DAC may be used. Request from DAC for additional underwater cultural heritage modelling maps showing proximity of Crux and Prelude to Djarindjin community and Bardi Jawi native title land. Shell to share the Underwater Cultural Heritage study once completed. **Not relevant matters to this EP** DAC indicated interest in East coast programs that could be adapted for several of their projects including community solar project. This will be progressed separately.	
67.	**Djarindjin Campgrounds** *Tier 3*	**Email from Shell** 24 March 2024 *(Initial email)* 11 June 2024 *(reminder email)* 07 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Djarindjin Campgrounds several times with information on this EP with no response received.	No objections or claims received.	No applicable.	*See footnote
610.	**Djuludki Consultive Committee** *Tier 3*	**In person** 06 November 2024 **Email from Shell** 15 November 2024 19 November 2024 **Email from Djuludki Consultive Committee** 19 November 2024	Consultation occurred through 607 TEACA first for this RP. **In person on 06 November 2024** Shell presented tailored presentation on this EP, including detailed information on environmental impacts and risks, and associated management measures in place as well as the worst credible case scenarios and modelling results for arriving at the planning area. Shell also shared hard copies of the relevant information sheets. **Email on 15 November 2024 from Shell** Sharing the Crux animation, PowerPoint presentation and meeting notes for review. **Email on 19 November 2024 from Djuludki Consultive Committee** Thanks for passing on information. Confirming names will not be published. **Email on 19 November 2024 from Shell** Thanks for passing on information. Confirming names will not be published.	No objections or claims received.	**Relevant matter to this EP** The committee directed Shell to a report completed by the Thamarrurr Rangers outlining the finding of local skink and mouse previously thought to be extinct and an Impact Report completed for the Bradshaw Defence ILUA that provided environmental and social impact assessment. Shell researched the matter and found it was not relevant to the planning area of this EP. Shell to provide the committee with draft EP. Shell completed this. **Not relevant matters to this EP** A number of actions were raised not relevant to this EP, but to Shell's business e.g. social investment programs. These are being actioned by Shell. Shell was invited to present to the Bradshaw Liaison Committee on the Crux project. After assessing this, Shell determined they did not have any functions, interests or activities that may be affected, and therefore, are not a relevant person however may explore future engagement if relevant to Shell's business.	

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
58.	**Individual Indigenous Person 1** *Tier 3*	**Email from Shell** 4 April 2024 *(Initial email)* 11 June 2024 *(reminder email)* 15 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed this person several times with information on this EP with no response received.	No objections or claims received.	No applicable.	*See footnote
35.	**Joombarn-Buru Aboriginal Corporation RNTBC (JBAC)** *Tier 3*	**Email from Shell** 28 May 2024 *(Sufficient information)* 06 June 2024 11 June 2024 14 June 2024 21 June 2024 25 June 2024 26 June 2024 01 July 2024 16 July 2024 02 August 2024 05 August 2024 12 August 2024 02 September 2024 03 September 2024 05 September 2024 24 September 2024 16 October 2024 *(final call)* 18 October 2024 04 December 2024 13 December 2024 **Email from Joombarn-Buru** 03 June 2024 11 June 2024 12 June 2024 25 June 2024 26 June 2024 08 July 2024 01 August 2024 05 August 2024 08 August 2024 27 August 2024 03 September 2024 04 September 2024 17 October 2024 **Phone call** 12 June 2024	**Email on 28 May 2024 from Shell** Email with sufficient information. **Email on 03 June 2024 from JBAC** Confirming dates of Board meeting and inviting Shell to attend. **Email on 06 June 2024 from Shell** Confirming Shell's attendance and seeking best phone number to call on. **Email on 11 June 2024 from JBAC** Confirming phone number and availability to discuss tomorrow. **Email on 11 June 2024 from Shell** Confirming call tomorrow. **Phone call on 12 June 2024** Discussion regarding meeting logistics. **Email on 12, 14 , 21, 25 and 26 June from JBAC and Shell** Meeting logistics. **In person on 26 June 2024** Shell presented tailored presentation on this EP, including detailed information on environmental impacts and risks, and associated management measures in place as well as the worst credible case scenarios and modelling results for arriving at the planning area. **Email on 01 July 2024 from Shell** Confirming meeting attendees. **Email on 08 July 2024 from JBAC** Confirming meeting attendees and action items from meeting. **Email on 08 July 2024 from Shell** Will share the draft notes from the meeting. **Email on 16 July 2024 from Shell**	No objections or claims received.	**Matters relevant to this EP** JBAC identified marine species as a food source for JBAC members. Shell acknowledged that marine species are a food source and this is reflected in the EP. JBAC requested to be added as a notification point in the event of an oil spill in the Browse Regional Oil Pollution Emergency Plan (BROPEP) and Oil Spill Management Plan (OSMP) documents. This has been completed. JBAC shared information about song lines in the region with cultural neighbour block and direct Shell to attempt consultation with BJNAC, Shell confirmed BJNAC were a relevant person for the purposes of consultation on this EP. JBAC requested copies of accepted Crux EPs and Crux OPP. This has been completed. JBAC reiterated importance of speaking with proximal groups Bardi Jawi Niimidiman AC, Dambimangari, Kalumburu, Wilinggin, Balanggarra and Wunambal Gaambera. Shell noted that consultation with all the groups JBAC raised had either occurred, been offered or was ongoing. JBAC requested more information on produced water discharge. Further information on produced water discharge was shared with JBAC at the 04 September 2024 meeting JBAC requested Shell disclose oil spill modelling data to assist independent review process. Shell shared the full draft EP with JBAC to close this request. Shell provided further information to JBAC re tolerance level of Crux platform to earthquakes. JBAC requested that Shell consider studying impact to proximal fish through monitoring program. Shell advised JBAC that we would not be setting up a fish monitoring program as this has taken place on the North West Shelf project and Shell considered this technique historical and deemed it was not necessary in order to monitor key impacts from key discharges from offshore facilities like the Crux platform.	JBAC have been included as a notification point in a minor revision of the BROPEP and weekly contacts list document. Shell has met with JBAC twice and had several phone calls and multiple email exchanges. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		25 July 2024 *(Not answered)* **In person** 26 June 2024 04 September 2024 02 December 2024	Meeting follow up, including sharing presentation, animation and link to Crux OPP. **Email on 01 August 2024 from JBAC** Attached quote. **Email on 02 August 2024 from Shell** Confirming receipt of quote and requesting some further information. Confirming follow up actions. **Email on 05, 08 and 12 August 2024 from JBAC and Shell** Related to organisation of next meeting. **Email on 27 August 2024 from JBAC** Sharing JBAC's consultation protocol agreement for review. **Email on 02 September 2024 from Shell** Confirmed that Shell would review the consultation protocol agreement. Followed up on any matters specifically to cover in the next meeting. Confirmed attendees. **Email on 02 September 2024 from Shell** Confirming meeting timing. **Email on 03 September 2024 from JBAC** Confirming meeting time and following points to be followed up: 1. A copy of the Incident Response Plan 2. Any relevant information on discharge water 3. A list of Traditional Owner groups consulted as part of the initial NOPSEMA submission for the Crux Project. **Email on 03 September 2024 from Shell** Confirmed Shell had included in its presentation. **In person on 04 September 2024** Agenda developed to address questions raised at previous meeting on 26 June 2024. **Email on 04 September 2024 from JBAC** Requesting a copy of the presentation. **Email on 05 September 2024 from Shell** Confirmed will be sharing presentation along with meeting summary late this week or early next. **Email on 24 September 2024 from Shell** Sharing the presentation, meeting notes for review and the Browse Regional Oil Pollution Emergency Plan.		**Matters not relevant to this EP** JBAC raised that they are not seeing the social or economic benefit of operators in the Kimberley. Seeking broader reach and impact for community from Shell. JBAC indicated a preference to invest in people and land directly. This has been addressed separately, with Shell sharing other initiatives in the region that may be of interest to JBAC. A resourcing protocol was discussed for Kimberley groups in common cultural block. JBAC has shared this with Shell and this will be progressed outside of this EP. JBAC indicated an interest in the opportunity to use local people for oil spill response training. Shell shared details of the pilot with a PBC Ranger group that may have the potential to be expanded. This will be progressed as an ongoing consultation commitment. JBAC requested Shell consider how Elder's care can be incorporated into the Social Investment Strategy. This is not considered a relevant matter to this EP but will be dealt with as a separate matter. JBAC requested that Shell consider funding an independent study into the large reef in the Kimberley. This will be reviewed outside of the EP process. Shell to share a collated Indigenous business funnel for Prelude/Crux and Indigenous Business Listing for JBAC. This will be reviewed outside the EP.	

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			Email on 16 October 2024 from Shell Final call out email. **Email on 17 October 2024 from JBAC** Following up on consultation protocol. **Email on 18 October 2024 from Shell** Seeking time to discuss consultation protocol. **Phone call on 02 December 2024** Discussing meeting and consultation agreement. JBAC confirmed they are satisfied with consultation to date and consultation protocol to be discussed in 2025. Requested confirmation of EP to be submitted to share with the Board. **Email on 04 December 2024 from Shell** Related to draft consultation protocol and confirming the submission timings for this EP. **Email on 13 December 2024 from Shell** Sharing draft EP section relating to JBAC for comment prior to submission of this EP.			
611.	**Kardu Lalingkin Consultive Committee** *Tier 3*	**In person** 08 November 2024 **Email from Shell** 15 November 2024 19 November 2024 **Email from Kardu Lalingkin Consultive Committee** 19 November 2024	Consultation occurred through 607 TEACA first for this RP. **In person on 08 November 2024** Shell presented tailored presentation on this EP, including detailed information on environmental impacts and risks, and associated management measures in place as well as the worst credible case scenarios and modelling results for arriving at the planning area. Shell also shared hard copies of the relevant information sheets. **Email on 15 November 2024 from Shell** Sharing the Crux animation, PowerPoint presentation and meeting notes for review. **Email on 19 November 2024 from Kardu Lalingkin Consultive Committee** Thanks for passing on information. Confirming names will not be published. **Email on 19 November 2024 from Shell** Thanks for passing on information. Confirming names will not be published.	No objections or claims received.	**Not a relevant matter to this EP** An action was raised not relevant to this EP, but to Shells business e.g. social investment programs. This is being actioned by Shell as a separate matter.	
95.	**Kimberley Aboriginal Law and Cultural Centre (KALACC)** *Tier 3*	**Email from Shell** 04 April 2024 *(Initial email)* 11 June 2024 *(reminder email)*	**Email on 04 April 2024 from Shell** Sufficient information provided on this EP.	No objections or claims received.	**Matters relevant to this EP**	Shell has been emailing KALACC since April with information on this EP and in contact with KALACC since June with the intent of organising a meeting with them.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		17 June 2024 26 July 2024 16 October 2024 *(final call)* 14 November 2024 17 November 2024 25 November 2024 03 December 2024 06 December 2024 13 December 2024 20 January 2025 24 January 2025 28 January 2025 20 February 2025 13 March 2025 17 March 2025 02 April 2025 08 April 2025 09 April 2025 06 June 2025 **Email from KALACC** 11 June 2024 12 June 2024 08 November 2024 15 November 2024 05 December 2024 22 January 2025 28 January 2025 20 February 2025 12 March 2025 14 March 2025 25 March 2025 08 April 2025 09 April 2025 **Phone calls** 25 November 2024 *(unanswered)* 03 December 2024 24 February 2025 *(left a message)* 06 June 2025 *(unanswered)* **Face to face meeting** 15 April 2025	**Email on 11 June 2024 from Shell** Reminder email. **Email on 12 June 2024 from KALACC** Seeking a meeting with Shell. **Email on 17 June 2024 from Shell** Confirming Shell would like to meet with KALACC and offering opportunities to do so. **Email on 26 July 2024 from Shell** Follow up on request to meet with Shell. **Email on 16 October 2024 from Shell** Final call out email. **Email on 08 November 2024 from KALACC** Request to meet with Shell and to engage directly with affected communities along the coast. **Email on 14 November 2024 from Shell** Offering a time to meet. **Email on 15 November 2024 from KALACC** Asking for support to arrange a meeting. **Email on 17 November 2024 from Shell** Shell is happy to assist with costs. **Email on 18 November 2024 from KALACC** Will get back to Shell with some dates. **Email on 25 November 2024 from Shell** Following up for dates. **Email on 25 November 2024** Tried to call to arrange dates. Attached costs. **Phone call on 03 December 2024** Gave an overview of KALACC and overarching purpose, including identification of culturally significant sites. KALACC would prefer to meet at Board meeting in late February. Shell notified KALACC of submission timeframes. **Email on 03 December 2024 from Shell** Reiterating consultation timeframes and confirmation of commitment to ongoing consultation including attending Board meeting in February 2025. **Email on 05 December 2024 from KALACC**		KALACC indicated that they would like to meet with Shell. Shell has followed up on this request and a meeting was held on 15 April 2025. KALACC asked Shell to consider a fee for service model for Kimberley Ranger groups to respond to and monitor impacts of any spill events. KALACC also asked Shell to consider options to provide oil spill training to relevant Ranger Groups. This will be progressed outside of this EP as an ongoing consultation commitment. KALACC requested Shell to include BJNAC Chairperson in all correspondence to Bardi Jawi Niimidiman AC (PBC). Shell intends to meet this request for this and any future EPs. **Matters not relevant to this EP** Shell to confirm time required to demobilize staff from facility, this will be closed out in relation to the Prelude EP submission. Shell to examine current recruitment processes to ensure cultural appropriateness, in conjunction with Cultural Advisory Group. This is something that Shell will look at outside of the EP process.	Shell shared a draft version of this EP in October and offered a final opportunity to provide feedback on this EP. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			Looking at working together with Shell for initiatives outside the purposes of this EP and building a relationship with Shell. **Email on 06 December 2024 from Shell** Confirming date for meeting and discussing meeting logistics. **Email on 13 December 2024 from Shell** Related to scheduled meeting. **Emails on 20, 22, 24 and 28 January 2025** Related to scheduling a meeting. **Emails on 20 February 2025** Related to scheduling a meeting **Email on 12, 13, 14 and 17 March 2025** Confirming date for Board meeting. **Email on 25 March 2025 from KALACC** Additional meeting arrangements- this was pursued outside of the EP process. **Email on 02 April 2025 from Shell** Finance related. **Emails on 08 April 2025** Meeting logistics. **Emails on 09 April 2025** Finance related. **Meeting on 15 April 2025** **Email on 06 June 2025 from Shell** Sharing the draft meeting notes for KALACC to amend.			
62.	**Kimberley Cultural Adventures** *Tier 3*	**Email from Shell** 24 May 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Kimberley Cultural Adventures several times with information on this EP with no response received.	No objections or claims received.	No applicable.	*See footnote
37.	**Kimberley Indigenous Saltwater Advisory Group (ISWAG)** *Tier 3*	Consulted through 39 Kimberley Ranger Network.	See 39 Kimberley Ranger Network.	No objections or claims received.	No applicable.	*See footnote
96.	**Kimberley Jiyigas** *Tier 3*	**Email from Shell** 4 April 2024 *(Initial email)*	Shell emailed this person several times with information on this EP with only automated responses received.	No objections or claims received.	No applicable.	*See footnote

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*				
39.	**Kimberley Ranger Network (KRN)** *Tier 3*	**Email from Shell** 4 April 2024 *(Initial email)* 23 May 2024 29 May 2024 19 June 2024 25 June 2024 20 August 2024 21 August 2024 15 October 2024 *(final call)* **Email from KRN** 24 May 2024 19 June 2024 20 August 2024 21 August 2024 **In person** 20 June 2024	**Email on 04 April 2024** Sufficient information provided on this EP. **Email on 23 May 2024 from Shell** Seeking to organise a workshop with Nyul Nyul Rangers for a pilot oil spill response training. **Email on 24 May 2024 from KRN** Email outlines preference for a coordinated approach to consultation using existing networks. Also linked in the Kimberley Indigenous Saltwater Advisory Group (ISWAG) **Email on 29 May 2024 from Shell** Seeking to have a call to discuss further or meet in person. **Email on 19 June 2024 from KRN & Shell** Meeting arrangements. **In person on 20 June 2024** Introductions and brief background to Prelude and Crux operations. Kimberley Ranger Network gave overview of current structure of ISWAG and KRN. Discussed oil spill response training and intent Shell had to roll this out as a pilot. KRN bimonthly Coordinator meetings could introduce concept to gauge interest and then deliver in October when the ISWAG Forum would be held. KLC interested in scale of in-depth training including boom/practical training and up to accredited training. **Email on 25 June 2024 from Shell** Request for meeting dates and best contact for Nyul Nyul Rangers. **Email on 20 August 2024 from Shell** Sharing an update on the Crux project. **Email on 20 August 2024 from KRN** Currently out of office at AGM. **Email on 21 August 2024 from Shell** Noting that Shell would like to organise for September/October. **Email on 21 August 2024 from KRN** Confirmed KRN would get back to Shell with best format to consult with iSWAG.	No objections or claims received.	KRN would like a coordinated approach for setting up pilot oil spill response training using existing networks. This will be progressed outside of this EP as an ongoing consultation commitment and Shell will continue to endeavour to organise this.	Shell continues to work with KRN to organise a pilot oil spill response, this will occur as part of Shell's ongoing consultation commitment. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			Email on 15 October 2024 from Shell Final call out email with draft EP to review. No response received.			
40.	**KRED (Ambooriny Burru Charitable organisation)** *Tier 3*	**Email from Shell** 04 April 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed KRED several times with information on this EP with no response received.	No objections or claims received.	No applicable.	*See footnote
99.	**Legune Pastoral Lease**	Contact made through 114. NLC and also through 607. TEACA.	See 114 NLC and 607 TEACA.	No objections or claims received.	No applicable.	*See footnote
42.	**Lombadina Aboriginal Corporation incl. Accommodation and Tours** *Tier 3*	**Email from Shell** 04 April 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Lombadina Aboriginal Corporation several times with information on this EP with no response received.	No objections or claims received.	No applicable.	*See footnote
56.	**Madanaa Nada Aboriginal Corporation RNTBC** *Tier 3*	**Email from Shell** 05 April 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Madanaa Nada Aboriginal Corporation RNTBC several times with information on this EP with no response received.	No objections or claims received.	No applicable.	*See footnote
70.	**Mercedes Cove Exclusive Coastal Retreat** *Tier 3*	**Email from Shell** 24 May 2024 *(Initial email)* 11 June 2024 *(reminder email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Mercedes Cove Exclusive Coastal Retreat several times with information on this EP with no response received.	No objections or claims received.	No applicable.	*See footnote
113.	**Nimanburr Aboriginal Corporation** *Tier 3*	Consulted through 38 KLC.	See 38 KLC (KLC still listed as contact point in ORIC) and email on 17 October 2023 on Nimanburr contact details.	No objections or claims received.	No applicable.	*See footnote
132.	**NT Indigenous Business Network (NTIBN)** *Tier 3*	**Email from Shell** 28 May 2024 *(Initial email)* 09 August 2024 16 October 2024 04 September 2024 06 September 2024 30 September 2024 17 October 2024 (*final call)* **Email from NTIBN** 12 August 2024	**Email on 24 April 2024** Sufficient information provided on this EP. **Email on 09 August 2024 from Shell** Reminder email. **Email on 12 August 2024 from NTIBN** Confirmed that NTIBN would like to be consulted. Suggested a session in September/October. **Email on 16 August 2024 from Shell** Seeking to organise a session.	No objections or claims received.	**Relevant matters to this EP** NTIBN recommended Shell speak with other saltwater groups along Kimberley coast. NTIBN also commented about the need to speak to those with appropriate cultural authority. Shell confirmed that it has met with a large number of Groups over the last 18 months, with varying degrees of response. Acknowledged the consultation process is voluntary. Shell continues to seek advice from Indigenous relevant persons on who has cultural authority to speak. One relevant person mentioned a recently announced an NT Ground Gravity Survey and asked for impacts on gravity to the Crux Project. Shell	No measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		04 September 2024 10 September 2024 17 October 2024 **In person** 25 September 2024	**Email on 04 September 2024 from Shell** Follow up on organising a session. **Email on 04 September 2024 from NTIBN** Confirmed a potential date. **Email on 06 September 2024 from Shell** Confirmed the date works for Shell. **Email on 10 September 2024 from NTIBN** Requesting Shell to review flyer for event. **In person on 25 September 2024** Shell presented tailored presentation on this EP, including detailed information on environmental impacts and risks, and associated management measures in place as well as the worst credible case scenarios and modelling results for arriving at the planning area. **Email on 30 September 2024 from Shell** Sharing the Crux animation, PowerPoint presentation and meeting notes for review. **Email on 17 October 2024 from Shell** Final call out email. **Email on 17 October 2024 from NTIBN** Update in contact details.		advised that there are no known or potential impacts on gravity. A question was asked about loss of well control incident in Australia in last 5 years for Shell. Shell responded to the question about loss of well control that there had been no loss of well incidents in Australia in the last 5 years. **Not relevant matters to this EP** NTIBN asked a number of questions related to Shell's business in Australia, which are not relevant to this EP, but which Shell will close out directly with NTIBN.	
49.	**Nyamba Buru Yawuru Aboriginal Corporation** *Tier 3*	**Email from Shell** 28 May 2024 *(Initial email)* 08 August 2024 *(update email)* 16 October 2024 (*final call)*	Shell emailed Nyamba Buru Yawuru Aboriginal Corporation several times with information on this EP with no response received.	No objections or claims received.	No applicable.	*See footnote
609.	**Rak Badjalarr Consultive Committee** *Tier 3*	**In person** 15 October 2024 **Email from Shell** 24 October 2024 19 November 2024 **Email from Rak Badjalarr Consultive Committee** 19 November 2924	Consultation occurred through 607. TEACA first for this RP. **In person on 15 October 2024** Shell presented tailored presentation on this EP, including detailed information on environmental impacts and risks, and associated management measures in place as well as the worst credible case scenarios and modelling results for arriving at the planning area. Shell also shared hard copies of the relevant information sheets. **Email on 24 October 2024 from Shell** Sharing the Crux animation, PowerPoint presentation and meeting notes for review. **Email on 19 November 2024 from Rak Badjalarr Consultive Committee**	No objections or claims received.	**Relevant matter to this EP** Shell to provide information around approach to management of sacred sites where information provided by TO groups. Shell has provided this information. **Not relevant matters to this EP** A number of actions were raised not relevant to this EP, but to Shells business e.g. social investment programs. These are being actioned by Shell as a separate matter.	

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			Confirming email has been forwarded to the right person for review. **Email on 19 November 2024 from Shell** Thanks for passing on information. Confirming names will not be published.			
118.	**Thamarrurr Rangers** *Tier 3*	**Email from Shell** 11 June 2024 *(initial email)* 09 August 2024 *(update email)* 11 October 2024 (*final call)*	Shell emailed Thamarrurr Rangers several times with information on this EP with no response received.	No objections or claims received.	No applicable.	*See footnote
607.	**Top End Aboriginal Coastal Alliance (TEACA)**	**Email from Shell** 05 June 2024 *(initial email)* 14 June 2024 01 July 2024 08 July 2024 09 July 2024 05 August 2024 06 August 2024 08 August 2024 16 August 2024 18 August 2024 29 August 2024 20 September 2024 25 September 2024 30 September 2024 **Email from TEACA** 21 May 2024 13 June 2024 18 June 2024 02 July 2024 08 July 2024 09 July 2024 05 August 2024 06 August 2024 07 August 2024 17 August 2024 30 August 2024 08 September 2024 10 September 2024 20 September 2024 21 September 2024 **In person** 18 July 2024 07 August 2024 25 September 2024 15 October 2024	**Phone call on 20 May 2024 from TEACA** TEACA reached Shell via the Community Hotline. **Email on 20 May 2024 from TEACA** Letter outlining that TEACA consider themselves a relevant person and proposing Shell and TEACA meet. **Phone call on 05 June 2024** Shell confirming intent to meet with TEACA committee members. **Email on 05 June 2024 from Shell** Follow up email from phone call, suggesting suitable dates to meet and providing sufficient information on Crux for TEACA. **Email on 13 June 2024 from TEACA** Confirming TEACA would like to meet, they will come back to Shell with dates. **Email on 14 June 2024 from Shell** Confirming Shell will wait for further information. **Email on 18 June 2024 from TEACA** Confirmation of dates to meet in Darwin, cost estimates and a bio of management committee. Request for GIS shape files. **Email on 01 July 2024 from Shell** Confirming due diligence had been completed and attendance at meeting. Confirmation that Shell accepted cost estimate and would be sending GIS files by large file transfer. **Email on 02 July 2024 from TEACA** Proposing a location for the meeting and updated cost estimate. **Email on 08 July 2024 from TEACA**	No objections or claims received.	**Matters relevant to this EP** TEACA self-identified as a relevant person for the purposes of consultation on this EP. Shell confirmed they are considered a relevant person for this EP. TEACA requested GIS shape files, which Shell provided. TEACA directed Shell to engage with relevant consultative committees. Three Consultative Committees have been identified as relevant persons for the purposes of consultation on this EP. TEACA recommended Shell also consult with Miriuwung-Gajerrong and Legune Pastoral Lease. Shell confirmed Miriuwung-Gajerrong and Legune Pastoral Lease are considered relevant for this EP and Shell has been attempting to consult with them. TEACA's requested Shell to fund a consultant SME for consultation. Shell did not support TEACA's request to fund a consultant SME to be present for consultation. Post consultation, Shell offered the use of the Independent Environment Panel to review the EP if required. **Matters not relevant to this EP** TEACA requested a meeting with Select Carbon which Shell accommodated. TEACA requested to experience the Prelude Virtual Reality which Shell are happy to accommodate when there is a good time. TEACA requested Shell to consider Tiwi Clans for consultation. This will be considered further for future EPs.	Shell has been consulting with TEACA since June 2024 and has met with them 4 times in person and once on a Teams call. Shell has shared with them requested information. No additional measures have been adopted. Accordingly, consultation in the course of preparation of this EP has been completed in accordance with the OPGGS(E) Regulations.

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
		Teams meeting 19 August 2024 **Phone call** 20 May 2024 05 June 2024	Confirming receipt of email. Notifying Shell that they would be meeting with NOPSEMA in Perth first week of August. **Email on 08 July 2024 from Shell** Confirming receipt of email and travel to Darwin, as well as tentatively lock in a time while TEACA are in Perth. **Email on 08 July 2024 from Shell** Setting TEACA up as a vendor. **Email on 08 July 2024 from TEACA** Requesting a call. **Email on 08 July 2024 from Shell** Confirming vendor set up and that Good Advice is acting on behalf of TEACA. Shared shapefiles. **Email on 09 July 2024 from TEACA** Meeting logistics. **Email on 09 July 2024 from Shell** Meeting logistics. **In person on 18 July 2024** Shell presented tailored presentation on this EP, including detailed information on environmental impacts and risks, and associated management measures in place as well as the worst credible case scenarios and modelling results for arriving at the planning area. **Email on 05 & 06 August 2024 from TEACA and Shell** Meeting logistics. **Email on 07 August 2024 from TEACA** Invoice attached. **In person 07 August 2024** Q&A on this EP. **Email on 07 August 2024 from TEACA** Thanks for meeting. **Email on 08 August 2024 from Shell** Thanks for meeting. **Email on 16 August 2024 from Shell** Attaching presentation, Crux animation and draft meeting notes. **Email on 17 August 2024 from TEACA**			

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			Proposing next meeting on 19 August. **Email on 18 August 2024 from Shell** Confirming availability. **Teams meeting on 19 August 2024** Furthering consultation with TEACA and First Nations Consultative Committees. **Email on 29 August 2024 from Shell** Request for information for due diligence process. **Email on 30 August 2024 from TEACA** Sharing the Committee Charters. **Email on 08 and 10 September 2024 from TEACA** Sharing cost estimates. **Email on 20 September 2024 from TEACA** Invoice attached. **Email on 20 September 2024 from Shell** Meeting logistics. **Email on 21 September 2024 from TEACA** Meeting logistics. **Email on 24 September 2024 from Shell** Shell accepts the cost estimate. Would like to meet while in Darwin. **Email on 25 September 2024 from Shell** Confirmed timing to meet. **In person on 25 September 2024** **Email on 30 September 2024 from Shell** Scheduling consultation with consultative committee. **Email on 04 October 2024 from TEACA** GIS Maps related. **Email on 08 October 2024 from Shell** Confirming data for Shape files. **In person on 15 October 2024** Consultation in relation to RP609 Rak Badjalarr Consultive Committee which TEACA facilitated.			

RP Number	Relevant Person	Dates of correspondence and follow up	Summary of Consultation / Efforts to Consult	Assessment of merits of objection or claim	Relevant and not relevant matters to this EP	Measures adopted and justification for consultation carried out
			Email on 16 October 2024 from Shell Logistics for additional meetings with Consultative Committees, sharing the draft EP and advising of planned submission date. **Email on 17 October 2024 from Shell** Requesting list of attendees from meeting on 15 October 2024. **Email on 17 October 2024 from TEACA** Sharing attendees. **Email on 17 October 2024 from Shell** Thanking TEACA for previous email and advising Shell to share draft meeting notes in due course. **Email on 18 October 2024 from TEACA** Confirming dates for Consultative Committees. **Email on 18 October 2024 from Shell** Confirming availability for the dates suggested. **Email on 19 November 2024 from TEACA** Related to privacy requests for submission to NOPSEMA. **Email on 19 November 2024 from Shell** Thanking TEACA.			
530.	**Top End Aboriginal Corporation RNTBC** *Tier 3*	Consulted through 114 NLC.	See 114 NLC.	No objections or claims received.	No applicable.	*See footnote
105.	**Yawoorroong Miriuwung Gajerrong Yirrgeb Noong Dawang Aboriginal Corporation (MG Corp)** *Tier 3*	**Email from Shell** 28 May 2024 *(Initial email)* 08 August 2024 *(update email)* 16 October 2024 *(final call)* **Phone call** 28 May 2024	**Phone call on 28 May 2024** Phoned to seek advice on contact details. These were provided. **Email on 28 May 2024 from Shell** Sufficient information provided on this EP. **Email on 08 August 2024 from Shell** Update email. **Email on 16 October 2024 from Shell** Final call out email. No response received	No objections or claims received.	No applicable.	*See footnote

Footnote.

*In accordance with Shell's approach to consultation, multiple attempts have been made to contact this relevant person during a reasonable period with no response received to date. Other mechanisms have been used to comply with Shell's requirement to consult with relevant persons on the proposed activity, for example an advertising campaign conducted from April – June 2024. Relevant persons can provide feedback to Shell via the EP webpage during the implementation of the EP with any new relevant matters assessed in accordance with the EP (Section 5.8). Consultation in the course of preparation of the EP has been completed in accordance with the OPGGS(E) Regulations.

Appendix C Oil Spill Modelling - RPS Technical Note

This Appendix contains the Technical Note prepared by RPS on behalf of INPEX. It explains the limitation of the oil spill modelling and is directly relevant to the modelling presented in this EP. Shell has received permission from INPEX and RPS to include this Technical Note.

Appendix B.7 a) Technical note - RPS

Response to Inpex questions on Oil Spill Modelling

The following technical guidance has been prepared by me, Scott Langtry, as a subject matter expert in oil spill modelling as applied to environmental management of oil field operations within the offshore waters of Australia. The details provided constitute my opinions based on specialised knowledge developed through my education, training, study, and experience, including working experience carrying out oil spill modelling for risk assessment and response to real spill incidents over 26 years.

This report has been compiled in response to a request by Inpex Australia to provide answers to the following questions:

1.0 Base Scope

Question	Answer
a) Describe generally the purpose of oil spill modelling.	See addendum, Section 1.0.
b) Develop a report which describes the model conservatism, and how the conservatisms affect model outputs and results, as related to the thresholds presented in (c) and (d) below.	See addendum, Section 2.0 and details below.
c) 10 ppb entrained oil threshold:	
(i) Can you confirm that the 10 ppb entrained threshold, when evaluated through the model, is based on 'instantaneous exposure", when the 10 ppb threshold is actually derived from dissolved oil exposure over a time-weighted average?	Yes. The model calculations are analysed for distributions of oil mass in different states (floating, entrained, dissolved, stranded, evaporated) at each model time step. Typically, 15-minute time steps (or less) are used to maximise accuracy of the weathering and transport calculations. Consequently, entrained oil >10 ppb (parts per billion) calculated for durations as short as 15 minutes during any replicate simulation would flag a location as 'affected'. This flag would only need to occur during 1 of 300 simulations (=0.3% probability of occurrence) for that location to be enclosed by a polygon defining the

	Environment that May Be Affected (EMBA) as defined in the NOPSEMA guideline (2019). A 10 ppb entrained threshold is not based on evidence that 10 ppb of entrained oil droplets (alone) is harmful for either short term (e.g., 15 minutes or for any longer duration (e.g., 48-96 hrs). The NOPSEMA guideline has applied the same threshold for both dissolved and entrained hydrocarbon concentrations as instantaneous exposures. The dissolved threshold concentration was calculated by toxicity studies applying long-term exposures (48-96 hrs of exposure) to the components of oil that can dissolve into water from oil mixtures and no correction for shorter exposure durations has been applied in the NOPSEMA guidelines (see below; part ii). At the outer bounds of the EMBA calculated for a blowout simulation spanning 70 or more days, entrained oil would be present as widely dispersed and insoluble droplets with small diameter (10-50 µm). No insoluble compounds will remain to dissolve into the water to trigger the toxic effects demonstrated by toxicity testing on marine organisms. Direct contact with droplets or consumption of droplets may have influence but risks of influence would depend upon encounter rates, which would depend on the concentration of droplets and the duration that they are present. As an indication of the meaning of the 10 ppb concentration threshold that the NOPSEMA guidelines recommend for entrained oil, this would represent one insoluble droplet suspended in 40,000 L of water for a droplet of 25 µm diameter. It would be necessary to have one million droplets of this size to form a standard drop of oil from an oil dropper (0.05 ml). Consequently, the potential for direct contact by marine biota with a droplet at this threshold concentration when triggered by durations as short as 15 minutes is highly conservative for any consequence through direct contact with droplets.
(ii) Can you describe how the use of instantaneous thresholds in the model may affect the model outputs/geographical areas exposed above threshold?	Instantaneous thresholds have a very large influence upon the geographic extent that is mapped as the EMBA, an influence larger than all other conservative measures applied. Hydrocarbons impose a narcotic effect on organisms through absorption of soluble hydrocarbons from water into their tissue, and it takes longer than 15 minutes for

	harmful soluble compounds to accumulate to levels that impose effect when the concentration of harmful, soluble, hydrocarbons in the water is higher than 10 ppb. Species vary by sensitivity and different oils vary in terms of the toxic components present. The lowest toxic threshold for soluble hydrocarbons (~10 ppb) has been derived as a generic trigger value for potential sublethal influence from a large body of laboratory toxicity testing where exposure has been maintained for 48-96 hrs to ensure saturation of body tissues. A value of ~10 ppb is the lowest value reported for the most sensitive marine species using the water solutions generated from the most toxic oil mixtures. Exponentially higher concentrations are required to achieve equivalent effects over shorter durations. At least 100 times higher concentrations would remain conservative for durations of <1 hr. Instantaneous thresholds treat all areas exposed for a time as short as 15 minutes as if they were exposed constantly for 2 to 4 days (following evidence from toxicity studies). This is very conservative, and reliance on the extent of the EMBA alone obscures information that would be available to show those locations that may be more at risk, such as those locations where longer exposures may occur. Further clarification can be provided.
(iii) Can you comment on how the probability maps/contours generated by the model using instantaneous oil exposure thresholds would be affected, compared to what would occur using time-weighted exposure thresholds?	Comparisons of model calculations for areas that might experience instantaneous exposures (e.g., >10 ppb of entrained oil for 15 minutes) versus time-weighted exposures (e.g., >10 ppb on average over 24, 48 or 96 hours) indicates that the difference depends on the scenario, oil type and component (floating, entrained, dissolved). The outer extent of the EMBA may be reduced to as small as 20% of the surface area (i.e., the surface area enclosed by the EMBA may be reduced by up to 80%) when based on time-weighted exposures. The shape of the EMBA will also typically change to highlight locations where environmental forcing is more likely to direct higher concentrations of spilled material repeatedly or to retain spilled material for longer during a long duration release (e.g., a blowout) – detail that should be relevant to risk assessment, planning and consultation purposes.

	Allowing for as little as 2 subsequent time steps or for 2 records of exceedance at any time during any spill simulation, will result in marked reduction of the geographic area and alter the shape calculated for the EMBA, showing that large parts of the existing EMBA calculations can be due to single, 15-minute, records. Further clarification can be provided.
c) 10 g/m^2 shoreline contact threshold:	
(i) Can you describe how the model calculates oil accumulation volumes on shorelines, in consideration of the modelled shoreline grid-cell/lineal shoreline lengths vs actual/realistic shoreline lengths and the effect this may have on volumes of oil ashore calculated by the model?	Accumulation of oil onto shorelines is calculated as the mass of oil per unit of shoreline area. The coastline at mean sea level is subdivided into fixed, rectangular, grid cells of a defined area described by fixed length and width. For example: • 1 km long x 10 m wide (10,000 m^2 area per cell) for blowouts. • 400 m long x 10 m wide (4,000 m^2 area per cell) for diesel spills. Owing to the grid scale applied, the coastline shape must be simplified in areas of small-scale complexity. Very complex and convoluted shorelines will be represented by a smaller area than reality, adding conservatism by lowering the area used when calculating the mass of oil per unit area. The more complex the coastline the larger the degree of conservatism. If the model calculates that any part of a patch of floating oil contacts any part of a coastline cell, the total mass of oil in that patch is transferred to the coastline cell as a conservative calculation for oil stranding. Any subsequent oil patches that contact that coastline cell will add to the tally in that coastline cell over time. The maximum possible load at any time will be capped at the carrying capacity set for shoreline cells (40 m^3 over 10,000 m^2 for low viscosity oils (condensates and diesel, etc.). Any excess oil will be re-floated and may then accumulate on other coastline cells. Evaporation and degradation are calculated for stranded oil to reduce the tally of oil in a coastline cell over time.

	When all simulations are complete, the highest mass recorded at any time due to inputs versus losses is found for each coastline cell in each simulation. The highest mass from any simulation is divided by the shoreline area of the cell to determine the peak concentration (grams of oil/area in m^2) as the most conservative calculation for the amount of oil that might be present, for clean-up and other considerations. The peak concentration calculated for each shoreline cell among all replicate simulations is compared to thresholds of relevance. Any shoreline cell with peak mass per area > minimum threshold (e.g., 10 g/m^2) during any replicate simulation will be included in the EMBA polygon. Note that: 1. The peak concentration that is calculated will be higher if the surface area available for accumulation is under-represented in the model compared to reality. 2. The peak concentration that is calculated may be, and typically is, higher than the concentration that would be calculated at the end of the simulation, after further weathering is allowed for. 3. No differential is made between oil on the surface and oil that has entered the substrate. Further clarification can be provided.
(ii) Can you describe if the model includes consideration of tidal movements or wetting and drying of intertidal areas, and how this may affect modelled oil concentration outputs, vs what might occur in reality?	The model does not account for wetting and drying of the intertidal zone. Both the coastline position and water level are treated as fixed, and calculations assume a fixed average width of the shoreline interface (10 m wide) is always available for accumulation. One outcome at a very local scale is that the model cannot differentiate between the happenstance of oil arriving when the shoreline extends further seaward (at lower tide, exposing a wider zone) or when it might have shrunk back to a narrower zone (at higher tide). Although the intertidal width will vary over time, in reality, and oil might be spread over varying area, the area allowance is assumed fixed to an average of 10 m wide when calculating the mass accumulated per area. In reality, concentrations of oil would likely vary with the tide in areas with very large tidal ranges and low slope,

	and we have applied a fixed width as an assumed average. One conservatism is that shorelines are assumed to be "sticky" – binding the oil to the shorelines with no re-floating due to subsequent tidal flooding. This assumes oil accumulations would migrate up and down, occupying the same width of the shoreline as the tide varied. The exception is if the carrying capacity of the shoreline is exceeded. For condensates and diesel this would only be allowed in the model if the thickness exceeded 4 mm, allowing for high accumulation capacity (e.g., 32 tons per shoreline cell for a 1 km long x 10 m wide shoreline if the density averaged 800 kg/m^3). Noting that the model domain must cover areas of hundreds of thousands of km^2 for a blowout scenario, the fixed coastline assumptions represent necessary simplifications requiring a conservative approach. Further clarification can be provided.
(iii) Can you confirm if the model continues to calculate oil weathering of stranded oil on a shoreline, specifically evaporation and melting point?	Yes. As stated above (part i), oil weathering continues to apply to oil classed as stranded. Loss of oil mass from coastline cells can occur through three processes: 1. Evaporation. 2. Degradation (representing microbial action and photo-oxidation). 3. Re-floating (if the carrying capacity of the coastline cell is exceeded). The composition of the oil when freshly released at source is represented by the proportion of the whole oil contributed by groups of hydrocarbons, varying by volatility. Composition change is calculated over time through evaporation and dissolution when the oil is floating, and the composition of oil patches is known by the model at the time of stranding. Calculations for variable rates of evaporation, by sub-components, continues for stranded oil until only the non-evaporating residues (boiling point >380 °C) remain. Calculations for evaporation rates are based on wind speed and average ambient temperature (30 °C for the Inpex studies), not elevated temperatures that might occur during daytime on heat-retaining surfaces.

	Calculations for evaporation are, therefore, conservative if evaporating components remain in the stranded oil. If only residues strand, no loss of oil through evaporation will be calculated on shorelines. Degradation is applied to the total mass (regardless of composition) at a fixed rate. A conservative rate of 3% of the mass per day is applied. This rate has been derived from published tests on more complex oil types than diesel or condensate and is considered conservative for condensates in lieu of further research to confirm rates of degradation of both oil types. The model does not calculate for melting point to decide whether the oil is on the substrate (e.g., as solid wax) or in the substrate (e.g., as a melted wax).
(iv) Can you describe if the model takes into consideration the effect of exposed intertidal shoreline temperature (i.e., sand/rock temperature) and the effect this may have on stranded oil including effect on oil melting point and subsequent behaviour of the stranded oil?	Degradation rates do not account for substrate temperature. This will be conservative in settings with high average substrate temperatures because degradation rates do increase at higher temperatures. The same ambient temperature and prevailing wind speeds are used for both floating and stranded oil for calculating evaporation rates. This will be conservative if the oil arrives with volatile content and the real temperatures are higher than assumed (30°C for the Inpex study locations) on average. This would not be conservative if only residues arrive at coastline cells. No calculations are made by the model for the physical state (solid/liquid) of hydrocarbons, or of uptake by sediments. Such considerations would need to be made outside of the model calculations. Further clarification can be provided.

1.1 Supplementary Scope

(a) Can you confirm if there are any other factors which may affect conservatisms within the model?	See addendum.
(b) if Yes, can you please explain these additional factors.	See addendum.

Addendum

1.0 (a) Describe generally the purpose of oil spill modelling.

Modelling of oil fate and transport is useful, and has been applied to multiple purposes:

- Calculating risks of exposure to facilities, personnel, interests of other parties and environmental resources if a spill scenario were to eventuate.
- Guiding preparations for response, including identifying those resources that may need to be defended and what responses may be practical given factors such as the nature of the place at risk and the evolution through weathering of the oil type(s) that might be spilled.
- Forecasting the drift and behaviour of oil slicks ahead of real time to guide response to real spills.
- Forecasting the efficacy of alternative response measures.
- Guidance of environmental monitoring efforts to sense influence or impact.
- Post-spill assessment to inform and quantify social, environmental, or commercial impacts.

The first general application is the basis of EMBA calculations at present, but with the results simplified to calculating the area enclosing all locations where greater than low threshold concentrations might occur instantaneously at very low probabilities.

Other calculations from modelling are available and may be applied as contextual measures. These include:

- Mapping locations at higher probability of contact > instantaneous thresholds.
- Mapping locations at risk of longer durations of contact > instantaneous thresholds.
- Mapping locations at higher probability of contact at > time-integrated thresholds.
- Mapping locations based on potential concentrations (maximums and statistical distributions such as mean and higher percentiles).

1.0 (b) Develop a report which describes the model conservatism, and how the conservatisms affect model outputs and results, as related to the thresholds presented in (c) and (d) below.

General background

In general, oil spill models are a collection of interacting formulae and calculations that have been compiled to best represent current knowledge of processes that affect oil when released into the marine environment.

These processes are complex and interacting, requiring organised formulation to avoid errors and bias.

The formulations are numerical tools that allow comparative testing for different outcomes depending upon the scenario and prevailing conditions, subject to errors and uncertainties in both the inputs and the formulae.

Key processes have been studied to varying degrees over several decades through empirical studies, observations, and laboratory experiments. Some processes and their dependencies are well understood, while others have larger uncertainties and are the subject of ongoing testing and development.

The model formulations allow management of uncertainties through sensitivity allowances and/or conservative calculations or inputs (i.e., arrangements that are more likely to overstate and not understate risks).

Potential sources of conservatism

As a general principle, the ongoing calculation of concentrations over a large number of sequential time steps (e.g., 7,680 contiguous time-steps in an 80-day blowout simulation), with calculations at each time step dependent upon a previous calculation of state, can be expected to lead to magnification of any model errors at the outer distances and durations.

The current NOPSEMA guidance for calculating the EMBA has changed the focus of modelling assessment efforts from identifying locations that are most at risk (typically closer to the source and at risk of contact over shorter elapsed times) to map out only an outer bound of possibilities. One consequence of this is that the EMBA definition is now highly dependent on model capabilities, uncertainties, and compounding of errors in calculations for defining when concentrations will fall below very low concentrations.

The modelling software that I will detail to address model calculations and conservatism is the Spill Impact Model Application Package (SIMAP) that has been applied to most oil spill risk assessments in Australia, including those carried out for INPEX, but considerations will be common to other oil spill models of similar capability.

SIMAP is three-dimensional and is structured as a series of interacting algorithms that consider all known key processes that may affect the transport and weathering of hydrocarbon mixtures:

- Buoyancy (upward vertical transport from subsea).
- Initial spreading due to gravity and surface tension.
- Horizontal transport due to wind and current.
- Spreading (transport in the vertical and horizontal) due to dispersive forces.
- Wave-induced entrainment into the water column (as oil droplets).
- Dissolution (of soluble hydrocarbons) into the water column.
- Vertical dispersion of dissolved hydrocarbons (vertical spreading due to dispersive forces).
- Evaporation to the atmosphere.
- Emulsification (uptake of water into floating oil films).
- Change in viscosity due to change in composition and emulsification.
- Sedimentation (through binding with suspended sediment).
- Shoreline stranding – shoreline specific.
- Re-floating from shorelines (if capacity exceeded).
- Degradation (to component molecules).

The model uses oil composition and physical properties as input, and calculates changes in the mass distribution of the spilled oil over time among six states in response to the release scenario (e.g., onto the water, from subsea blowouts, etc.) and a sequence of environmental conditions:

1. Floating as a film on the water surface.

2. Entrained (at some depth) as oil droplets suspended in the water column.
3. Dissolved (at some depth) in the water column from films or suspended droplets.
4. Evaporated (to the atmosphere).
5. Stranded on a shoreline.
6. Degraded to simpler chemical components (hydrogen, carbons, etc.).

The NOPSEMA guidelines require that the worst-case (or worst plausible case) spill scenario is modelled for a given oilfield operation. For drilling operations into reservoirs where gas/condensates are targeted, that will involve a long-term (>70-day) release of gas and condensate at the highest rate possible through a fully open reservoir.

This scenario will generate the highest potential initial concentrations, both in reality and in the model, and is a conservative starting point.

Key considerations for conservatisms in the modelling are calculations for initial concentrations, the initial distribution of oil mass among the states, and processes that affect reductions in the concentrations of oil in each state over time.

Calculations for gas-condensate releases, more so than for heavier oil types, are very sensitive to model calculations of entrainment rates because these oil mixtures have both very low viscosity (hence will be susceptible to entrainment) and are mostly composed of volatile hydrocarbons (hence will be susceptible to evaporation, if exposed to the atmosphere). Entrainment and dissolution are competing fate pathway to floating and evaporation.

Over-prediction of entrainment rates will reduce the evaporation rate that is calculated (a general loss term for calculation of oil mass that would otherwise be on or in the water, or on shorelines) and leads to higher concentrations of entrained oil being calculated further from the source.

Entrainment is calculated for two processes by the model:

- As droplets released subsea (for blowouts).
- Generated by waves breaking up slicks into droplets and mixing the droplets into the surface layer, or keeping droplets that were entrained by the process above mixed into that layer.

Considerable care is required to calculate the initial droplet-size distributions accurately for subsea blowout scenarios involving highly volatile condensates (as opposed to less volatile mixtures) due to the large influence of droplet-size calculations upon entrainment rates versus evaporation rates. Calculations for oil droplet sizes have been an active area of model development and the modelling currently incorporates the most recent calculations from authoritative sources (SINTEF, TAMOC, etc.) but understatement of droplet sizes remains a risk for overstatement of entrainment rates because most research has involved heavier oil types.

Calculations for entrainment due to wave action in the SIMAP model were updated ~5 years ago to new formulations following a large volume of research conducted for the Deepwater Horizon blowout. The updated formulations increased the sensitivity to wave action, lowering thresholds for wind speed required to generate or maintain entrainment for low viscosity oils.

Sensitivity testing suggests that the allowances may be overly conservative for entrainment rates when applied to highly volatile condensates. In turn, calculations

would likely be conservative for dissolution rates and dissolved hydrocarbon concentrations for these products because faster dissolution is calculated for entrained oil than for slicks.

The model will calculate reduction of oil concentrations for surface and subsurface oil concentrations (entrained and dissolved) due to dispersion, representing the spreading and thinning of patches and plumes over time due to the mixing forces in the ocean.

Contemporary calculations for dispersion are typically set for moderate sea conditions for the scenario setting and not for more energetic conditions that can occur. On average, it is expected that this approach will result in maintenance of higher concentrations over longer distances than might occur in reality. The level of conservatism would vary depending on the frequency of occurrence of windy conditions that would trigger breaking sea waves.

A further level of conservatism for calculation of entrainment (increasing dissolution) versus floating (increasing evaporation) for surface releases of highly volatile condensates is the model time step. Highly volatile condensates with a low residue content will flash off rapidly, in reality, when spread thinly onto the water surface. However, calculation at 15-minute steps, which is a practical rate for long term blowout modelling, may underestimate the evaporation rate that is calculated for such condensates and overestimate the calculation for maintenance of entrained oil concentrations above low thresholds. Evaporation rates are calculated to occur at a slower rate for soluble hydrocarbons that are dissolved in surface-waters than at the surface, which could lead to overstatement of dissolved hydrocarbon concentrations exceeding low thresholds.

Some loss of mass is calculated for entrained oil over time due to dissolution of the soluble compounds. These compounds will typically represent a small proportion of the mass of an oil initially (typically 6-12% for condensates) so there would be only a relatively small influence on reduction of entrained oil concentrations.

It is also noteworthy that the model can calculate when entrained oil droplets have lost all soluble components. However, the NOPSEMA guidelines are applied equally to entrained oil that has remaining soluble components and those that have migrated long distances over long time periods and would have weathered to lose all soluble components. Because the EMBA line defines the widest boundaries, it will be the concentrations of weathered entrained oil that are tested against the NOPSEMA guideline threshold.

Degradation rates are applied to allow for reduction of oil concentrations over time. These rates are derived from literature accounts, and different rates are applied to floating, entrained, dissolved, and stranded oil. All rates are assumed to be conservative for condensates, in particular, because they tend to be composed of simpler hydrocarbons than those oils used to measure degradation rates, which could lead to concentrations being maintained for longer distances and durations than might occur, in reality, in warm tropical and sub-tropical settings. The rate currently applied to the insoluble components of entrained oil is a constant rate of ~8% of the mass per day.

Collectively for these uncertainties, calculations for entrainment mass concentrations and dissolved hydrocarbons will tend to be increasingly conservative over many sequential calculations.

The extremely low threshold set by the NOPSEMA guidelines for entrained oil is interacting with the conservative allowances for entrained concentrations for gas

condensates to dominate calculations for the EMBA for both blowout and surface release scenarios for this oil type. In other words, the extent of the entrained oil contour applied to the EMBA calculation is always larger than for any other component.

A further, potential, consequence of maintaining entrained concentrations for longer, in combination with the low threshold set by the NOPSEMA guidelines for oil contact with shorelines (as opposed to accumulation), is that model calculations for re-floating of oil from an entrained state become more critical. The model only needs to calculate that re-floating has led to a small patch of oil at the surface that is equal to or marginally higher than the low threshold (10 g/m^2 on the surface) from an overstated entrained oil concentration to flag a once-off calculation for shoreline exposure at a location that can be isolated by a long distance from the extent calculated for surface slicks to decrease below threshold concentrations when remaining at surface. One such occurrence among 300 simulations will flag a shoreline location for inclusion in the EMBA at a further distance than is indicated for the persistence of surface slicks above the low threshold. Although entrainment and re-floating are real processes that can occur, it is plausible that model errors are responsible for triggering the flagging of some stranding events judged by the low instantaneous threshold at the outer bounds of the EMBA.

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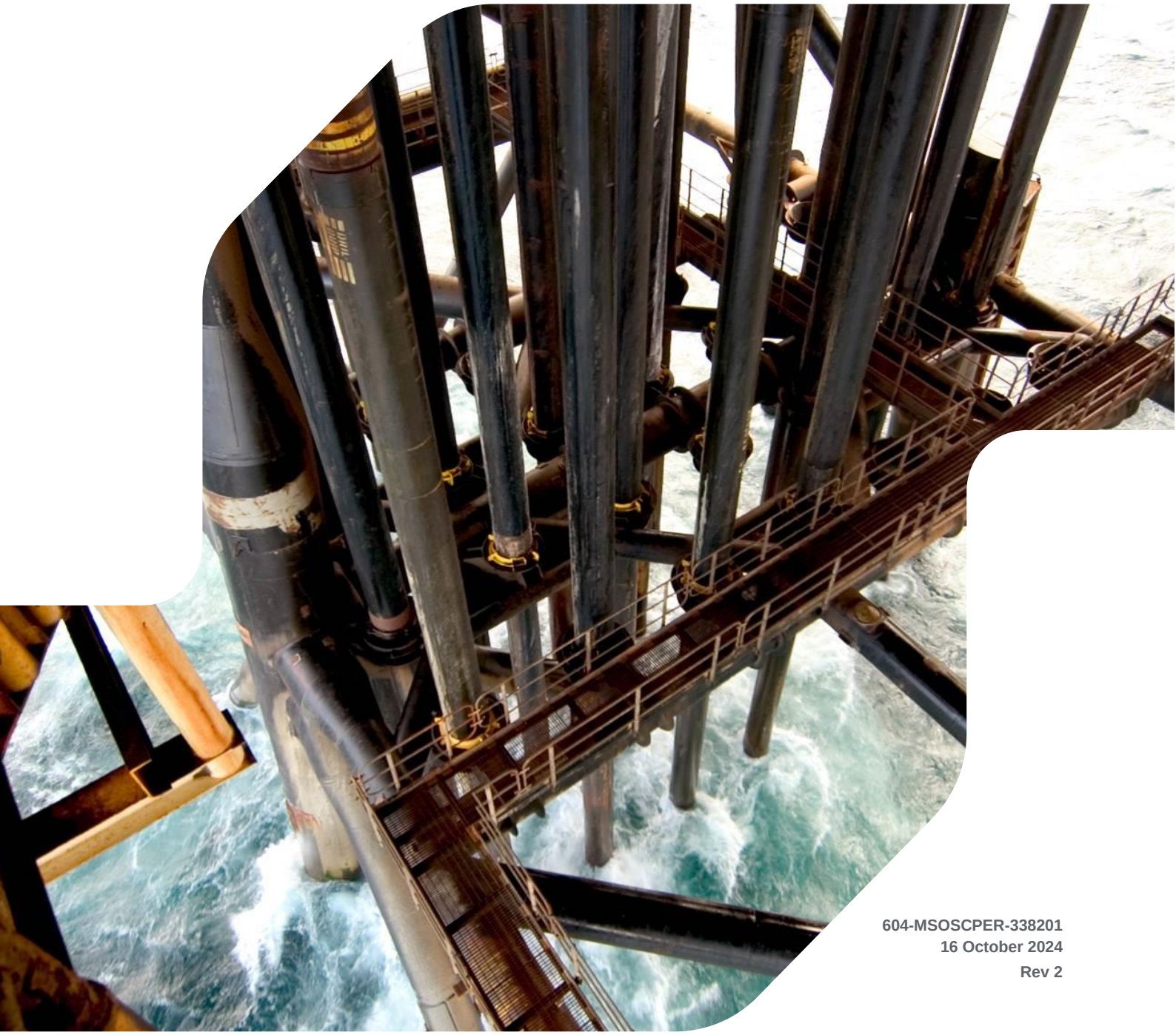
Appendix D Oil Spill Modelling - RPS Loss of Well Control

This Appendix contains the detailed RPS modelling report commissioned by Shell for the Worst-Case Scenario for a Loss of Well Control (surface – Scenario 3). The modelling covered the expected fate and impact of Crux Condensate from a surface loss of well control over a period of 80 days (total of 87,077m^3).

SHELL CRUX OIL SPILL MODELLING REANALYSIS

Tables



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1 SCENARIO 3

1.1.1.1 Floating oil

Table 1.1 Summary of the exposure to floating oil outcomes at sensitive receptors for a 80-day surface release of 87,077 m³ of Crux Condensate

		Probability (%) of films arriving at receptors at			Minimum time to receptor (hours) for films at		
		≥ 1 g/m²	≥ 10 g/m²	≥ 50 g/m²	≥ 1 g/m²	≥ 10 g/m²	≥ 50 g/m²
Australian Marine Parks	Argo-Rowley Terrace MP*	<1	<1	<1	NC	NC	NC
	Ashmore Reef MP	<1	<1	<1	NC	NC	NC
	Cartier Island MP	2	<1	<1	1,029	NC	NC
	Kimberley MP*	<1	<1	<1	NC	NC	NC
	Oceanic Shoals MP*	<1	<1	<1	NC	NC	NC
Biologically Important Areas	Dugong BIA	<1	<1	<1	NC	NC	NC
	Marine Turtle BIA	5	<1	<1	272	NC	NC
	Seabirds BIA	12	<1	<1	168	NC	NC
	Sharks BIA	100	100	12	1	1	41
	Whales BIA	3	<1	<1	906	NC	NC
Coastlines	Indonesia	<1	<1	<1	NC	NC	NC
	Browse Island	<1	<1	<1	NC	NC	NC
	Scott Reef North	<1	<1	<1	NC	NC	NC
	Scott Reef South	<1	<1	<1	NC	NC	NC
	Cartier Island	2	<1	<1	1,042	NC	NC
	Seringapatam Reef	<1	<1	<1	NC	NC	NC
Exclusive Economic Zone	East Timorian Exclusive Economic Zone*	<1	<1	<1	NC	NC	NC
	Indonesian Exclusive Economic Zone*	3	<1	<1	900	NC	NC
Fisheries	Northern Prawn Fishery	<1	<1	<1	NC	NC	NC
	Southern Bluefin Tuna Fishery	100	100	12	1	1	41
	North-West Slope Trawl Fishery*	85	16	<1	18	59	NC
	Western Skipjack Fishery	100	100	12	1	1	41
	Western Tuna and Billfish Fishery	100	100	12	1	1	41
	Kimberley*	<1	<1	<1	NC	NC	NC
IMCRA	Northwest Shelf*	<1	<1	<1	NC	NC	NC
	Oceanic Shoals*	95	58	<1	9	26	NC
	Mitchell*	<1	<1	<1	NC	NC	NC
IBRA	Timor Sea Coral Islands*	2	<1	<1	1,042	NC	NC
	Ancient Coastline at 125m Depth Contour*	31	<1	<1	60	NC	NC

		Probability (%) of films arriving at receptors at			Minimum time to receptor (hours) for films at		
		≥ 1 g/m²	≥ 10 g/m²	≥ 50 g/m²	≥ 1 g/m²	≥ 10 g/m²	≥ 50 g/m²
Key Ecological Features	Ashmore Reef and Cartier Island and surrounding Commonwealth Waters	2	<1	<1	863	NC	NC
	Carbonate Bank and Terrace System of the Sahul Shelf*	14	<1	<1	113	NC	NC
	Continental Slope Demersal Fish Communities*	2	<1	<1	270	NC	NC
	Pinnacles of the Bonaparte Basin*	<1	<1	<1	NC	NC	NC
	Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex	<1	<1	<1	NC	NC	NC
Marine Parks	North Kimberley MP	<1	<1	<1	NC	NC	NC
State Waters	Western Australia State Waters*	<1	<1	<1	NC	NC	NC
Nature Reserve	Scott Reef NR	<1	<1	<1	NC	NC	NC
Reefs, Shoals and Banks	Ashmore Reef	<1	<1	<1	NC	NC	NC
	Barracouta Shoal*	9	<1	<1	192	NC	NC
	Barton Shoal*	<1	<1	<1	NC	NC	NC
	Big Bank Shoals*	<1	<1	<1	NC	NC	NC
	Dillon Shoal*	<1	<1	<1	NC	NC	NC
	Echo Shoals*	<1	<1	<1	NC	NC	NC
	Echuca Shoal*	<1	<1	<1	NC	NC	NC
	Eugene McDermott Shoal*	64	6	<1	36	224	NC
	Gale Bank*	<1	<1	<1	NC	NC	NC
	Goeree Shoal*	91	29	<1	9	17	NC
	Heywood Shoal*	7	<1	<1	86	NC	NC
	Hibernia Reef*	<1	<1	<1	NC	NC	NC
	Jabiru Shoals*	<1	<1	<1	NC	NC	NC
	Johnson Bank*	<1	<1	<1	NC	NC	NC
	Karmt Shoal*	<1	<1	<1	NC	NC	NC
	Mangola Shoal*	<1	<1	<1	NC	NC	NC
	Pee Shoal*	<1	<1	<1	NC	NC	NC
	Sahul Bank*	<1	<1	<1	NC	NC	NC
	Sandy Islet	<1	<1	<1	NC	NC	NC
	Scott Reef North*	<1	<1	<1	NC	NC	NC
	Scott Reef South	<1	<1	<1	NC	NC	NC
	Seringapatam Reef*	<1	<1	<1	NC	NC	NC
	Vee Shoal*	<1	<1	<1	NC	NC	NC
	Vulcan Shoal*	55	4	<1	41	203	NC

		Probability (%) of films arriving at receptors at			Minimum time to receptor (hours) for films at		
		≥ 1 g/m²	≥ 10 g/m²	≥ 50 g/m²	≥ 1 g/m²	≥ 10 g/m²	≥ 50 g/m²
	Woodbine Bank*	<1	<1	<1	NC	NC	NC
WA Fisheries	Abalone*	100	100	12	1	1	41
	Broome Prawn*	11	<1	<1	137	NC	NC
	Kimberley Crab Fishery*	100	100	12	1	1	41
	Kimberley Prawn*	100	100	12	1	1	41
	Mackerel Fishery*	100	100	12	1	1	41
	Northern Demersal Scalefish*	100	100	12	1	1	41
	Pilbara Crab Fishery*	<1	<1	<1	NC	NC	NC
	South West Coast Salmon*	100	100	12	1	1	41
	Specimen Shell*	100	100	12	1	1	41
	West Coast Deep Sea Crustacean*	100	100	12	1	1	41

NC: No contact to receptor predicted for specified threshold. NA: Not applicable

* Floating oil will not accumulate on submerged features and at open ocean locations. Long-term accumulation has not been calculated for features that periodically emerge, marked with this symbol.

1.1.1.2 Shoreline oil

Table 1.2 Summary of the annualised exposure to shoreline oil accumulation at sensitive receptors for a 80-day surface release of 87,077 m³ of Crux Condensate.

		Probability (%) of shoreline oil on receptors at			Minimum time to receptor (hours) for shoreline oil at			Maximum local accumulated concentration (g/m²)		Maximum accumulated volume (m³) along this shoreline with concentrations ≥ 10 g/m²		Maximum accumulated volume (m³) along this shoreline with concentrations ≥ 100 g/m²		Maximum accumulated volume (m³) along this shoreline with concentrations ≥ 1,000 g/m²		Maximum length of shoreline (km) with concentrations ≥ 10 g/m²		Maximum length of shoreline (km) with concentrations ≥ 100 g/m²		Maximum length of shoreline (km) with concentrations ≥ 1,000 g/m²	
		≥ 10 g/m²	≥ 100 g/m²	≥ 1,000 g/m²	≥ 10 g/m²	≥ 100 g/m²	≥ 1,000 g/m²	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill
Australian Marine Parks	Argo-Rowley Terrace MP*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Ashmore Reef MP	21	<1	<1	397	NC	NC	6.1	54	<1	5	NC	NC	NC	NC	3	17	NC	NC	NC	NC
	Cartier Island MP	33	6	2	260	846	1,053	67	2,387	4	121	3	119	2	74	3	14	<1	11	<1	3
	Kimberley MP*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Oceanic Shoals MP*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Biologically Important Areas	Dugong BIA	1	<1	<1	1,683	NC	NC	0.7	11	<1	<1	NC	NC	NC	NC	<1	1	NC	NC	NC	NC
	Marine Turtle BIA	33	6	2	260	846	1,053	67	2,387	4	121	3	119	2	74	6	28	<1	11	<1	3
	Seabirds BIA	33	6	2	260	846	1,053	67	2,387	5	121	3	119	2	74	7	33	<1	11	<1	3
	Sharks BIA	27	<1	<1	528	NC	NC	12	87	<1	4	NC	NC	NC	NC	2	7	NC	NC	NC	NC
	Whales BIA	21	2	<1	397	1,809	NC	6.1	160	2	11	<1	2	NC	NC	5	28	<1	1	NC	NC
Coastlines	Indonesia	2	<1	<1	1,606	NC	NC	0.3	16	<1	<1	NC	NC	NC	NC	<1	2	NC	NC	NC	NC
	Kupang	2	<1	<1	1,606	NC	NC	0.3	16	<1	<1	NC	NC	NC	NC	<1	2	NC	NC	NC	NC
	Browse Island	27	<1	<1	528	NC	NC	12	87	<1	4	NC	NC	NC	NC	2	7	NC	NC	NC	NC
	Scott Reef North	6	<1	<1	1,061	NC	NC	2.4	97	<1	8	NC	NC	NC	NC	<1	18	NC	NC	NC	NC
	Scott Reef South	8	<1	<1	1,073	NC	NC	2.8	93	<1	7	NC	NC	NC	NC	<1	12	NC	NC	NC	NC
	Cartier Island	33	6	2	260	846	1,053	67	2,387	4	121	3	119	2	74	3	14	<1	11	<1	3
	Pulau Dao	<1	<1	<1	NC	NC	NC	0.1	3.9	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
	Pulau Ndana	<1	<1	<1	NC	NC	NC	0.1	4.4	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
	Pulau Rote	<1	<1	<1	NC	NC	NC	<0.1	2.8	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
	Seringapatam Reef	8	<1	<1	589	NC	NC	2.1	39	<1	3	NC	NC	NC	NC	<1	9	NC	NC	NC	NC
	Australian Exclusive Economic Zone*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Exclusive Economic Zone	East Timorian Exclusive Economic Zone*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Indonesian Exclusive Economic Zone*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	North-West Slope Trawl Fishery*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fisheries	Northern Prawn Fishery	<1	<1	<1	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
	Southern Bluefin Tuna Fishery	33	6	2	260	846	1,053	67	2,387	5	121	3	119	2	74	9	33	<1	11	<1	3
	Western Skipjack Fishery	33	6	2	260	846	1,053	67	2,387	5	121	3	119	2	74	9	33	<1	11	<1	3

		Probability (%) of shoreline oil on receptors at			Minimum time to receptor (hours) for shoreline oil at			Maximum local accumulated concentration (g/m²)		Maximum accumulated volume (m³) along this shoreline with concentrations ≥ 10 g/m²		Maximum accumulated volume (m³) along this shoreline with concentrations ≥ 100 g/m²		Maximum accumulated volume (m³) along this shoreline with concentrations ≥ 1,000 g/m²		Maximum length of shoreline (km) with concentrations ≥ 10 g/m²		Maximum length of shoreline (km) with concentrations ≥ 100 g/m²		Maximum length of shoreline (km) with concentrations ≥ 1,000 g/m²	
		≥ 10 g/m²	≥ 100 g/m²	≥ 1,000 g/m²	≥ 10 g/m²	≥ 100 g/m²	≥ 1,000 g/m²	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill
	Western Tuna and Billfish Fishery	33	6	2	260	846	1,053	67	2,387	5	121	3	119	2	74	9	33	<1	11	<1	3
	Kimberley*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
IMCRA	Northwest Shelf*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
IMCRA	Oceanic Shoals*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
IMCRA	Mitchell*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
IBRA	Timor Sea Coral Islands*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
IBRA	Ancient Coastline at 125m Depth Contour*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Key Ecological Features	Ashmore Reef and Cartier Island and surrounding Commonwealth Waters	33	6	2	260	846	1,053	67	2,387	4	121	3	119	2	74	5	28	<1	11	<1	3
Key Ecological Features	Carbonate Bank and Terrace System of the Sahul Shelf*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Key Ecological Features	Continental Slope Demersal Fish Communities*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Key Ecological Features	Pinnacles of the Bonaparte Basin*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Key Ecological Features	Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex	8	<1	<1	589	NC	NC	2.8	97	<1	9	NC	NC	NC	NC	2	27	NC	NC	NC	NC
Key Ecological Features	North Kimberley MP	2	<1	<1	1,541	NC	NC	0.2	13	<1	<1	NC	NC	NC	NC	<1	1	NC	NC	NC	NC
Marine Parks	Scott Reef NR	8	<1	<1	1,061	NC	NC	2.8	93	<1	8	NC	NC	NC	NC	<1	16	NC	NC	NC	NC
Nature Reserve	Ashmore Reef	21	<1	<1	397	NC	NC	6.1	54	<1	5	NC	NC	NC	NC	3	17	NC	NC	NC	NC
Reefs, Shoals and Banks	Barracouta Shoal*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Reefs, Shoals and Banks	Barton Shoal*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Reefs, Shoals and Banks	Big Bank Shoals*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Reefs, Shoals and Banks	Dillon Shoal*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Reefs, Shoals and Banks	Echo Shoals*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Reefs, Shoals and Banks	Echuca Shoal*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Reefs, Shoals and Banks	Eugene McDermott Shoal*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Reefs, Shoals and Banks	Gale Bank*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Reefs, Shoals and Banks	Goeree Shoal*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Reefs, Shoals and Banks	Heywood Shoal*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

		Probability (%) of shoreline oil on receptors at			Minimum time to receptor (hours) for shoreline oil at			Maximum local accumulated concentration (g/m²)		Maximum accumulated volume (m³) along this shoreline with concentrations ≥ 10 g/m²		Maximum accumulated volume (m³) along this shoreline with concentrations ≥ 100 g/m²		Maximum accumulated volume (m³) along this shoreline with concentrations ≥ 1,000 g/m²		Maximum length of shoreline (km) with concentrations ≥ 10 g/m²		Maximum length of shoreline (km) with concentrations ≥ 100 g/m²		Maximum length of shoreline (km) with concentrations ≥ 1,000 g/m²	
		≥ 10 g/m²	≥ 100 g/m²	≥ 1,000 g/m²	≥ 10 g/m²	≥ 100 g/m²	≥ 1,000 g/m²	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill
	Hibernia Reef*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Jabiru Shoals*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Johnson Bank*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Karmt Shoal*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Mangola Shoal*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Pee Shoal*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sahul Bank*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sandy Islet	<1	<1	<1	NC	NC	NC	0.2	3.1	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
	Scott Reef North*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Scott Reef South	8	<1	<1	1,061	NC	NC	2.8	93	<1	8	NC	NC	NC	NC	<1	16	NC	NC	NC	NC
	Seringapatam Reef*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Vee Shoal*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Vulcan Shoal*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Woodbine Bank*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Western Australia State Waters*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
WA Fisheries	Abalone*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Broome Prawn*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Kimberley Crab Fishery*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Kimberley Prawn*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Mackerel Fishery*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Northern Demersal Scalefish*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Pilbara Crab Fishery*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	South West Coast Salmon*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Specimen Shell*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	West Coast Deep Sea Crustacean*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

NC: No contact to receptor predicted for specified threshold. NA: Not applicable

* Calculations for shoreline oil have been made for any land within the feature. However, because floating oil will not accumulate on submerged features and at open ocean locations, shoreline accumulation has not been calculated for features that periodically emerge, marked with this symbol. For all other features not marked with an asterix, the highest concentrations calculated for any shoreline within the feature are shown. Note that some features cover a large area and the calculations do not apply throughout the area.

1.1.1.3 Entrained oil

Table 1.3 Summary of the annualised exposure to entrained oil outcomes at sensitive receptors for a 80-day surface release of 87,077 m³ of Crux Condensate.

		Probability (%) of entrained hydrocarbon concentration contact		Minimum time to receptor waters (hours) at		Maximum entrained hydrocarbon concentration (ppb)	
		≥ 10 ppb	≥ 100 ppb	≥ 10 ppb	≥ 100 ppb	averaged over all replicate spills §	in the worst replicate spill §
Australian Marine Parks	Argo-Rowley Terrace MP	3	<1	1,330	NC	2	16
	Ashmore Reef MP	21	2	392	1,195	9	117
	Cartier Island MP	39	10	229	339	27	179
	Kimberley MP	17	1	251	979	6	110
	Oceanic Shoals MP	28	<1	158	NC	9	69
Biologically Important Areas	Dugong BIA	<1	<1	NC	NC	<1	<1
	Marine Turtle BIA	47	16	163	333	37	248
	Seabirds BIA	62	30	89	112	59	299
	Sharks BIA	100	100	1	1	3,609	6,746
	Whales BIA	52	8	219	428	26	250
Coastlines	Davidsons Point - Cape Bougainville (A)	<1	<1	NC	NC	<1	<1
	Indonesia	4	<1	977	NC	<1	23
	Kupang	<1	<1	NC	NC	<1	10
	Browse Island	53	3	239	473	21	141
	Nusa Tenggara Timur	4	<1	977	NC	<1	23
	Scott Reef North	15	<1	946	NC	5	46
	Scott Reef South	9	<1	978	NC	4	44
	Seringapatam Reef	19	<1	574	NC	7	82
	Cartier Island	39	8	245	339	25	157
	Pulau Dao	4	<1	985	NC	<1	23
	Pulau Ndana	4	<1	977	NC	<1	16
	Pulau Rote	4	<1	993	NC	<1	17
Exclusive Economic Zone	Australian Exclusive Economic Zone	100	100	1	1	3,609	6,746
	East Timorian Exclusive Economic Zone	21	<1	229	NC	6	67
	Indonesian Exclusive Economic Zone	40	4	198	673	16	178
Fisheries	North-West Slope Trawl Fishery	99	88	17	17	365	1,057
	Northern Prawn Fishery	8	<1	266	NC	2	27
	Southern Bluefin Tuna Fishery	100	100	1	1	3,609	6,746
	Western Skipjack Fishery	100	100	1	1	3,609	6,746

		Probability (%) of entrained hydrocarbon concentration contact		Minimum time to receptor waters (hours) at		Maximum entrained hydrocarbon concentration (ppb)	
		≥ 10 ppb	≥ 100 ppb	≥ 10 ppb	≥ 100 ppb	averaged over all replicate spills §	in the worst replicate spill §
	Western Tuna and Billfish Fishery	100	100	1	1	3,609	6,746
IMCRA	Kimberley	7	<1	353	NC	2	39
	Northwest Shelf	52	5	191	424	26	158
	Oceanic Shoals	100	96	4	4	739	1,740
IBRA	Mitchell	<1	<1	NC	NC	<1	<1
	Timor Sea Coral Islands	49	8	245	339	25	157
Key Ecological Features	Ancient Coastline at 125m Depth Contour	91	77	40	45	155	415
	Ashmore Reef and Cartier Island and surrounding Commonwealth Waters	39	10	230	333	27	221
	Carbonate Bank and Terrace System of the Sahul Shelf	59	24	79	88	48	312
	Continental Slope Demersal Fish Communities	67	29	158	205	62	302
	Pinnacles of the Bonaparte Basin	7	<1	816	NC	2	23
	Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex	19	<1	574	NC	7	82
Marine Parks	North Kimberley MP	<1	<1	NC	NC	<1	2
Nature Reserve	Scott Reef NR	10	<1	976	NC	4	45
Reefs, Shoals and Banks	Ashmore Reef	20	1	561	1,645	9	115
	Barracouta Shoal	55	15	161	268	34	183
	Barton Shoal	9	<1	675	NC	4	48
	Big Bank Shoals	9	<1	725	NC	3	30
	Dillon Shoal	10	<1	699	NC	3	43
	Echo Shoals §	4	<1	752	NC	2	15
	Echuca Shoal §	33	<1	202	425	18	73
	Eugene McDermott Shoal §	92	52	27	28	261	349
	Gale Bank	2	<1	319	NC	<1	15
	Goeree Shoal §	<1	<1	9	19	403	2
	Heywood Shoal	85	47	85	180	94	337
	Hibernia Reef	16	<1	360	NC	7	75
	Jabiru Shoals	23	1	361	1,066	10	109
	Johnson Bank	27	2	329	910	12	164
	Karmt Shoal	12	<1	697	NC	3	47
	Mangola Shoal	18	<1	414	NC	8	92
	Pee Shoal	19	<1	382	NC	8	83

		Probability (%) of entrained hydrocarbon concentration contact		Minimum time to receptor waters (hours) at		Maximum entrained hydrocarbon concentration (ppb)	
		≥ 10 ppb	≥ 100 ppb	≥ 10 ppb	≥ 100 ppb	averaged over all replicate spills §	in the worst replicate spill §
	Sahul Bank §	23	3	342	1,321	11	142
	Sandy Islet	4	<1	1,076	NC	3	36
	Scott Reef North	15	<1	937	NC	5	49
	Scott Reef South	11	<1	946	NC	4	47
	Seringapatam Reef	19	<1	575	NC	7	82
	Vee Shoal	18	<1	746	NC	6	46
	Vulcan Shoal §	20	<1	37	46	190	24
	Woodbine Bank	26	2	306	889	13	165
State Waters	Western Australia State Waters	52	1	246	532	18	104
WA Fisheries	Abalone	100	100	1	1	3,609	6,746
	Broome Prawn	77	27	139	200	65	301
	Kimberley Crab Fishery	100	100	1	1	3,609	6,746
	Kimberley Prawn	100	100	1	1	3,609	6,746
	Mackerel Fishery	100	100	1	1	3,609	6,746
	Northern Demersal Scalefish	100	100	1	1	3,609	6,746
	Pilbara Crab Fishery	3	<1	1,265	NC	<1	31
	South West Coast Salmon	100	100	1	1	3,609	6,746
	Specimen Shell	100	100	1	1	3,609	6,746
	West Coast Deep Sea Crustacean	100	100	1	1	3,609	6,746

NC: No contact to receptor predicted for specified threshold.

§ For deeply submerged features marked with this symbol, the Probabilities and maximum concentrations have been calculated at the depth of the submerged feature (e.g. for deep shoals, the calculations are for the minimum depth of the shoal). The average concentrations indicate the highest concentrations at any depth, averaged among replicate simulations. In practice, concentrations will tend to be higher towards the water surface.

1.1.1.4 Dissolved Aromatic Hydrocarbons

Table 1.4 Summary of the annualised exposure to of dissolved aromatic hydrocarbon outcomes at sensitive receptors resulting from release of 87,077 m³ of Crux Condensate onto the water surface over 80 days (1,088.5 m³/d).

		Probability (%) of dissolved aromatic concentration			Minimum time to receptor waters (hours) at			Maximum dissolved aromatic hydrocarbon concentration (ppb), at any depth	
		≥ 10 ppb	≥ 50 ppb	≥ 400 ppb	≥ 10 ppb	≥ 50 ppb	≥ 400 ppb	averaged over all replicate simulations	in the worst replicate simulation
Australian Marine Parks	Argo-Rowley Terrace MP	<1	<1	<1	NC	NC	NC	NC	NC
	Ashmore Reef MP	1	<1	<1	2,133	NC	NC	<1	25
	Cartier Island MP	6	1	<1	334	1,166	NC	3	70
	Kimberley MP	1	<1	<1	1,420	NC	NC	<1	11
	Oceanic Shoals MP	1	<1	<1	216	NC	NC	<1	20
Biologically Important Areas	Dugong BIA	<1	<1	<1	NC	NC	NC	NC	NC
	Marine Turtle BIA	10	1	<1	301	570	NC	3	109
	Seabirds BIA	25	7	<1	178	225	NC	11	274
	Sharks BIA	100	100	49	1	1	8	396	1,285
	Whales BIA	8	1	<1	440	712	NC	2	85
Coastlines	Davidsons Point - Cape Bougainville (A)	<1	<1	<1	NC	NC	NC	NC	NC
	Indonesia	<1	<1	<1	NC	NC	NC	<1	<1
	Browse Island	5	1	<1	720	2,123	NC	2	66
	Scott Reef North	<1	<1	<1	NC	NC	NC	<1	<1
	Scott Reef South	<1	<1	<1	NC	NC	NC	<1	<1
	Seringapatam Reef	<1	<1	<1	NC	NC	NC	<1	3
	Cartier Island	3	<1	<1	337	NC	NC	<1	28
	Pulau Dao	<1	<1	<1	NC	NC	NC	<1	<1
	Pulau Ndana	<1	<1	<1	NC	NC	NC	NC	NC
	Pulau Rote	<1	<1	<1	NC	NC	NC	<1	<1
Exclusive Economic Zone	Australian Exclusive Economic Zone	100	100	49	1	1	8	396	1,285
	East Timorian Exclusive Economic Zone	1	<1	<1	259	NC	NC	<1	13
	Indonesian Exclusive Economic Zone	8	2	<1	229	649	NC	4	183
Fisheries	North-West Slope Trawl Fishery	74	48	3	18	18	91	89	731
	Northern Prawn Fishery	<1	<1	<1	NC	NC	NC	<1	<1
	Southern Bluefin Tuna Fishery	100	100	49	1	1	8	396	1,285

		Probability (%) of dissolved aromatic concentration			Minimum time to receptor waters (hours) at			Maximum dissolved aromatic hydrocarbon concentration (ppb), at any depth	
		≥ 10 ppb	≥ 50 ppb	≥ 400 ppb	≥ 10 ppb	≥ 50 ppb	≥ 400 ppb	averaged over all replicate simulations	in the worst replicate simulation
	Western Skipjack Fishery	100	100	49	1	1	8	396	1,285
	Western Tuna and Billfish Fishery	100	100	49	1	1	8	396	1,285
IMCRA	Kimberley	<1	<1	<1	NC	NC	NC	<1	2
	Northwest Shelf	9	1	<1	432	709	NC	3	58
	Oceanic Shoals	91	77	10	5	8	33	174	821
IBRA	Mitchell	<1	<1	<1	NC	NC	NC	<1	<1
	Timor Sea Coral Islands	3	<1	<1	337	NC	NC	<1	28
Key Ecological Features	Ancient Coastline at 125m Depth Contour	68	31	<1	45	47	NC	39	349
	Ashmore Reef and Cartier Island and surrounding Commonwealth Waters	6	1	<1	334	1,166	NC	3	70
	Carbonate Bank and Terrace System of the Sahul Shelf	24	6	<1	100	102	NC	10	307
	Continental Slope Demersal Fish Communities	23	7	<1	205	231	NC	9	234
	Pinnacles of the Bonaparte Basin	<1	<1	<1	NC	NC	NC	<1	<1
	Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex	<1	<1	<1	NC	NC	NC	<1	3
Marine Parks	North Kimberley MP	<1	<1	<1	NC	NC	NC	NC	NC
Nature Reserve	Scott Reef NR	<1	<1	<1	NC	NC	NC	<1	<1
Reefs, Shoals and Banks	Ashmore Reef	1	<1	<1	2,143	NC	NC	<1	22
	Barracouta Shoal	12	<1	<1	327	NC	NC	3	49
	Barton Shoal	<1	<1	<1	NC	NC	NC	<1	9
	Big Bank Shoals	<1	<1	<1	NC	NC	NC	<1	<1
	Dillon Shoal	<1	<1	<1	NC	NC	NC	<1	<1
	Echo Shoals §	<1	<1	<1	NC	NC	NC	NC	NC
	Echuca Shoal §	1	<1	<1	824	NC	NC	<1	14
	Eugene McDermott Shoal §	54	28	<1	28	41	NC	55	388
	Gale Bank	<1	<1	<1	NC	NC	NC	<1	<1
	Goeree Shoal §	4	<1	<1	38	76	394	81	24
	Heywood Shoal	40	9	<1	147	265	NC	15	155

		Probability (%) of dissolved aromatic concentration			Minimum time to receptor waters (hours) at			Maximum dissolved aromatic hydrocarbon concentration (ppb), at any depth	
		≥ 10 ppb	≥ 50 ppb	≥ 400 ppb	≥ 10 ppb	≥ 50 ppb	≥ 400 ppb	averaged over all replicate simulations	in the worst replicate simulation
	Hibernia Reef	<1	<1	<1	NC	NC	NC	<1	6
	Jabiru Shoals	2	1	<1	529	1,693	NC	<1	52
	Johnson Bank	2	<1	<1	2,119	NC	NC	<1	25
	Karmt Shoal	<1	<1	<1	NC	NC	NC	<1	2
	Mangola Shoal	1	<1	<1	1,637	NC	NC	<1	33
	Pee Shoal	3	<1	<1	408	NC	NC	<1	26
	Sahul Bank §	2	<1	<1	465	NC	NC	<1	22
	Sandy Islet	<1	<1	<1	NC	NC	NC	NC	NC
	Scott Reef North	<1	<1	<1	NC	NC	NC	<1	<1
	Scott Reef South	<1	<1	<1	NC	NC	NC	<1	2
	Seringapatam Reef	<1	<1	<1	NC	NC	NC	<1	3
	Vee Shoal	<1	<1	<1	NC	NC	NC	<1	4
	Vulcan Shoal §	36	13	<1	84	131	567	36	258
	Woodbine Bank	1	<1	<1	1,599	NC	NC	<1	28
State Waters	Western Australia State Waters	3	1	<1	722	2,126	NC	2	58
WA Fisheries	Abalone	100	100	49	1	1	8	396	1,285
	Broome Prawn	31	9	<1	160	213	NC	12	317
	Kimberley Crab Fishery	100	100	49	1	1	8	396	1,285
	Kimberley Prawn	100	100	49	1	1	8	396	1,285
	Mackerel Fishery	100	100	49	1	1	8	396	1,285
	Northern Demersal Scalefish	100	100	49	1	1	8	396	1,285
	Pilbara Crab Fishery	<1	<1	<1	NC	NC	NC	NC	NC
	South West Coast Salmon	100	100	49	1	1	8	396	1,285
	Specimen Shell	100	100	49	1	1	8	396	1,285
	West Coast Deep Sea Crustacean	100	100	49	1	1	8	396	1,285

NC: No contact to receptor predicted for specified threshold.

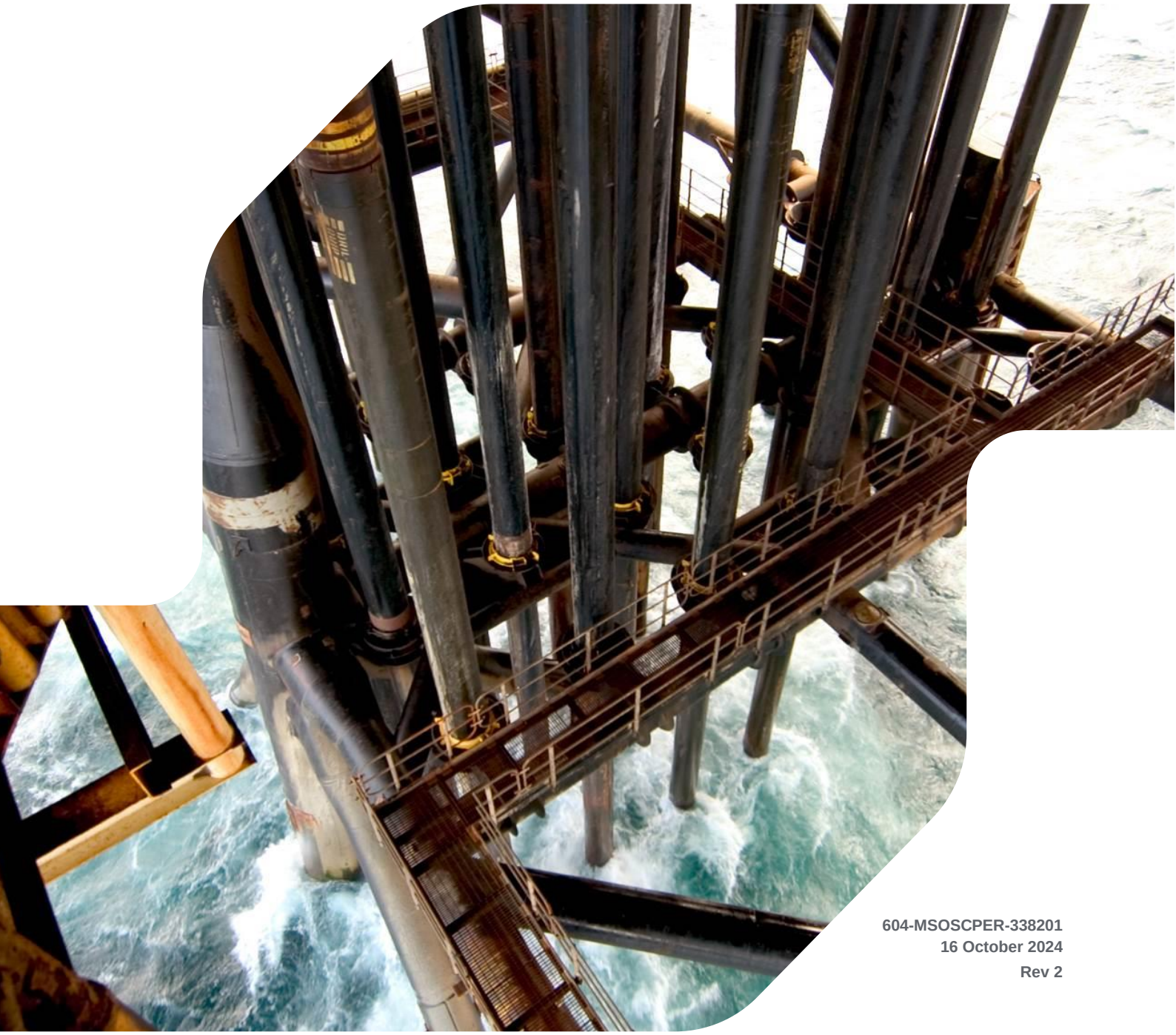
* Floating oil will not accumulate on submerged features and at open ocean locations. Long-term accumulation has not been calculated for features that periodically emerge, marked with this symbol.

Appendix E Oil Spill Modelling - RPS Subsea Pipeline Rupture

This Appendix contains the detailed RPS modelling report commissioned by Shell for the Worst-Case Scenario for a Subsea Pipeline Rupture (seabed). The modelling covered a subsea pipeline rupture of 1,804m^3 of Crux Condensate over a 4-hour period.

SHELL CRUX OIL SPILL MODELLING REANALYSIS

Tables



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1 SCENARIO 4

1.1.1.1 Floating oil

Table 1.1 Summary of the exposure to floating oil outcomes at sensitive receptors for a 4-hour subsea release of 1,804 m³ of Crux Condensate

		Probability (%) of films arriving at receptors at			Minimum time to receptor (hours) for films at		
		≥ 1 g/m²	≥ 10 g/m²	≥ 50 g/m²	≥ 1 g/m²	≥ 10 g/m²	≥ 50 g/m²
Australian Marine Parks	Ashmore Reef MP	0.5	<1	<1	144	NC	NC
	Cartier Island MP	0.5	<1	<1	118	NC	NC
Biologically Important Areas	Marine Turtle BIA	1	<1	<1	89	NC	NC
	Seabirds BIA	3.5	2	<1	39	44	NC
	Sharks BIA	23.5	15.5	9.5	2	2	2
	Whales BIA	0.5	<1	<1	129	NC	NC
Coastlines	Browse Island	<1	<1	<1	NC	NC	NC
Exclusive Economic Zone	Australian Exclusive Economic Zone*	90	87	81	1	1	1
	Indonesian Exclusive Economic Zone*	0.5	<1	<1	216	NC	NC
Fisheries	North-West Slope Trawl Fishery*	90	87	81	1	1	1
	Southern Bluefin Tuna Fishery	90	87	81	1	1	1
	Western Skipjack Fishery	90	87	81	1	1	1
	Western Tuna and Billfish Fishery	90	87	81	1	1	1
IMCRA	Northwest Shelf*	0.5	<1	<1	186	NC	NC
	Oceanic Shoals*	3	1.5	<1	26	27	NC
IBRA	Timor Sea Coral Islands*	0.5	<1	<1	120	NC	NC
Islands	Cartier Island	0.5	<1	<1	120	NC	NC
Key Ecological Features	Ancient Coastline at 125m Depth Contour*	3	1.5	0.5	20	21	31
	Ashmore Reef and Cartier Island and surrounding Commonwealth Waters	0.5	<1	<1	118	NC	NC
	Carbonate Bank and Terrace System of the Sahul Shelf*	<1	<1	<1	NC	NC	NC
	Continental Slope Demersal Fish Communities*	2	1	<1	39	49	NC
Reefs, Shoals, Banks	Ashmore Reef	0.5	<1	<1	148	NC	NC
	Barracouta Shoal*	<1	<1	<1	NC	NC	NC
	Eugene McDermott Shoal*	<1	<1	<1	NC	NC	NC

		Probability (%) of films arriving at receptors at			Minimum time to receptor (hours) for films at		
		≥ 1 g/m²	≥ 10 g/m²	≥ 50 g/m²	≥ 1 g/m²	≥ 10 g/m²	≥ 50 g/m²
	Goeree Shoal*	<1	<1	<1	NC	NC	NC
	Heywood Shoal*	1.5	0.5	<1	29	46	NC
	Hibernia Reef*	<1	<1	<1	NC	NC	NC
	Jabiru Shoals*	<1	<1	<1	NC	NC	NC
	Johnson Bank*	0.5	<1	<1	132	NC	NC
	Pee Shoal*	<1	<1	<1	NC	NC	NC
	Sahul Bank*	<1	<1	<1	NC	NC	NC
	Vulcan Shoal*	<1	<1	<1	NC	NC	NC
	Woodbine Bank*	<1	<1	<1	NC	NC	NC
State Waters	Western Australia State Waters*	<1	<1	<1	NC	NC	NC
WA Fisheries	Abalone*	90	87	81	1	1	1
	Broome Prawn*	2	0.5	<1	40	66	NC
	Kimberley Crab Fishery*	90	87	81	1	1	1
	Kimberley Prawn*	90	87	81	1	1	1
	Mackerel Fishery*	90	87	81	1	1	1
	Northern Demersal Scalefish*	90	87	81	1	1	1
	South West Coast Salmon*	90	87	81	1	1	1
	Specimen Shell*	90	87	81	1	1	1
	West Coast Deep Sea Crustacean*	90	87	81	1	1	1

NC: No contact to receptor predicted for specified threshold. NA: Not applicable

* Floating oil will not accumulate on submerged features and at open ocean locations. Long-term accumulation has not been calculated for features that periodically emerge, marked with this symbol.

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1.1.1.2 Shoreline oil

Table 1.2 Summary of the annualised exposure to shoreline oil accumulation at sensitive receptors for a 4-hour subsea release of 1,804 m³ of Crux Condensate.

		Probability (%) of shoreline oil on receptors at			Minimum time to receptor (hours) for shoreline oil at			Maximum local accumulated concentration (g/m²)		Maximum accumulated volume (m³) along this shoreline with concentrations ≥ 10 g/m²		Maximum accumulated volume (m³) along this shoreline with concentrations ≥ 100 g/m²		Maximum accumulated volume (m³) along this shoreline with concentrations ≥ 1,000 g/m²		Maximum length of shoreline (km) with concentrations ≥ 10 g/m²		Maximum length of shoreline (km) with concentrations ≥ 100 g/m²		Maximum length of shoreline (km) with concentrations ≥ 1,000 g/m²	
		≥ 10 g/m²	≥ 100 g/m²	≥ 1,000 g/m²	≥ 10 g/m²	≥ 100 g/m²	≥ 1,000 g/m²	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill
Australian Marine Parks	Ashmore Reef MP	1	0.5	<1	147	149	NC	4.3	851	<1	57	<1	53	NC	NC	<1	50	<1	30	NC	NC
	Cartier Island MP	3	1	<1	118	121	NC	4	495	<1	19	<1	17	NC	NC	<1	17	<1	8	NC	NC
Biologically Important Areas	Marine Turtle BIA	3	1	<1	118	121	NC	4.3	851	<1	75	<1	69	NC	NC	<1	62	<1	38	NC	NC
	Seabirds BIA	3	1	<1	118	121	NC	4.3	851	<1	75	<1	69	NC	NC	<1	62	<1	38	NC	NC
	Sharks BIA	<1	<1	<1	NC	NC	NC	<0.1	0.3	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
	Whales BIA	1	1	<1	147	149	NC	4.3	851	<1	57	<1	53	NC	NC	<1	50	<1	30	NC	NC
Coastlines	Browse Island	<1	<1	<1	NC	NC	NC	<0.1	0.3	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Exclusive Economic Zone	Australian Exclusive Economic Zone*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Indonesian Exclusive Economic Zone*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fisheries	North-West Slope Trawl Fishery*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Southern Bluefin Tuna Fishery	3	1	<1	118	121	NC	4.3	851	<1	75	<1	69	NC	NC	<1	62	<1	38	NC	NC
	Western Skipjack Fishery	3	1	<1	118	121	NC	4.3	851	<1	75	<1	69	NC	NC	<1	62	<1	38	NC	NC
	Western Tuna and Billfish Fishery	3	1	<1	118	121	NC	4.3	851	<1	75	<1	69	NC	NC	<1	62	<1	38	NC	NC
IMCRA	Northwest Shelf*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Oceanic Shoals*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
IBRA	Timor Sea Coral Islands*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Islands	Cartier Island	3	1	<1	118	121	NC	4	495	<1	19	<1	17	NC	NC	<1	17	<1	8	NC	NC
Key Ecological Features	Ancient Coastline at 125m Depth Contour*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Ashmore Reef and Cartier Island and surrounding	3	1	<1	118	121	NC	4.3	851	<1	75	<1	69	NC	NC	<1	62	<1	38	NC	NC

		Probability (%) of shoreline oil on receptors at			Minimum time to receptor (hours) for shoreline oil at			Maximum local accumulated concentration (g/m²)		Maximum accumulated volume (m³) along this shoreline with concentrations ≥ 10 g/m²		Maximum accumulated volume (m³) along this shoreline with concentrations ≥ 100 g/m²		Maximum accumulated volume (m³) along this shoreline with concentrations ≥ 1,000 g/m²		Maximum length of shoreline (km) with concentrations ≥ 10 g/m²		Maximum length of shoreline (km) with concentrations ≥ 100 g/m²		Maximum length of shoreline (km) with concentrations ≥ 1,000 g/m²	
		≥ 10 g/m²	≥ 100 g/m²	≥ 1,000 g/m²	≥ 10 g/m²	≥ 100 g/m²	≥ 1,000 g/m²	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill	averaged over all replicate spills	in the worst replicate spill
	Commonwealth Waters																				
	Carbonate Bank and Terrace System of the Sahul Shelf*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Continental Slope Demersal Fish Communities*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Reefs, Shoals and Banks	Ashmore Reef	1	0.5	<1	147	149	NC	4.3	851	<1	57	<1	53	NC	NC	<1	50	<1	30	NC	NC
	Barracouta Shoal*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Eugene McDermott Shoal*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Goeree Shoal*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Heywood Shoal*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Hibernia Reef*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Jabiru Shoals*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Johnson Bank*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Pee Shoal*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sahul Bank*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Vulcan Shoal*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Woodbine Bank*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
WA Fisheries	Abalone*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Broome Prawn*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Kimberley Crab Fishery*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Kimberley Prawn*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Mackerel Fishery*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Northern Demersal Scalefish*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	South West Coast Salmon*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Specimen Shell*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	West Coast Deep Sea Crustacean*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

NC: No contact to receptor predicted for specified threshold. NA: Not applicable

* Calculations for shoreline oil have been made for any land within the feature. However, because floating oil will not accumulate on submerged features and at open ocean locations, shoreline accumulation has not been calculated for features that periodically emerge, marked with this symbol. For all other features not marked with an asterix, the highest concentrations calculated for any shoreline within the feature are shown. Note that some features cover a large area and the calculations do not apply throughout the area.

1.1.1.3 Entrained oil

Table 1.3 Summary of the annualised exposure to of entrained oil outcomes at sensitive receptors for a 4-hour subsea release of 1,804 m³ of Crux Condensate.

		Probability (%) of entrained hydrocarbon concentration contact			Minimum time to receptor waters (hours) at			Maximum entrained hydrocarbon concentration (ppb)	
		≥ 10 ppb	≥ 100 ppb	≥ 1,000 ppb	≥ 10 ppb	≥ 100 ppb	≥ 1,000 ppb	averaged over all replicate spills	in the worst replicate spill
Australian Marine Parks	Ashmore Reef MP	2	0.5	<1	144	152	NC	<1	104
	Cartier Island MP	3	<1	<1	122	NC	NC	2	73
Biologically Important Areas	Marine Turtle BIA	5	1	<1	82	119	NC	3	135
	Seabirds BIA	17	8.5	<1	40	43	NC	19	635
	Sharks BIA	50.5	35	12.5	1	2	2	521	14,944
	Whales BIA	7	1	<1	105	148	NC	3	139
Coastlines	Browse Island	1.5	<1	<1	230	NC	NC	<1	63
Exclusive Economic Zone	Australian Exclusive Economic Zone	65.5	52.5	32.5	1	1	1	1,799	34,172
	Indonesian Exclusive Economic Zone	3	<1	<1	142	NC	NC	<1	95
Fisheries	North-West Slope Trawl Fishery	65.5	52.5	32.5	1	1	1	1,799	34,172
	Southern Bluefin Tuna Fishery	65.5	52.5	32.5	1	1	1	1,799	34,172
	Western Skipjack Fishery	65.5	52.5	32.5	1	1	1	1,799	34,172
	Western Tuna and Billfish Fishery	65.5	52.5	32.5	1	1	1	1,799	34,172
IMCRA	Northwest Shelf	2.5	<1	<1	210	NC	NC	<1	94
	Oceanic Shoals	13.5	4.5	<1	17	18	NC	16	942
IBRA	Timor Sea Coral Islands	3	0.5	<1	130	161	NC	2	101
Islands	Cartier Island	3	<1	<1	130	NC	NC	2	71
Key Ecological Features	Ancient Coastline at 125m Depth Contour	15	6	0.5	11	17	33	19	1,208
	Ashmore Reef and Cartier Island and surrounding Commonwealth Waters	3	0.5	<1	126	152	NC	2	104

		Probability (%) of entrained hydrocarbon concentration contact			Minimum time to receptor waters (hours) at			Maximum entrained hydrocarbon concentration (ppb)	
		≥ 10 ppb	≥ 100 ppb	≥ 1,000 ppb	≥ 10 ppb	≥ 100 ppb	≥ 1,000 ppb	averaged over all replicate spills	in the worst replicate spill
	Carbonate Bank and Terrace System of the Sahul Shelf	2.5	<1	<1	153	NC	NC	<1	57
	Continental Slope Demersal Fish Communities	18.5	9.5	<1	31	32	NC	26	782
Reefs, Shoals and Banks	Ashmore Reef	1.5	0.5	<1	147	161	NC	<1	101
	Barracouta Shoal	2.5	<1	<1	129	NC	NC	<1	65
	Eugene McDermott Shoal §	2.5	0.5	<1	75	77	NC	2	129
	Goeree Shoal §	<1	<1	<1	63	76	NC	4	NC
	Heywood Shoal	10.5	3.5	<1	31	37	NC	9	321
	Hibernia Reef	2	<1	<1	231	NC	NC	<1	33
	Jabiru Shoals	0.5	<1	<1	219	NC	NC	<1	23
	Johnson Bank	1.5	<1	<1	142	NC	NC	<1	29
	Pee Shoal	<1	<1	<1	NC	NC	NC	<1	8
	Sahul Bank §	0.5	<1	<1	205	NC	NC	<1	43
	Vulcan Shoal §	<1	<1	<1	29	29	NC	8	10
	Woodbine Bank	1	<1	<1	173	NC	NC	<1	32
State Waters	Western Australia State Waters	1.5	<1	<1	242	NC	NC	<1	41
WA Fisheries	Abalone	65.5	52.5	32.5	1	1	1	1,799	34,172
	Broome Prawn	22	10	0.5	26	28	30	35	1,122
	Kimberley Crab Fishery	65.5	52.5	32.5	1	1	1	1,799	34,172
	Kimberley Prawn	65.5	52.5	32.5	1	1	1	1,799	34,172
	Mackerel Fishery	65.5	52.5	32.5	1	1	1	1,799	34,172
	Northern Demersal Scalefish	65.5	52.5	32.5	1	1	1	1,799	34,172
	South West Coast Salmon	65.5	52.5	32.5	1	1	1	1,799	34,172
	Specimen Shell	65.5	52.5	32.5	1	1	1	1,799	34,172
	West Coast Deep Sea Crustacean	65.5	52.5	32.5	1	1	1	1,799	34,172

NC: No contact to receptor predicted for specified threshold.

§ For deeply submerged features marked with this symbol, the Probabilities and maximum concentrations have been calculated at the depth of the submerged feature (e.g. for deep shoals, the calculations are for the minimum depth of the shoal). The average concentrations indicate the highest concentrations at any depth, averaged among replicate simulations. In practice, concentrations will tend to be higher towards the water surface

1.1.1.4 Dissolved Aromatic Hydrocarbons

Table 1.4 Summary of the annualised exposure to of dissolved aromatic hydrocarbon outcomes at sensitive receptors resulting from a 4-hour subsea release of 1,804 m^3 of Crux Condensate.

		Probability (%) of dissolved aromatic concentration			Minimum time to receptor waters (hours) at			Maximum dissolved aromatic hydrocarbon concentration (ppb), at any depth	
		≥ 10 ppb	≥ 50 ppb	≥ 400 ppb	≥ 10 ppb	≥ 50 ppb	≥ 400 ppb	averaged over all replicate simulations	in the worst replicate simulation
Australian Marine Parks	Ashmore Reef MP	<1	<1	<1	NC	NC	NC	<1	<1
	Cartier Island MP	<1	<1	<1	NC	NC	NC	<1	2
Biologically Important Areas	Marine Turtle BIA	0.5	<1	<1	278	NC	NC	<1	15
	Seabirds BIA	2.5	1	<1	61	69	NC	<1	128
	Sharks BIA	20	6.5	0.5	2	2	6	12	609
	Whales BIA	1	<1	<1	169	NC	NC	<1	37
Coastlines	Browse Island	<1	<1	<1	NC	NC	NC	<1	4
Exclusive Economic Zone	Australian Exclusive Economic Zone	58	18.5	0.5	1	1	6	30	780
	Indonesian Exclusive Economic Zone	0.5	<1	<1	183	NC	NC	<1	38
Fisheries	North-West Slope Trawl Fishery	58	18.5	0.5	1	1	6	30	780
	Southern Bluefin Tuna Fishery	58	18.5	0.5	1	1	6	30	780
	Western Skipjack Fishery	58	18.5	0.5	1	1	6	30	780
	Western Tuna and Billfish Fishery	58	18.5	0.5	1	1	6	30	780

IMCRA	Northwest Shelf	<1	<1	<1	NC	NC	NC	<1	6
	Oceanic Shoals	2	0.5	<1	44	48	NC	<1	187
IBRA	Timor Sea Coral Islands	<1	<1	<1	NC	NC	NC	<1	<1
Islands	Cartier Island	<1	<1	<1	NC	NC	NC	<1	<1
Key Ecological Features	Ancient Coastline at 125m Depth Contour	1.5	1	<1	34	45	NC	2	224
	Ashmore Reef and Cartier Island and surrounding Commonwealth Waters	<1	<1	<1	NC	NC	NC	<1	5
	Carbonate Bank and Terrace System of the Sahul Shelf	0.5	<1	<1	234	NC	NC	<1	14
	Continental Slope Demersal Fish Communities	3	1	<1	38	51	NC	<1	129
Reefs, Shoals and Banks	Ashmore Reef	<1	<1	<1	NC	NC	NC	<1	<1
	Barracouta Shoal	<1	<1	<1	NC	NC	NC	<1	2
	Eugene McDermott Shoal §	0.5	<1	<1	77	79	NC	<1	25
	Goeree Shoal §	<1	<1	<1	83	NC	NC	<1	<1
	Heywood Shoal	1	0.5	<1	95	122	NC	<1	131
	Hibernia Reef	<1	<1	<1	NC	NC	NC	NC	NC
	Jabiru Shoals	0.5	<1	<1	207	NC	NC	<1	26
	Johnson Bank	<1	<1	<1	NC	NC	NC	<1	3
	Pee Shoal	0.5	<1	<1	229	NC	NC	<1	14
	Sahul Bank §	<1	<1	<1	NC	NC	NC	<1	<1
	Vulcan Shoal §	0.5	<1	<1	100	NC	NC	<1	13
	Woodbine Bank	<1	<1	<1	NC	NC	NC	<1	2
State Waters	Western Australia State Waters	<1	<1	<1	NC	NC	NC	<1	<1

WA Fisheries	Abalone	58	18.5	0.5	1	1	6	30	609
	Broome Prawn	4.5	1	<1	29	33	NC	2	127
	Kimberley Crab Fishery	58	18.5	0.5	1	1	6	30	780
	Kimberley Prawn	58	18.5	0.5	1	1	6	30	609
	Mackerel Fishery	58	18.5	0.5	1	1	6	30	780
	Northern Demersal Scalefish	58	18.5	0.5	1	1	6	30	780
	South West Coast Salmon	58	18.5	0.5	1	1	6	30	780
	Specimen Shell	58	18.5	0.5	1	1	6	30	609
	West Coast Deep Sea Crustacean	58	18.5	0.5	1	1	6	30	780

NC: No contact to receptor predicted for specified threshold.

§ For deeply submerged features marked with this symbol, the Probabilities and maximum concentrations have been calculated at the depth of the submerged feature (e.g. for deep shoals, the calculations are for the minimum depth of the shoal). The average concentrations indicate the highest concentrations at any depth, averaged among replicate simulations. In practice, concentrations will tend to be higher towards the water surface.

Appendix F EPBC Act Protected Matters Reports

This Appendix includes four sperate protected matters reports obtained from the EPBC Act PMST. The input data for PMST is summarised as follows and an image from the PMST search tool is provided at the start of each report within this appendix:

F.1: Protected Matters Report (Planning Area)

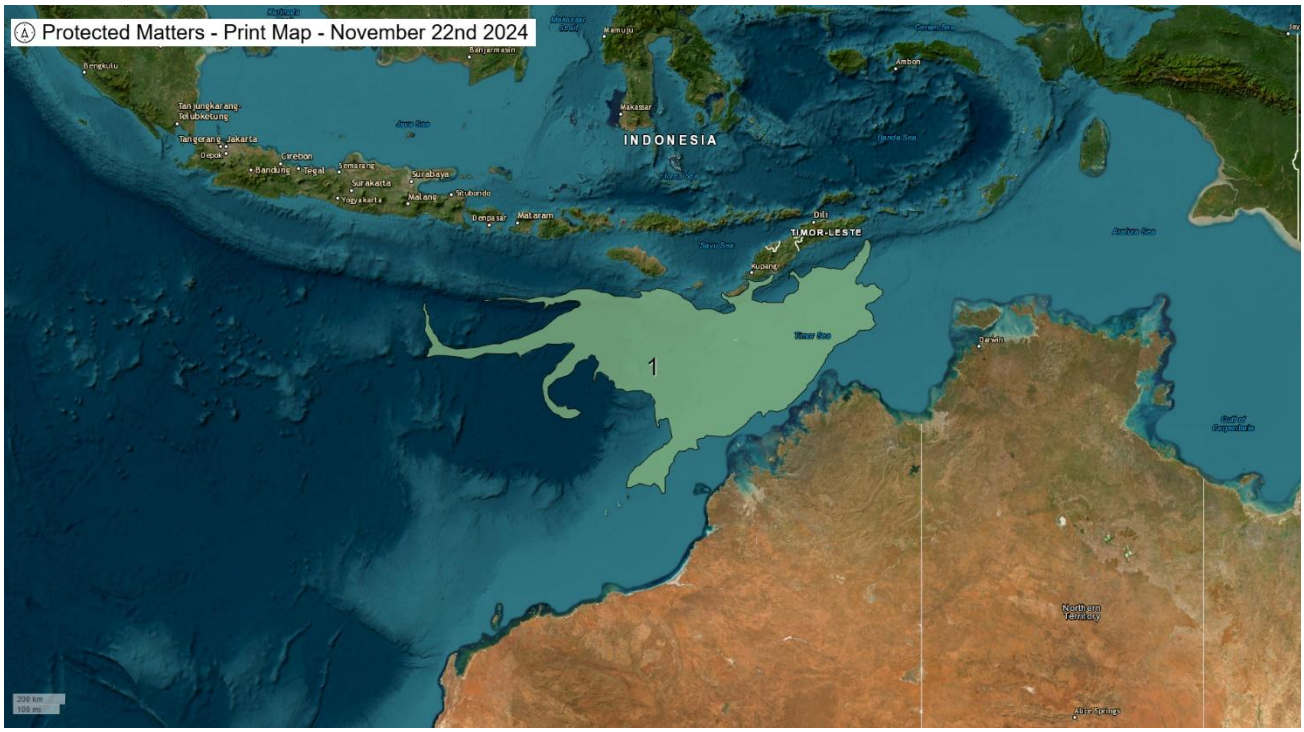
F.2: Protected Matters Report (Activity Area)

F.3: Protected Matters Report (Light Assessment Area)

F.4: Protected Matters Report (Noise Assessment Area)

F.1: Protected Matters Report (Planning Area)

Input data:



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 22-Nov-2024

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance (Ramsar	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	10
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	31
Listed Migratory Species:	60

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	3
Commonwealth Heritage Places:	2
Listed Marine Species:	97
Whales and Other Cetaceans:	29
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	10
Habitat Critical to the Survival of Marine Turtles:	1

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	4
Regional Forest Agreements:	None
Nationally Important Wetlands:	1
EPBC Act Referrals:	129
Key Ecological Features (Marine):	10
Biologically Important Areas:	37
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

National Heritage Places		[Resource Information]
Name	State	Legal Status
Natural		
The West Kimberley	WA	Listed place

Wetlands of International Importance (Ramsar Wetlands)	[Resource Information]
Ramsar Site Name	Proximity
Ashmore reef national nature reserve	Within Ramsar site

Commonwealth Marine Area	[Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name
Commonwealth Marine Areas (EPBC Act)
Commonwealth Marine Areas (EPBC Act)
Commonwealth Marine Areas (EPBC Act)
Commonwealth Marine Areas (EPBC Act)
Commonwealth Marine Areas (EPBC Act)
Commonwealth Marine Areas (EPBC Act)
Commonwealth Marine Areas (EPBC Act)
Commonwealth Marine Areas (EPBC Act)
Commonwealth Marine Areas (EPBC Act)
Commonwealth Marine Areas (EPBC Act)

Listed Threatened Species		[Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Breeding known to occur within area

Scientific Name	Threatened Category	Presence Text
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Russkoye Bar-tailed Godwit [86432]	Endangered	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Phaethon lepturus fulvus Christmas Island White-tailed Tropicbird, Golden Bosunbird [26021]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Phaethon rubricauda westralis Red-tailed Tropicbird (Indian Ocean), Indian Ocean Red-tailed Tropicbird [91824]	Endangered	Breeding known to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
MAMMAL		

Scientific Name	Threatened Category	Presence Text
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
REPTILE		
Aipysurus apraefrontalis Short-nosed Sea Snake, Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus foliosquama Leaf-scaled Sea Snake, Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat may occur within area
Aipysurus fuscus Dusky Sea Snake [1119]	Endangered	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Scientific Name	Threatened Category	Presence Text
Lepidochelys olivacea		
Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
SHARK		
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Glyphis garricki		
Northern River Shark, New Guinea River Shark [82454]	Endangered	Species or species habitat may occur within area
Pristis clavata		
Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis pristis		
Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area
Pristis zijsron		
Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sphyrna lewini		
Scalloped Hammerhead [85267]	Conservation Dependent	Species or species habitat known to occur within area

Listed Migratory Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Anous stolidus		
Common Noddy [825]		Breeding known to occur within area

Scientific Name	Threatened Category	Presence Text
Ardenna pacifica Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Breeding known to occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Onychoprion anaethetus Bridled Tern [82845]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding known to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sternula albifrons Little Tern [82849]		Congregation or aggregation known to occur within area
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Migratory Marine Species		

Scientific Name	Threatened Category	Presence Text
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area
Carcharias taurus Grey Nurse Shark [64469]		Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Scientific Name	Threatened Category	Presence Text
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area
Megaptera novaeangliae Humpback Whale [38]		Breeding known to occur within area
Mobula alfredi as Manta alfredi Reef Manta Ray, Coastal Manta Ray [90033]		Species or species habitat known to occur within area
Mobula birostris as Manta birostris Giant Manta Ray [90034]		Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Scientific Name	Threatened Category	Presence Text
Orcaella heinsohni Australian Snubfin Dolphin [81322]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa sahulensis as Sousa chinensis Australian Humpback Dolphin [87942]		Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cecropis daurica Red-rumped Swallow [80610]		Species or species habitat may occur within area
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat known to occur within area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Limosa lapponica		
Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Thalasseus bergii		
Greater Crested Tern [83000]		Breeding known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State
Unknown	
Commonwealth Land - [52276]	ACI
Commonwealth Land - [52278]	ACI
Commonwealth Land - [52277]	ACI

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Ashmore Reef National Nature Reserve	EXT	Listed place
Scott Reef and Surrounds - Commonwealth Area	EXT	Listed place

Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text
Bird		
Acrocephalus orientalis		
Oriental Reed-Warbler [59570]		Species or species habitat known to occur within area overfly marine area
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Anous minutus Black Noddy [824]		Breeding known to occur within area
Anous stolidus Common Noddy [825]		Breeding known to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Breeding known to occur within area
Ardenna pacifica as Puffinus pacificus Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Cecropis daurica as Hirundo daurica Red-rumped Swallow [80610]		Species or species habitat may occur within area overfly marine area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Breeding known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area overfly marine area
Hydroprogne caspia as Sterna caspia Caspian Tern [808]		Breeding known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat known to occur within area overfly marine area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area overfly marine area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Onychoprion anaethetus as Sterna anaethetus Bridled Tern [82845]		Breeding known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding known to occur within area
Phaethon lepturus fulvus Christmas Island White-tailed Tropicbird, Golden Bosunbird [26021]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sternula albifrons as Sterna albifrons Little Tern [82849]		Congregation or aggregation known to occur within area
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Thalasseus bengalensis as Sterna bengalensis Lesser Crested Tern [66546]		Breeding known to occur within area
Thalasseus bergii as Sterna bergii Greater Crested Tern [83000]		Breeding known to occur within area
Fish		
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammal		
Dugong dugon Dugong [28]		Breeding known to occur within area
Reptile		
Aipysurus apraefrontalis Short-nosed Sea Snake, Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus duboisii Dubois' Sea Snake, Dubois' Seasnake, Reef Shallows Sea Snake [1116]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Aipysurus foliosquama Leaf-scaled Sea Snake, Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat may occur within area
Aipysurus fuscus Dusky Sea Snake [1119]	Endangered	Species or species habitat known to occur within area
Aipysurus laevis Olive Sea Snake, Olive-brown Sea Snake [1120]		Species or species habitat may occur within area
Aipysurus mosaicus as Aipysurus eydouxii Mosaic Sea Snake [87261]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Sea Snake, Mjoberg's Sea Snake [1121]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Emydocephalus annulatus Eastern Turtle-headed Sea Snake [1125]		Species or species habitat may occur within area
Ephalophis greyae as Ephalophis greyi Mangrove Sea Snake [93738]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Hydrelaps darwiniensis Port Darwin Sea Snake, Black-ringed Mangrove Sea Snake [1100]		Species or species habitat may occur within area
Hydrophis atriceps Black-headed Sea Snake [1101]		Species or species habitat may occur within area
Hydrophis coggeri Cogger's Sea Snake [25925]		Species or species habitat may occur within area
Hydrophis elegans Elegant Sea Snake, Bar-bellied Sea Snake [1104]		Species or species habitat may occur within area
Hydrophis hardwickii as Lapemis hardwickii Spine-bellied Sea Snake [93516]		Species or species habitat may occur within area
Hydrophis inornatus Plain Sea Snake [1107]		Species or species habitat may occur within area
Hydrophis kingii as Disteira kingii Spectacled Sea Snake [93511]		Species or species habitat may occur within area
Hydrophis macdowelli as Hydrophis mcdowelli MacDowell's Sea Snake, Small-headed Sea Snake, [75601]		Species or species habitat may occur within area
Hydrophis major as Disteira major Olive-headed Sea Snake [93512]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Sea Snake, Ornate Reef Sea Snake [1111]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Hydrophis peronii as Acalyptophis peronii Horned Sea Snake [93509]		Species or species habitat may occur within area
Hydrophis platura as Pelamis platurus Yellow-bellied Sea Snake [93746]		Species or species habitat may occur within area
Hydrophis stokesii as Astrotia stokesii Stokes' Sea Snake [93510]		Species or species habitat may occur within area
Hydrophis zweiffei as Enhydrina schistosa Australian Beaked Sea Snake [93514]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Whales and Other Cetaceans		[Resource Information]
Current Scientific Name	Status	Type of Presence
Mammal		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Current Scientific Name	Status	Type of Presence
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Indopacetus pacificus Longman's Beaked Whale [72]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia sima Dwarf Sperm Whale [85043]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]		Breeding known to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon ginkgodens Gingko-toothed Beaked Whale, Gingko-toothed Whale, Gingko Beaked Whale [59564]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
Orcaella heinsohni Australian Snubfin Dolphin [81322]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa sahulensis Australian Humpback Dolphin [87942]		Species or species habitat may occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area

Current Scientific Name	Status	Type of Presence
Tursiops aduncus (Arafura/Timor Sea populations)		
Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat likely to occur within area
Tursiops truncatus s. str.		
Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris		
Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks	[Resource Information]
Park Name	Zone & IUCN Categories
Kimberley	Habitat Protection Zone (IUCN IV)
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)
Kimberley	Multiple Use Zone (IUCN VI)
Oceanic Shoals	Multiple Use Zone (IUCN VI)
Argo-Rowley Terrace	National Park Zone (IUCN II)
Ashmore Reef	Recreational Use Zone (IUCN IV)
Ashmore Reef	Sanctuary Zone (IUCN Ia)
Cartier Island	Sanctuary Zone (IUCN Ia)
Argo-Rowley Terrace	Special Purpose Zone (Trawl) (IUCN VI)
Oceanic Shoals	Special Purpose Zone (Trawl) (IUCN VI)

Habitat Critical to the Survival of Marine Turtles		[Resource Information]
Scientific Name	Behaviour	Presence
Dec - Jan		
Chelonia mydas		
Green Turtle [1765]	Nesting	Known to occur

Extra Information

State and Territory Reserves		[Resource Information]
Protected Area Name	Reserve Type	State
Browse Island	Nature Reserve	WA
North Kimberley	Marine Park	WA
Scott Reef	Nature Reserve	WA
Unnamed WA41775	5(1)(h) Reserve	WA

Nationally Important Wetlands	[Resource Information]
Wetland Name	State
Ashmore Reef	EXT

EPBC Act Referrals			[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status
Browse to North West Shelf Development, Indian Ocean, WA	2018/8319		Approval
Marine Route Survey for Subsea Fibre Optic Data Cable System - Australia West	2024/09826		Completed
Northern Endeavour Phase 1 Decommissioning	2022/09327		Post-Approval
Project Crux Cable Lay and Operation	2022/09441		Completed
Project Fitzroy Expansion Offshore Cable Lay	2023/09674		Referral Decision
Controlled action			
2-D seismic survey Scott Reef	2000/125	Controlled Action	Post-Approval
Audacious Oil Field Standalone Development	2001/407	Controlled Action	Completed
Browse FLNG Development, Commonwealth Waters	2013/7079	Controlled Action	Post-Approval
Conduct an exploration drilling campaign	2010/5718	Controlled Action	Completed
Decommissioning of Buffalo Oil Field	2003/984	Controlled Action	Post-Approval
Decommissioning of Challis Oilfield	2003/942	Controlled Action	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Develop Ichthys gas-condensate field permit area W	2006/2767	Controlled Action	Completed
Development of Browse Basin Gas Fields (Upstream)	2008/4111	Controlled Action	Completed
Ichthys Gas Field, Offshore and onshore processing facilities and subsea pipeline	2008/4208	Controlled Action	Post-Approval
Montara 4, 5, and 6 Oil Production Wells, and Montara 3 Gas Re-Injection Well	2002/755	Controlled Action	Post-Approval
Prelude Floating Liquefied Natural Gas Facility and Gas Field Development	2008/4146	Controlled Action	Post-Approval
PTTEP AA Floating LNG Facility	2011/6025	Controlled Action	Completed
Torosa South Initial Appraisal Drilling	2007/3500	Controlled Action	Completed
Not controlled action			
3D marine seismic survey in WA 314P and WA 315P	2004/1927	Not Controlled Action	Completed
Adele Trend TQ3D Seismic Survey	2001/252	Not Controlled Action	Completed
AEC International Hydrocarbon Well Puffin 6	2000/36	Not Controlled Action	Completed
Audacious-3 oil drilling well	2003/1042	Not Controlled Action	Completed
Backpacker-1 Offshore Hydrocarbon Exploration Well	2001/300	Not Controlled Action	Completed
Buffalo In-Fill Production Wells	2001/475	Not Controlled Action	Completed
Controlled Source Electromagnetic 2D Survey	2009/4980	Not Controlled Action	Completed
Controlled Source Electromagnetic Survey	2010/5434	Not Controlled Action	Completed
Coot-1 hydrocarbon exploration well, Permit Area AC/L2 or AC/L3	2001/296	Not Controlled Action	Completed
Crux-A and Crux-B appraisal wells, Petroleum Permit Area AC/P23	2006/2748	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Crux gas-liquids development in permit AC/P23	2006/3154	Not Controlled Action	Completed
Drilling of 12 Hydrocarbon Exploration Wells, Permit Area WA-371-P	2006/3005	Not Controlled Action	Completed
Drilling of exploration well Audacious-1 in AC/P17	2000/5	Not Controlled Action	Completed
Drilling of exploration wells, Permit areas WA-301-P to WA-305-P	2002/769	Not Controlled Action	Completed
Echuca Shoals-2 Exploration of Appraisal Well	2006/3020	Not Controlled Action	Completed
Exploration Drilling in AC/P17, AC/P18 and AC/P24	2001/359	Not Controlled Action	Completed
Exploration Well AC/P23	2001/234	Not Controlled Action	Completed
Kaleidoscope exploration well	2001/182	Not Controlled Action	Completed
Marine Seismic Survey in WA-239-P	2000/24	Not Controlled Action	Completed
Marine Survey for the Australia-ASEAN Power Link AAPL	2020/8714	Not Controlled Action	Completed
Montara-3 Offshore Hydrocarbon Exploration Well Permit Area AC/RL3	2001/489	Not Controlled Action	Completed
P30 Hydrocarbon Exploration Well	2001/293	Not Controlled Action	Completed
Project Highclere Geophysical Survey	2021/9023	Not Controlled Action	Completed
Puffin Oil wells 7, 8 & 9 development	2005/2336	Not Controlled Action	Completed
Saucepan 1 Exploration Well ACP23	2000/2	Not Controlled Action	Completed
Skua and Swift Oilfields	2006/3195	Not Controlled Action	Completed
Strumbo-1 Gas Exploration Well Permit Area WA-288-P	2002/884	Not Controlled Action	Completed
Not controlled action (particular manner)			
2 (3D) Marine Seismic Surveys	2009/4994	Not Controlled Action (Particular	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
2D and 3D Seismic Survey	2011/6197	Not Controlled Action (Particular Manner)	Post-Approval
2D and 3D Seismic Survey WA-405-P	2009/5104	Not Controlled Action (Particular Manner)	Post-Approval
2D and 3D Seismic Survey WA-405-P	2008/4133	Not Controlled Action (Particular Manner)	Post-Approval
2D Marine Seismic Survey	2009/4728	Not Controlled Action (Particular Manner)	Post-Approval
2D marine seismic survey of Braveheart,Kurrajong,Sunshine and Crocodile	2006/2917	Not Controlled Action (Particular Manner)	Post-Approval
2D or 3D Marine Seismic Survey in Petroleum Permit Area AC/P35	2009/4864	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Marine Survey	2001/363	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic survey	2009/5076	Not Controlled Action (Particular Manner)	Post-Approval
2D seismic survey in permit areas WA-274P and WA-281P	2004/1521	Not Controlled Action (Particular Manner)	Post-Approval
2 geotechnical surveys - preliminary and final	2006/2886	Not Controlled Action (Particular Manner)	Post-Approval
3D Marine Seismic Survey	2008/4437	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
3D Marine Seismic Survey, Permit AC/P 23	2005/2364	Not Controlled Action (Particular Manner)	Post-Approval
3D marine seismic Survey - Maxima 3D MSS	2006/2945	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey, Browse Basin, WA	2009/5048	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey, near Scott Reef, Browse Basin	2005/2126	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey, petroleum exploration permit AC/P33	2006/2918	Not Controlled Action (Particular Manner)	Post-Approval
3D seismic survey of AC/P4, AC/P17 and AC/P24	2006/2857	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey WA-406-P Bonaparte Basin	2007/3904	Not Controlled Action (Particular Manner)	Post-Approval
AC/P37 3D Seismic Survey Ashmore Cartier	2007/3774	Not Controlled Action (Particular Manner)	Post-Approval
Auralandia 3D marine seismic survey	2011/5961	Not Controlled Action (Particular Manner)	Post-Approval
Aurora MC3D Marine Seismic Survey	2010/5510	Not Controlled Action (Particular Manner)	Post-Approval
Bassett 3D Marine Seismic Survey	2010/5538	Not Controlled Action (Particular Manner)	Post-Approval
Bonaparte 2D & 3D marine seismic survey	2011/5962	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Braveheart 2D Infill Marine Seismic Survey 100km offshore	2008/4442	Not Controlled Action (Particular Manner)	Post-Approval
Braveheart 2D Marine Seismic Survey	2005/2322	Not Controlled Action (Particular Manner)	Post-Approval
Canis 3D Marine Seismic Survey	2008/4492	Not Controlled Action (Particular Manner)	Post-Approval
Cartier East and Cartier West 3D Marine Seismic Surveys	2009/5230	Not Controlled Action (Particular Manner)	Post-Approval
Caswell MC3D Marine Seismic Survey	2012/6594	Not Controlled Action (Particular Manner)	Post-Approval
Conduct an exploration drilling campaign	2011/5964	Not Controlled Action (Particular Manner)	Post-Approval
Deep Water Northwest Shelf 2D Seismic Survey	2007/3260	Not Controlled Action (Particular Manner)	Post-Approval
Dillon South-1 Exploration Well Drilling - AC/P4, Territory of Ashmore/Cartier	2013/6849	Not Controlled Action (Particular Manner)	Post-Approval
Drilling of Audacious-5 appraisal well	2008/4327	Not Controlled Action (Particular Manner)	Post-Approval
Drilling of Exploration & Appraisal Wells Braveheart-1 & Cornea-3	2009/5160	Not Controlled Action (Particular Manner)	Post-Approval
Drilling of two appraisal wells	2011/5840	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Endurance 3D Marine Seismic Data Acquisition Survey	2007/3667	Not Controlled Action (Particular Manner)	Post-Approval
Exploration Drilling Campaign	2011/6047	Not Controlled Action (Particular Manner)	Post-Approval
Exploration Drilling Campaign, Browse Basin, WA-341-P, AC-P36 and WA-343-P	2013/6898	Not Controlled Action (Particular Manner)	Post-Approval
Exploration Drilling in Permit Areas WA-402-P & WA-403-P	2010/5297	Not Controlled Action (Particular Manner)	Post-Approval
Exploration Drilling Program - Permit areas - WA-314-P, WA-315-P, WA-398-P.	2008/4064	Not Controlled Action (Particular Manner)	Post-Approval
Geoscience Australia - Marine survey in Browse Basin to acquire data to assist assessment of CO2 sto	2013/6747	Not Controlled Action (Particular Manner)	Post-Approval
Gicea 3D Marine Seismic Survey	2008/4389	Not Controlled Action (Particular Manner)	Post-Approval
Gigas 2D Pilot Ocean Bottom Cable Marine Seismic Survey	2007/3839	Not Controlled Action (Particular Manner)	Post-Approval
Gold 2D Marine Seismic Survey Permit Areas WA375P and WA376P	2009/4698	Not Controlled Action (Particular Manner)	Post-Approval
Ichthys 3D Marine Seismic Survey	2010/5550	Not Controlled Action (Particular Manner)	Post-Approval
Kingtree & Ironstone-1 Exploration Wells	2011/5935	Not Controlled Action (Particular Manner)	Post-Approval
Koolama 2D Seismic Survey Dampier Basin	2010/5420	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Kraken, Lusca & Asperus 3D Marine Seismic Survey	2013/6730	Not Controlled Action (Particular Manner)	Post-Approval
Malita West 3D Seismic Survey WA-402-P and WA-403-P	2007/3936	Not Controlled Action (Particular Manner)	Post-Approval
Mariner Non-Exclusive 2D Seismic Survey	2011/6172	Not Controlled Action (Particular Manner)	Post-Approval
Octantis 3D Marine Seismic Survey, Permit Area AC/P41 off northern Western Australia	2007/3369	Not Controlled Action (Particular Manner)	Post-Approval
Offshore Exploration Drilling Campaign	2011/6222	Not Controlled Action (Particular Manner)	Post-Approval
Offshore Fibre Optic Cable Network Construction & Operation, Port Hedland WA to Darwin NT	2014/7223	Not Controlled Action (Particular Manner)	Post-Approval
Offshore Gas Exploration Drilling Campaign	2012/6384	Not Controlled Action (Particular Manner)	Post-Approval
Outer Canning exploration drilling program off NW coast of WA	2012/6618	Not Controlled Action (Particular Manner)	Post-Approval
Pilot Appraisal Well - Torosa South 1	2008/3991	Not Controlled Action (Particular Manner)	Post-Approval
Rosebud 3D Marine Seismic Survey in WA-30-R and TR/5	2012/6493	Not Controlled Action (Particular Manner)	Post-Approval
Sandalford 3D Seismic Survey	2012/6261	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Schild MC3D Marine Seismic Survey	2012/6373	Not Controlled Action (Particular Manner)	Post-Approval
Schild Phase 11 MC3D Marine Seismic Survey, Browse Basin	2013/6894	Not Controlled Action (Particular Manner)	Post-Approval
Scott Reef Seismic Research	2006/2647	Not Controlled Action (Particular Manner)	Post-Approval
Searcher bathymetry & geochemical seismic survey, Brawse Basin,Timor Sea,WA	2013/6980	Not Controlled Action (Particular Manner)	Post-Approval
Songa Venus Drilling and Testing Operations	2009/5122	Not Controlled Action (Particular Manner)	Post-Approval
Songa Venus Drilling Programme, Bonaparte Basin	2009/4990	Not Controlled Action (Particular Manner)	Post-Approval
Sunshine Infill 2D and Mimosa 2D Marine Seismic Surveys	2009/4699	Not Controlled Action (Particular Manner)	Post-Approval
Thoar 3D Marine Seismic Survey	2010/5668	Not Controlled Action (Particular Manner)	Post-Approval
Tiffany 3D Seismic Survey	2010/5339	Not Controlled Action (Particular Manner)	Post-Approval
Torosa-5 Apraisal Well, WA-30-R	2008/4430	Not Controlled Action (Particular Manner)	Post-Approval
Tow West Atlas wreck from present location to boundary of EEZ	2010/5652	Not Controlled Action (Particular Manner)	Post-Approval
Tridacna 3D Ocean Bottom Cable Marine Seismic Survey	2011/5959	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Ursa 3D Marine Seismic Survey	2008/4634	Not Controlled Action (Particular Manner)	Post-Approval
Vampire 2D Non Exclusive Seismic Survey, WA	2010/5543	Not Controlled Action (Particular Manner)	Post-Approval
Veritas Voyager 2D Marine Seismic Survey	2009/5151	Not Controlled Action (Particular Manner)	Post-Approval
Westralia SPAN Marine Seismic Survey, WA & NT	2012/6463	Not Controlled Action (Particular Manner)	Post-Approval
Woodside Southern Browse 3D Seismic Survey, WA	2007/3534	Not Controlled Action (Particular Manner)	Post-Approval
Zeemeermin MC3D seismic survey, Browse Basin, Offshore WA	2009/5023	Not Controlled Action (Particular Manner)	Post-Approval
Zeppelin 3D Seismic Survey	2011/6148	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			
2D Marine Seismic Survey	2008/4623	Referral Decision	Completed
Aurora extension MC3D Marine Seismic Survey	2011/5887	Referral Decision	Completed
BRSN08 3D Marine Seismic Survey	2008/4582	Referral Decision	Completed
Experimental Study of Behavioural and Physiological Impact on Fish of Seismic Ex	2006/2625	Referral Decision	Completed
Pilot Appraisal Well - Torosa South-1	2008/3985	Referral Decision	Completed
Puffin South-West Development of Oil Reserves	2007/3834	Referral Decision	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Referral decision			
Seismic Data Acquisition, Browse Basin	2010/5475	Referral Decision	Completed

Key Ecological Features [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Ancient coastline at 125 m depth contour	North-west
Ashmore Reef and Cartier Island and surrounding Commonwealth waters	North-west
Canyons linking the Argo Abyssal Plain with the Scott Plateau	North-west
Carbonate bank and terrace system of the Sahul Shelf	North-west
Carbonate bank and terrace system of the Van Diemen Rise	North
Continental Slope Demersal Fish Communities	North-west
Mermaid Reef and Commonwealth waters surrounding Rowley Shoals	North-west
Pinnacles of the Bonaparte Basin	North-west
Pinnacles of the Bonaparte Basin	North
Seringapatam Reef and Commonwealth waters in the Scott Reef Complex	North-west

Biologically Important Areas [Resource Information]

Scientific Name	Behaviour	Presence
Dugong		
Dugong dugon Dugong [28]	Breeding	Known to occur
Dugong dugon Dugong [28]	Calving	Known to occur
Dugong dugon Dugong [28]	Foraging	Known to occur
Dugong dugon Dugong [28]	Foraging (high density seagrass	Known to occur

Scientific Name	Behaviour	Presence
	beds)	
Dugong dugon Dugong [28]	Nursing	Known to occur
Marine Turtles		
Caretta caretta Loggerhead Turtle [1763]	Foraging	Known to occur
Chelonia mydas Green Turtle [1765]	Foraging	Likely to occur
Chelonia mydas Green Turtle [1765]	Internesting	Known to occur
Chelonia mydas Green Turtle [1765]	Internesting	Likely to occur
Chelonia mydas Green Turtle [1765]	Internesting buffer	Likely to occur
Chelonia mydas Green Turtle [1765]	Internesting buffer	Known to occur
Chelonia mydas Green Turtle [1765]	Mating	Likely to occur
Chelonia mydas Green Turtle [1765]	Nesting	Likely to occur
Chelonia mydas Green Turtle [1765]	Nesting	Known to occur
Eretmochelys imbricata Hawksbill Turtle [1766]	Foraging	Likely to occur
Eretmochelys imbricata Hawksbill Turtle [1766]	Internesting buffer	Likely to occur
Eretmochelys imbricata Hawksbill Turtle [1766]	Internesting buffer	Known to occur
Eretmochelys imbricata Hawksbill Turtle [1766]	Nesting	Known to occur

Scientific Name	Behaviour	Presence
Eretmochelys imbricata Hawksbill Turtle [1766]	Nesting	Likely to occur
Lepidochelys olivacea Olive Ridley Turtle [1767]	Foraging	Known to occur
Natator depressus Flatback Turtle [59257]	Foraging	Known to occur
Seabirds		
Ardenna pacifica Wedge-tailed Shearwater [84292]	Breeding	Known to occur
Fregata ariel Lesser Frigatebird [1012]	Breeding	Known to occur
Fregata minor Greater Frigatebird [1013]	Breeding	Known to occur
Phaethon lepturus White-tailed Tropicbird [1014]	Breeding	Known to occur
Sterna dougallii Roseate Tern [817]	Breeding	Known to occur
Sternula albifrons sinensis Little Tern [82850]	Resting	Known to occur
Sula leucogaster Brown Booby [1022]	Breeding	Known to occur
Sula sula Red-footed Booby [1023]	Breeding	Known to occur
Thalasseus bengalensis Lesser Crested Tern [66546]	Breeding	Known to occur
Sharks		
Rhincodon typus Whale Shark [66680]	Foraging	Known to occur
Whales		
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging	Known to occur

Scientific Name	Behaviour	Presence
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Migration	Known to occur
Megaptera novaeangliae Humpback Whale [38]	Calving	Known to occur
Megaptera novaeangliae Humpback Whale [38]	Migration	Known to occur
Megaptera novaeangliae Humpback Whale [38]	Nursing	Known to occur
Megaptera novaeangliae Humpback Whale [38]	Resting	Known to occur

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data is available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on the contents of this report.

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions when time permits.

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded breeding sites; and
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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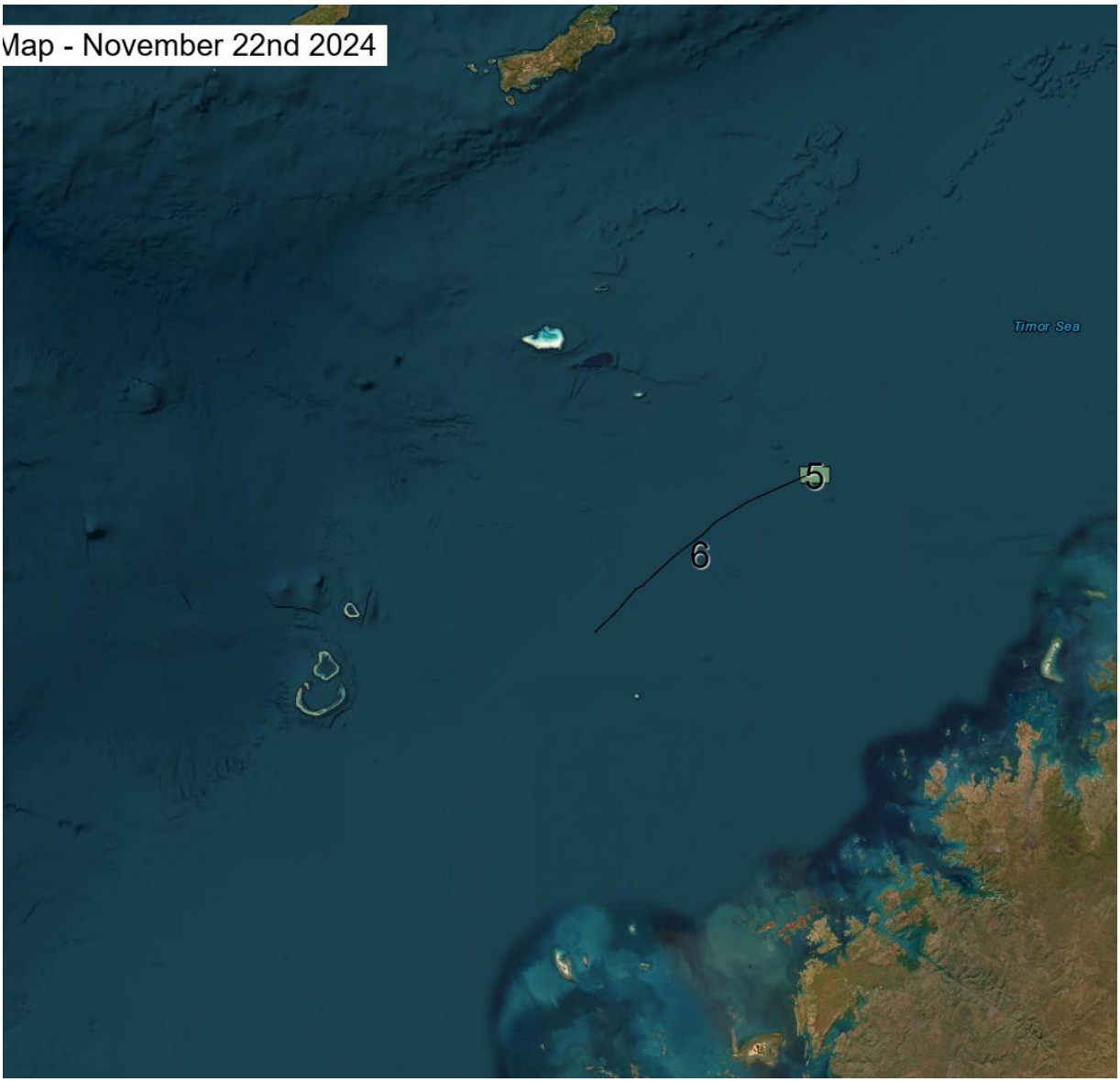
F.2: Protected Matters Report (Activity Area)

Input data:



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 22-Nov-2024

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	26
Listed Migratory Species:	37

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	70
Whales and Other Cetaceans:	25
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	1

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	43
Key Ecological Features (Marine):	2
Biologically Important Areas:	5
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name
Commonwealth Marine Areas (EPBC Act)
Commonwealth Marine Areas (EPBC Act)

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris canutus		
Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Papasula abbotti		
Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Phaethon lepturus fulvus		
Christmas Island White-tailed Tropicbird, Golden Bosunbird [26021]	Endangered	Species or species habitat may occur within area
Phaethon rubricauda westralis		
Red-tailed Tropicbird (Indian Ocean), Indian Ocean Red-tailed Tropicbird [91824]	Endangered	Species or species habitat likely to occur within area
MAMMAL		
Balaenoptera borealis		
Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus		
Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
REPTILE		
Aipysurus apraefrontalis		
Short-nosed Sea Snake, Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
Aipysurus foliosquama		
Leaf-scaled Sea Snake, Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat may occur within area
Aipysurus fuscus		
Dusky Sea Snake [1119]	Endangered	Species or species habitat known to occur within area
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Scientific Name	Threatened Category	Presence Text
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Lepidochelys olivacea		
Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
SHARK		
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Glyphis garricki		
Northern River Shark, New Guinea River Shark [82454]	Endangered	Species or species habitat may occur within area
Pristis pristis		
Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area
Pristis zijsron		
Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sphyrna lewini		
Scalloped Hammerhead [85267]	Conservation Dependent	Species or species habitat likely to occur within area

Listed Migratory Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		

Scientific Name	Threatened Category	Presence Text
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Foraging, feeding or related behaviour likely to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat likely to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area
Carcharias taurus Grey Nurse Shark [64469]		Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat known to occur within area
Mobula alfredi as Manta alfredi Reef Manta Ray, Coastal Manta Ray [90033]		Species or species habitat likely to occur within area
Mobula birostris as Manta birostris Giant Manta Ray [90034]		Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area overfly marine area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Foraging, feeding or related behaviour likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat likely to occur within area
Phaethon lepturus fulvus Christmas Island White-tailed Tropicbird, Golden Bosunbird [26021]	Endangered	Species or species habitat may occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area

Scientific Name	Threatened Category	Presence Text
Fish		
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Reptile		
Aipysurus apraefrontalis Short-nosed Sea Snake, Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
Aipysurus duboisii Dubois' Sea Snake, Dubois' Seasnake, Reef Shallows Sea Snake [1116]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Aipysurus foliosquama		
Leaf-scaled Sea Snake, Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat may occur within area
Aipysurus fuscus		
Dusky Sea Snake [1119]	Endangered	Species or species habitat known to occur within area
Aipysurus laevis		
Olive Sea Snake, Olive-brown Sea Snake [1120]		Species or species habitat may occur within area
Aipysurus mosaicus as Aipysurus eydouxii		
Mosaic Sea Snake [87261]		Species or species habitat may occur within area
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Emydocephalus annulatus		
Eastern Turtle-headed Sea Snake [1125]		Species or species habitat may occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Hydrophis coggeri		
Cogger's Sea Snake [25925]		Species or species habitat may occur within area
Hydrophis elegans		
Elegant Sea Snake, Bar-bellied Sea Snake [1104]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Hydrophis hardwickii as Lapemis hardwickii Spine-bellied Sea Snake [93516]		Species or species habitat may occur within area
Hydrophis kingii as Disteira kingii Spectacled Sea Snake [93511]		Species or species habitat may occur within area
Hydrophis macdowelli as Hydrophis mcdowelli MacDowell's Sea Snake, Small-headed Sea Snake, [75601]		Species or species habitat may occur within area
Hydrophis major as Disteira major Olive-headed Sea Snake [93512]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Sea Snake, Ornate Reef Sea Snake [1111]		Species or species habitat may occur within area
Hydrophis peronii as Acalyptophis peronii Horned Sea Snake [93509]		Species or species habitat may occur within area
Hydrophis platura as Pelamis platurus Yellow-bellied Sea Snake [93746]		Species or species habitat may occur within area
Hydrophis stokesii as Astrotia stokesii Stokes' Sea Snake [93510]		Species or species habitat may occur within area
Hydrophis zweiffei as Enhydrina schistosa Australian Beaked Sea Snake [93514]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area

Whales and Other Cetaceans

[Resource Information]

Current Scientific Name	Status	Type of Presence
Mammal		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia sima Dwarf Sperm Whale [85043]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
[Megaptera novaeangliae](#) Humpback Whale [38]		Species or species habitat known to occur within area
[Mesoplodon densirostris](#) Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
[Orcinus orca](#) Killer Whale, Orca [46]		Species or species habitat may occur within area
[Peponocephala electra](#) Melon-headed Whale [47]		Species or species habitat may occur within area
[Physeter macrocephalus](#) Sperm Whale [59]		Species or species habitat may occur within area
[Pseudorca crassidens](#) False Killer Whale [48]		Species or species habitat likely to occur within area
[Stenella attenuata](#) Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
[Stenella coeruleoalba](#) Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
[Stenella longirostris](#) Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
[Steno bredanensis](#) Rough-toothed Dolphin [30]		Species or species habitat may occur within area
[Tursiops aduncus](#) Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area

Current Scientific Name	Status	Type of Presence
Tursiops aduncus (Arafura/Timor Sea populations)		
Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Tursiops truncatus s. str.		
Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris		
Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Habitat Critical to the Survival of Marine Turtles		[Resource Information]
Scientific Name	Behaviour	Presence
Dec - Jan		
Chelonia mydas		
Green Turtle [1765]	Nesting	Known to occur

Extra Information

EPBC Act Referrals			[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status
Marine Route Survey for Subsea Fibre Optic Data Cable System - Australia West	2024/09826		Completed
Project Crux Cable Lay and Operation	2022/09441		Completed
Controlled action			
Develop Ichthys gas-condensate field permit area W	2006/2767	Controlled Action	Completed
Development of Browse Basin Gas Fields (Upstream)	2008/4111	Controlled Action	Completed
Ichthys Gas Field, Offshore and onshore processing facilities and subsea pipeline	2008/4208	Controlled Action	Post-Approval
Prelude Floating Liquefied Natural Gas Facility and Gas Field Development	2008/4146	Controlled Action	Post-Approval
Not controlled action			

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Adele Trend TQ3D Seismic Survey	2001/252	Not Controlled Action	Completed
Crux-A and Crux-B appraisal wells, Petroleum Permit Area AC/P23	2006/2748	Not Controlled Action	Completed
Crux gas-liquids development in permit AC/P23	2006/3154	Not Controlled Action	Completed
Drilling of 12 Hydrocarbon Exploration Wells, Permit Area WA-371-P	2006/3005	Not Controlled Action	Completed
Echuca Shoals-2 Exploration of Appraisal Well	2006/3020	Not Controlled Action	Completed
Exploration Well AC/P23	2001/234	Not Controlled Action	Completed
Kaleidoscope exploration well	2001/182	Not Controlled Action	Completed
Project Highclere Geophysical Survey	2021/9023	Not Controlled Action	Completed
Saucepan 1 Exploration Well ACP23	2000/2	Not Controlled Action	Completed
Not controlled action (particular manner)			
2D Marine Seismic Survey	2009/4728	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Marine Survey	2001/363	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic survey	2009/5076	Not Controlled Action (Particular Manner)	Post-Approval
2D seismic survey in permit areas WA-274P and WA-281P	2004/1521	Not Controlled Action (Particular Manner)	Post-Approval
3D Marine Seismic Survey, Permit AC/P 23	2005/2364	Not Controlled Action (Particular Manner)	Post-Approval
AC/P37 3D Seismic Survey Ashmore Cartier	2007/3774	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Aurora MC3D Marine Seismic Survey	2010/5510	Not Controlled Action (Particular Manner)	Post-Approval
Bassett 3D Marine Seismic Survey	2010/5538	Not Controlled Action (Particular Manner)	Post-Approval
Braveheart 2D Infill Marine Seismic Survey 100km offshore	2008/4442	Not Controlled Action (Particular Manner)	Post-Approval
Braveheart 2D Marine Seismic Survey	2005/2322	Not Controlled Action (Particular Manner)	Post-Approval
Canis 3D Marine Seismic Survey	2008/4492	Not Controlled Action (Particular Manner)	Post-Approval
Cartier East and Cartier West 3D Marine Seismic Surveys	2009/5230	Not Controlled Action (Particular Manner)	Post-Approval
Caswell MC3D Marine Seismic Survey	2012/6594	Not Controlled Action (Particular Manner)	Post-Approval
Deep Water Northwest Shelf 2D Seismic Survey	2007/3260	Not Controlled Action (Particular Manner)	Post-Approval
Exploration Drilling Campaign	2011/6047	Not Controlled Action (Particular Manner)	Post-Approval
Exploration Drilling Campaign, Browse Basin, WA-341-P, AC-P36 and WA-343-P	2013/6898	Not Controlled Action (Particular Manner)	Post-Approval
Gicea 3D Marine Seismic Survey	2008/4389	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Ichthys 3D Marine Seismic Survey	2010/5550	Not Controlled Action (Particular Manner)	Post-Approval
Kingtree & Ironstone-1 Exploration Wells	2011/5935	Not Controlled Action (Particular Manner)	Post-Approval
Octantis 3D Marine Seismic Survey, Permit Area AC/P41 off northern Western Australia	2007/3369	Not Controlled Action (Particular Manner)	Post-Approval
Offshore Fibre Optic Cable Network Construction & Operation, Port Hedland WA to Darwin NT	2014/7223	Not Controlled Action (Particular Manner)	Post-Approval
Schild Phase 11 MC3D Marine Seismic Survey, Browse Basin	2013/6894	Not Controlled Action (Particular Manner)	Post-Approval
Vampire 2D Non Exclusive Seismic Survey, WA	2010/5543	Not Controlled Action (Particular Manner)	Post-Approval
Westralia SPAN Marine Seismic Survey, WA & NT	2012/6463	Not Controlled Action (Particular Manner)	Post-Approval
Zeppelin 3D Seismic Survey	2011/6148	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			
2D Marine Seismic Survey	2008/4623	Referral Decision	Completed
BRSN08 3D Marine Seismic Survey	2008/4582	Referral Decision	Completed
Seismic Data Acquisition, Browse Basin	2010/5475	Referral Decision	Completed

Key Ecological Features [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region

Name	Region
Ancient coastline at 125 m depth contour	North-west
Continental Slope Demersal Fish Communities	North-west

Biologically Important Areas

[Resource Information]

Scientific Name	Behaviour	Presence
Seabirds		
Ardenna pacifica Wedge-tailed Shearwater [84292]	Breeding	Known to occur
Fregata ariel Lesser Frigatebird [1012]	Breeding	Known to occur
Fregata minor Greater Frigatebird [1013]	Breeding	Known to occur
Sula sula Red-footed Booby [1023]	Breeding	Known to occur
Sharks		
Rhincodon typus Whale Shark [66680]	Foraging	Known to occur

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data is available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on the contents of this report.

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions when time permits.

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded breeding sites; and
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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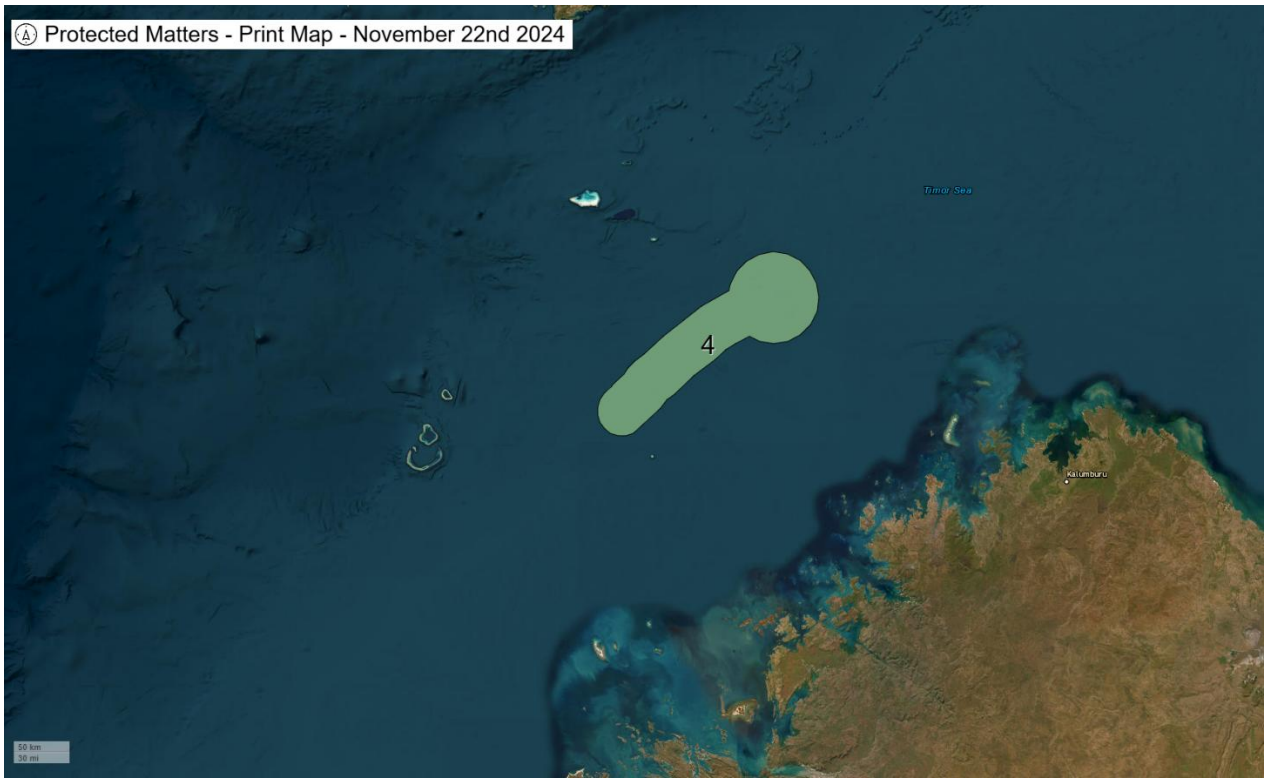
F.3: Protected Matters Report (Light Assessment Area)

Input data:



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 22-Nov-2024

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	26
Listed Migratory Species:	37

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	70
Whales and Other Cetaceans:	25
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	1

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	53
Key Ecological Features (Marine):	2
Biologically Important Areas:	6
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name
Commonwealth Marine Areas (EPBC Act)
Commonwealth Marine Areas (EPBC Act)

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris canutus		
Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Papasula abbotti		
Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
[Phaethon lepturus fulvus](#) Christmas Island White-tailed Tropicbird, Golden Bosunbird [26021]	Endangered	Foraging, feeding or related behaviour likely to occur within area
[Phaethon rubricauda westralis](#) Red-tailed Tropicbird (Indian Ocean), Indian Ocean Red-tailed Tropicbird [91824]	Endangered	Species or species habitat likely to occur within area
MAMMAL		
[Balaenoptera borealis](#) Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
[Balaenoptera musculus](#) Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
[Balaenoptera physalus](#) Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
REPTILE		
[Aipysurus apraefrontalis](#) Short-nosed Sea Snake, Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
[Aipysurus foliosquama](#) Leaf-scaled Sea Snake, Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat may occur within area
[Aipysurus fuscus](#) Dusky Sea Snake [1119]	Endangered	Species or species habitat known to occur within area
[Caretta caretta](#) Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour likely to occur within area
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Scientific Name	Threatened Category	Presence Text
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Lepidochelys olivacea		
Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
SHARK		
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Glyphis garricki		
Northern River Shark, New Guinea River Shark [82454]	Endangered	Species or species habitat may occur within area
Pristis pristis		
Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area
Pristis zijsron		
Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sphyrna lewini		
Scalloped Hammerhead [85267]	Conservation Dependent	Species or species habitat likely to occur within area

Listed Migratory Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		

Scientific Name	Threatened Category	Presence Text
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Foraging, feeding or related behaviour likely to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat likely to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area
Carcharias taurus Grey Nurse Shark [64469]		Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat known to occur within area
Mobula alfredi as Manta alfredi Reef Manta Ray, Coastal Manta Ray [90033]		Species or species habitat likely to occur within area
Mobula birostris as Manta birostris Giant Manta Ray [90034]		Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area overfly marine area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Foraging, feeding or related behaviour likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat likely to occur within area
Phaethon lepturus fulvus Christmas Island White-tailed Tropicbird, Golden Bosunbird [26021]	Endangered	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Fish		
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Reptile		
Aipysurus apraefrontalis Short-nosed Sea Snake, Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Aipysurus duboisii Dubois' Sea Snake, Dubois' Seasnake, Reef Shallows Sea Snake [1116]		Species or species habitat may occur within area
Aipysurus foliosquama Leaf-scaled Sea Snake, Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat may occur within area
Aipysurus fuscus Dusky Sea Snake [1119]	Endangered	Species or species habitat known to occur within area
Aipysurus laevis Olive Sea Snake, Olive-brown Sea Snake [1120]		Species or species habitat may occur within area
Aipysurus mosaicus as Aipysurus eydouxii Mosaic Sea Snake [87261]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Emydocephalus annulatus Eastern Turtle-headed Sea Snake [1125]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Hydrophis coggeri Cogger's Sea Snake [25925]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Hydrophis elegans Elegant Sea Snake, Bar-bellied Sea Snake [1104]		Species or species habitat may occur within area
Hydrophis hardwickii as Lapemis hardwickii Spine-bellied Sea Snake [93516]		Species or species habitat may occur within area
Hydrophis kingii as Disteira kingii Spectacled Sea Snake [93511]		Species or species habitat may occur within area
Hydrophis macdowelli as Hydrophis mcdowelli MacDowell's Sea Snake, Small-headed Sea Snake, [75601]		Species or species habitat may occur within area
Hydrophis major as Disteira major Olive-headed Sea Snake [93512]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Sea Snake, Ornate Reef Sea Snake [1111]		Species or species habitat may occur within area
Hydrophis peronii as Acalyptophis peronii Horned Sea Snake [93509]		Species or species habitat may occur within area
Hydrophis platura as Pelamis platurus Yellow-bellied Sea Snake [93746]		Species or species habitat may occur within area
Hydrophis stokesii as Astrotia stokesii Stokes' Sea Snake [93510]		Species or species habitat may occur within area
Hydrophis zweiffei as Enhydrina schistosa Australian Beaked Sea Snake [93514]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area

Whales and Other Cetaceans [Resource Information]

Current Scientific Name	Status	Type of Presence
Mammal		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
Kogia sima Dwarf Sperm Whale [85043]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat known to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Habitat Critical to the Survival of Marine Turtles		[Resource Information]
Scientific Name	Behaviour	Presence
Dec - Jan		
Chelonia mydas Green Turtle [1765]	Nesting	Known to occur

Extra Information

EPBC Act Referrals			[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status
Marine Route Survey for Subsea Fibre Optic Data Cable System - Australia West	2024/09826		Completed
Project Crux Cable Lay and Operation	2022/09441		Completed
Controlled action			
Develop Ichthys gas-condensate field permit area W	2006/2767	Controlled Action	Completed
Development of Browse Basin Gas Fields (Upstream)	2008/4111	Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Ichthys Gas Field, Offshore and onshore processing facilities and subsea pipeline	2008/4208	Controlled Action	Post-Approval
Montara 4, 5, and 6 Oil Production Wells, and Montara 3 Gas Re-Injection Well	2002/755	Controlled Action	Post-Approval
Prelude Floating Liquefied Natural Gas Facility and Gas Field Development	2008/4146	Controlled Action	Post-Approval
PTTEP AA Floating LNG Facility	2011/6025	Controlled Action	Completed
Not controlled action			
Adele Trend TQ3D Seismic Survey	2001/252	Not Controlled Action	Completed
Crux-A and Crux-B appraisal wells, Petroleum Permit Area AC/P23	2006/2748	Not Controlled Action	Completed
Crux gas-liquids development in permit AC/P23	2006/3154	Not Controlled Action	Completed
Drilling of 12 Hydrocarbon Exploration Wells, Permit Area WA-371-P	2006/3005	Not Controlled Action	Completed
Echuca Shoals-2 Exploration of Appraisal Well	2006/3020	Not Controlled Action	Completed
Exploration Well AC/P23	2001/234	Not Controlled Action	Completed
Kaleidoscope exploration well	2001/182	Not Controlled Action	Completed
Montara-3 Offshore Hydrocarbon Exploration Well Permit Area AC/RL3	2001/489	Not Controlled Action	Completed
P30 Hydrocarbon Exploration Well	2001/293	Not Controlled Action	Completed
Project Highclere Geophysical Survey	2021/9023	Not Controlled Action	Completed
Saucepan 1 Exploration Well ACP23	2000/2	Not Controlled Action	Completed
Not controlled action (particular manner)			
2 (3D) Marine Seismic Surveys	2009/4994	Not Controlled Action (Particular Manner)	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
2D Marine Seismic Survey	2009/4728	Not Controlled Action (Particular Manner)	Post-Approval
2D marine seismic survey of Braveheart,Kurrajong,Sunshine and Crocodile	2006/2917	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Marine Survey	2001/363	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic survey	2009/5076	Not Controlled Action (Particular Manner)	Post-Approval
2D seismic survey in permit areas WA-274P and WA-281P	2004/1521	Not Controlled Action (Particular Manner)	Post-Approval
3D Marine Seismic Survey	2008/4437	Not Controlled Action (Particular Manner)	Post-Approval
3D Marine Seismic Survey, Permit AC/P 23	2005/2364	Not Controlled Action (Particular Manner)	Post-Approval
AC/P37 3D Seismic Survey Ashmore Cartier	2007/3774	Not Controlled Action (Particular Manner)	Post-Approval
Aurora MC3D Marine Seismic Survey	2010/5510	Not Controlled Action (Particular Manner)	Post-Approval
Bassett 3D Marine Seismic Survey	2010/5538	Not Controlled Action (Particular Manner)	Post-Approval
Braveheart 2D Infill Marine Seismic Survey 100km offshore	2008/4442	Not Controlled Action (Particular Manner)	Post-Approval
Braveheart 2D Marine Seismic Survey	2005/2322	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Canis 3D Marine Seismic Survey	2008/4492	Not Controlled Action (Particular Manner)	Post-Approval
Cartier East and Cartier West 3D Marine Seismic Surveys	2009/5230	Not Controlled Action (Particular Manner)	Post-Approval
Caswell MC3D Marine Seismic Survey	2012/6594	Not Controlled Action (Particular Manner)	Post-Approval
Deep Water Northwest Shelf 2D Seismic Survey	2007/3260	Not Controlled Action (Particular Manner)	Post-Approval
Exploration Drilling Campaign	2011/6047	Not Controlled Action (Particular Manner)	Post-Approval
Exploration Drilling Campaign, Browse Basin, WA-341-P, AC-P36 and WA-343-P	2013/6898	Not Controlled Action (Particular Manner)	Post-Approval
Gicea 3D Marine Seismic Survey	2008/4389	Not Controlled Action (Particular Manner)	Post-Approval
Ichthys 3D Marine Seismic Survey	2010/5550	Not Controlled Action (Particular Manner)	Post-Approval
Kingtree & Ironstone-1 Exploration Wells	2011/5935	Not Controlled Action (Particular Manner)	Post-Approval
Octantis 3D Marine Seismic Survey, Permit Area AC/P41 off northern Western Australia	2007/3369	Not Controlled Action (Particular Manner)	Post-Approval
Offshore Fibre Optic Cable Network Construction & Operation, Port Hedland WA to Darwin NT	2014/7223	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Schild MC3D Marine Seismic Survey	2012/6373	Not Controlled Action (Particular Manner)	Post-Approval
Schild Phase 11 MC3D Marine Seismic Survey, Browse Basin	2013/6894	Not Controlled Action (Particular Manner)	Post-Approval
Searcher bathymetry & geochemical seismic survey, Brawse Basin,Timor Sea,WA	2013/6980	Not Controlled Action (Particular Manner)	Post-Approval
Tow West Atlas wreck from present location to boundary of EEZ	2010/5652	Not Controlled Action (Particular Manner)	Post-Approval
Vampire 2D Non Exclusive Seismic Survey, WA	2010/5543	Not Controlled Action (Particular Manner)	Post-Approval
Westralia SPAN Marine Seismic Survey, WA & NT	2012/6463	Not Controlled Action (Particular Manner)	Post-Approval
Zeppelin 3D Seismic Survey	2011/6148	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			
2D Marine Seismic Survey	2008/4623	Referral Decision	Completed
BRSN08 3D Marine Seismic Survey	2008/4582	Referral Decision	Completed
Seismic Data Acquisition, Browse Basin	2010/5475	Referral Decision	Completed

Key Ecological Features [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Ancient coastline at 125 m depth contour	North-west
Continental Slope Demersal Fish Communities	North-west

Biologically Important Areas		[Resource Information]
Scientific Name	Behaviour	Presence
Seabirds		
Ardenna pacifica Wedge-tailed Shearwater [84292]	Breeding	Known to occur
Fregata ariel Lesser Frigatebird [1012]	Breeding	Known to occur
Fregata minor Greater Frigatebird [1013]	Breeding	Known to occur
Phaethon lepturus White-tailed Tropicbird [1014]	Breeding	Known to occur
Sula sula Red-footed Booby [1023]	Breeding	Known to occur
Sharks		
Rhincodon typus Whale Shark [66680]	Foraging	Known to occur

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data is available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on the contents of this report.

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions when time permits.

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded breeding sites; and
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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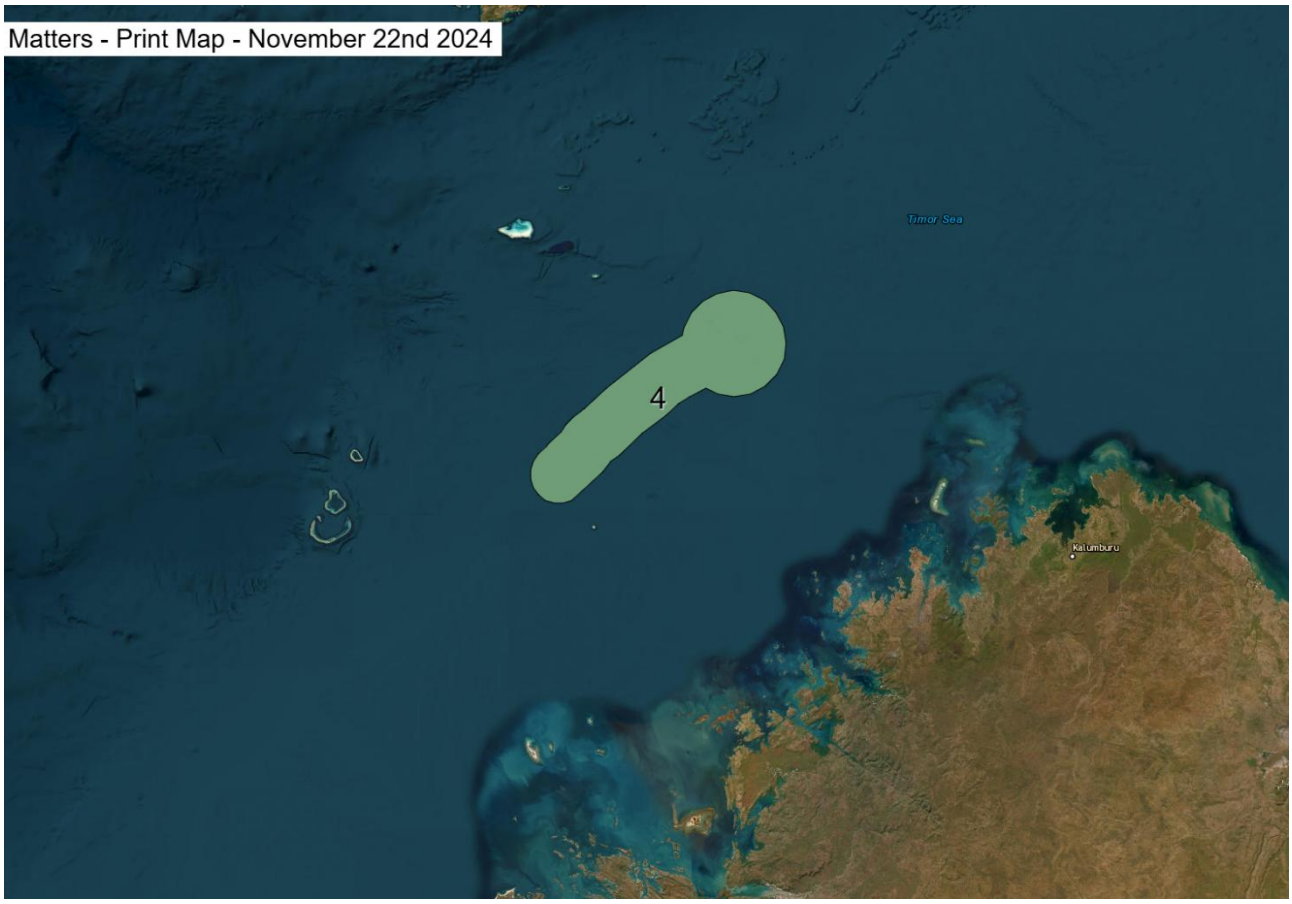
F.4: Protected Matters Report (Noise Assessment Area)

Input data:



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 22-Nov-2024

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	26
Listed Migratory Species:	37

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	70
Whales and Other Cetaceans:	25
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	1

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	53
Key Ecological Features (Marine):	2
Biologically Important Areas:	6
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name
Commonwealth Marine Areas (EPBC Act)
Commonwealth Marine Areas (EPBC Act)

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris canutus		
Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Papasula abbotti		
Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
[Phaethon lepturus fulvus](#) Christmas Island White-tailed Tropicbird, Golden Bosunbird [26021]	Endangered	Foraging, feeding or related behaviour likely to occur within area
[Phaethon rubricauda westralis](#) Red-tailed Tropicbird (Indian Ocean), Indian Ocean Red-tailed Tropicbird [91824]	Endangered	Species or species habitat likely to occur within area
MAMMAL		
[Balaenoptera borealis](#) Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
[Balaenoptera musculus](#) Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
[Balaenoptera physalus](#) Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
REPTILE		
[Aipysurus apraefrontalis](#) Short-nosed Sea Snake, Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
[Aipysurus foliosquama](#) Leaf-scaled Sea Snake, Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat may occur within area
[Aipysurus fuscus](#) Dusky Sea Snake [1119]	Endangered	Species or species habitat known to occur within area
[Caretta caretta](#) Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour likely to occur within area
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Scientific Name	Threatened Category	Presence Text
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Lepidochelys olivacea		
Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
SHARK		
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Glyphis garricki		
Northern River Shark, New Guinea River Shark [82454]	Endangered	Species or species habitat may occur within area
Pristis pristis		
Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area
Pristis zijsron		
Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sphyrna lewini		
Scalloped Hammerhead [85267]	Conservation Dependent	Species or species habitat likely to occur within area

Listed Migratory Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		

Scientific Name	Threatened Category	Presence Text
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Foraging, feeding or related behaviour likely to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat likely to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area
Carcharias taurus Grey Nurse Shark [64469]		Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat known to occur within area
Mobula alfredi as Manta alfredi Reef Manta Ray, Coastal Manta Ray [90033]		Species or species habitat likely to occur within area
Mobula birostris as Manta birostris Giant Manta Ray [90034]		Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area overfly marine area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Foraging, feeding or related behaviour likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat likely to occur within area
Phaethon lepturus fulvus Christmas Island White-tailed Tropicbird, Golden Bosunbird [26021]	Endangered	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Fish		
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Reptile		
Aipysurus apraefrontalis Short-nosed Sea Snake, Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Aipysurus duboisii Dubois' Sea Snake, Dubois' Seasnake, Reef Shallows Sea Snake [1116]		Species or species habitat may occur within area
Aipysurus foliosquama Leaf-scaled Sea Snake, Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat may occur within area
Aipysurus fuscus Dusky Sea Snake [1119]	Endangered	Species or species habitat known to occur within area
Aipysurus laevis Olive Sea Snake, Olive-brown Sea Snake [1120]		Species or species habitat may occur within area
Aipysurus mosaicus as Aipysurus eydouxii Mosaic Sea Snake [87261]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Emydocephalus annulatus Eastern Turtle-headed Sea Snake [1125]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Hydrophis coggeri Cogger's Sea Snake [25925]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Hydrophis elegans Elegant Sea Snake, Bar-bellied Sea Snake [1104]		Species or species habitat may occur within area
Hydrophis hardwickii as Lapemis hardwickii Spine-bellied Sea Snake [93516]		Species or species habitat may occur within area
Hydrophis kingii as Disteira kingii Spectacled Sea Snake [93511]		Species or species habitat may occur within area
Hydrophis macdowelli as Hydrophis mcdowelli MacDowell's Sea Snake, Small-headed Sea Snake, [75601]		Species or species habitat may occur within area
Hydrophis major as Disteira major Olive-headed Sea Snake [93512]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Sea Snake, Ornate Reef Sea Snake [1111]		Species or species habitat may occur within area
Hydrophis peronii as Acalyptophis peronii Horned Sea Snake [93509]		Species or species habitat may occur within area
Hydrophis platura as Pelamis platurus Yellow-bellied Sea Snake [93746]		Species or species habitat may occur within area
Hydrophis stokesii as Astrotia stokesii Stokes' Sea Snake [93510]		Species or species habitat may occur within area
Hydrophis zweiffei as Enhydrina schistosa Australian Beaked Sea Snake [93514]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area

Whales and Other Cetaceans [Resource Information]

Current Scientific Name	Status	Type of Presence
Mammal		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
Kogia sima Dwarf Sperm Whale [85043]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat known to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Habitat Critical to the Survival of Marine Turtles		[Resource Information]
Scientific Name	Behaviour	Presence
Dec - Jan		
Chelonia mydas Green Turtle [1765]	Nesting	Known to occur

Extra Information

EPBC Act Referrals			[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status
Marine Route Survey for Subsea Fibre Optic Data Cable System - Australia West	2024/09826		Completed
Project Crux Cable Lay and Operation	2022/09441		Completed
Controlled action			
Develop Ichthys gas-condensate field permit area W	2006/2767	Controlled Action	Completed
Development of Browse Basin Gas Fields (Upstream)	2008/4111	Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Ichthys Gas Field, Offshore and onshore processing facilities and subsea pipeline	2008/4208	Controlled Action	Post-Approval
Montara 4, 5, and 6 Oil Production Wells, and Montara 3 Gas Re-Injection Well	2002/755	Controlled Action	Post-Approval
Prelude Floating Liquefied Natural Gas Facility and Gas Field Development	2008/4146	Controlled Action	Post-Approval
PTTEP AA Floating LNG Facility	2011/6025	Controlled Action	Completed
Not controlled action			
Adele Trend TQ3D Seismic Survey	2001/252	Not Controlled Action	Completed
Crux-A and Crux-B appraisal wells, Petroleum Permit Area AC/P23	2006/2748	Not Controlled Action	Completed
Crux gas-liquids development in permit AC/P23	2006/3154	Not Controlled Action	Completed
Drilling of 12 Hydrocarbon Exploration Wells, Permit Area WA-371-P	2006/3005	Not Controlled Action	Completed
Echuca Shoals-2 Exploration of Appraisal Well	2006/3020	Not Controlled Action	Completed
Exploration Well AC/P23	2001/234	Not Controlled Action	Completed
Kaleidoscope exploration well	2001/182	Not Controlled Action	Completed
Montara-3 Offshore Hydrocarbon Exploration Well Permit Area AC/RL3	2001/489	Not Controlled Action	Completed
P30 Hydrocarbon Exploration Well	2001/293	Not Controlled Action	Completed
Project Highclere Geophysical Survey	2021/9023	Not Controlled Action	Completed
Saucepan 1 Exploration Well ACP23	2000/2	Not Controlled Action	Completed
Not controlled action (particular manner)			
2 (3D) Marine Seismic Surveys	2009/4994	Not Controlled Action (Particular Manner)	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
2D Marine Seismic Survey	2009/4728	Not Controlled Action (Particular Manner)	Post-Approval
2D marine seismic survey of Braveheart,Kurrajong,Sunshine and Crocodile	2006/2917	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Marine Survey	2001/363	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic survey	2009/5076	Not Controlled Action (Particular Manner)	Post-Approval
2D seismic survey in permit areas WA-274P and WA-281P	2004/1521	Not Controlled Action (Particular Manner)	Post-Approval
3D Marine Seismic Survey	2008/4437	Not Controlled Action (Particular Manner)	Post-Approval
3D Marine Seismic Survey, Permit AC/P 23	2005/2364	Not Controlled Action (Particular Manner)	Post-Approval
AC/P37 3D Seismic Survey Ashmore Cartier	2007/3774	Not Controlled Action (Particular Manner)	Post-Approval
Aurora MC3D Marine Seismic Survey	2010/5510	Not Controlled Action (Particular Manner)	Post-Approval
Bassett 3D Marine Seismic Survey	2010/5538	Not Controlled Action (Particular Manner)	Post-Approval
Braveheart 2D Infill Marine Seismic Survey 100km offshore	2008/4442	Not Controlled Action (Particular Manner)	Post-Approval
Braveheart 2D Marine Seismic Survey	2005/2322	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Canis 3D Marine Seismic Survey	2008/4492	Not Controlled Action (Particular Manner)	Post-Approval
Cartier East and Cartier West 3D Marine Seismic Surveys	2009/5230	Not Controlled Action (Particular Manner)	Post-Approval
Caswell MC3D Marine Seismic Survey	2012/6594	Not Controlled Action (Particular Manner)	Post-Approval
Deep Water Northwest Shelf 2D Seismic Survey	2007/3260	Not Controlled Action (Particular Manner)	Post-Approval
Exploration Drilling Campaign	2011/6047	Not Controlled Action (Particular Manner)	Post-Approval
Exploration Drilling Campaign, Browse Basin, WA-341-P, AC-P36 and WA-343-P	2013/6898	Not Controlled Action (Particular Manner)	Post-Approval
Gicea 3D Marine Seismic Survey	2008/4389	Not Controlled Action (Particular Manner)	Post-Approval
Ichthys 3D Marine Seismic Survey	2010/5550	Not Controlled Action (Particular Manner)	Post-Approval
Kingtree & Ironstone-1 Exploration Wells	2011/5935	Not Controlled Action (Particular Manner)	Post-Approval
Octantis 3D Marine Seismic Survey, Permit Area AC/P41 off northern Western Australia	2007/3369	Not Controlled Action (Particular Manner)	Post-Approval
Offshore Fibre Optic Cable Network Construction & Operation, Port Hedland WA to Darwin NT	2014/7223	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Schild MC3D Marine Seismic Survey	2012/6373	Not Controlled Action (Particular Manner)	Post-Approval
Schild Phase 11 MC3D Marine Seismic Survey, Browse Basin	2013/6894	Not Controlled Action (Particular Manner)	Post-Approval
Searcher bathymetry & geochemical seismic survey, Brawse Basin,Timor Sea,WA	2013/6980	Not Controlled Action (Particular Manner)	Post-Approval
Tow West Atlas wreck from present location to boundary of EEZ	2010/5652	Not Controlled Action (Particular Manner)	Post-Approval
Vampire 2D Non Exclusive Seismic Survey, WA	2010/5543	Not Controlled Action (Particular Manner)	Post-Approval
Westralia SPAN Marine Seismic Survey, WA & NT	2012/6463	Not Controlled Action (Particular Manner)	Post-Approval
Zeppelin 3D Seismic Survey	2011/6148	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			
2D Marine Seismic Survey	2008/4623	Referral Decision	Completed
BRSN08 3D Marine Seismic Survey	2008/4582	Referral Decision	Completed
Seismic Data Acquisition, Browse Basin	2010/5475	Referral Decision	Completed

Key Ecological Features [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Ancient coastline at 125 m depth contour	North-west
Continental Slope Demersal Fish Communities	North-west

Biologically Important Areas		[Resource Information]
Scientific Name	Behaviour	Presence
Seabirds		
Ardenna pacifica Wedge-tailed Shearwater [84292]	Breeding	Known to occur
Fregata ariel Lesser Frigatebird [1012]	Breeding	Known to occur
Fregata minor Greater Frigatebird [1013]	Breeding	Known to occur
Phaethon lepturus White-tailed Tropicbird [1014]	Breeding	Known to occur
Sula sula Red-footed Booby [1023]	Breeding	Known to occur
Sharks		
Rhincodon typus Whale Shark [66680]	Foraging	Known to occur

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data is available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on the contents of this report.

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions when time permits.

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded breeding sites; and
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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Appendix G Concordance with Crux Offshore Project Proposal

Under the OPGGS(E) Regulations, offshore petroleum projects are required to be assessed and approved via NOPSEMA acceptance of an OPP. The Crux OPP was accepted by NOPSEMA in August 2020. The Crux OPP outlines the scope of the development and its activities at the concept stage, including a comprehensive and thorough evaluation of likely environmental impacts and risks, as well as the establishment of a framework for the forward environmental management and performance in relation to project impacts and risks.

OPPs are developed at an early stage of project development before the detailed planning of specific activities is fully complete. Consequently, refinement of the detailed descriptions of these activities, and their associated impacts and risks, are expected to be provided and adapted in EPs as the project/activity definitions mature (NOPSEMA Guidance Note: Offshore project proposal content requirements N-04790-GN1663 A473026).

Since the Crux OPP was an early stage, whole-of-project assessment prior to detailed technical definition (i.e. pre-FEED), the EPOs in the Crux OPP may not be inherited verbatim in every subsequent EP, however any EP EPOs will maintain the equivalent, or better, level of environmental performance for the activities that fall within the scope of that EP. Similarly, the key management controls outlined in the Crux OPP are considered to be initial judgements on likely available key controls, but adjustments in these key controls may occur in subsequent EPs, subject to final design and operational processes established.

To confirm that the EPOs and key controls (control measures and associated Environmental Performance Standards) within this EP will ensure an equivalent or better level of environmental performance to that described in the Crux OPP for the aspects relevant to the activities within the scope of this EP, Table G-1 presents a comparison of EPOs in the Crux OPP and this EP; Table G-2 presents a comparison of key management controls in the Crux OPP with the EPS in this EP; and Table G-3 presents a comparison of the description of the project for any criteria that are associated with refinement or modification along with an explanation and evaluation of resulting environmental performance.

The assessment of concordance with the Crux OPP shows that the EPOs and controls/EPS defined in this EP will ensure an equivalent, or better, level of environmental performance to that described in the Crux OPP for the activities/aspects that fall within the scope of this EP.

Table G-1 Concordance with the Crux Gas Field Development OPP - Environmental Performance Outcomes (EPOs)

Aspect / OPP EPO	EP achieves equivalent, or better, level of environmental performance?	EP EPO[120]	Evaluation of change (where applicable)
Physical Presence, Vessel Movements and Seabed Disturbance			
Direct impacts to benthic habitats from the Crux project will be limited to < 0.1% of the total project area.	Yes	(EPO 4.2) Direct impacts to benthic habitats from the Crux infrastructure installation and subsea maintenance activities will be limited to <25 hectares of the total Project Area.	EP EPO ensures direct impacts to benthic habitats over the life of the Project will be <0.1% of the total Project area. This OPP EPO was addressed in previous Crux EPs - Crux Installation and Cold Commissioning EP (2200-010-HE-5880-00002).
Direct seabed disturbance from the Crux project will be limited to < 315,980 m^2.	Yes		EP EPO ensures direct impacts to benthic habitats will be <0.1% of the total Project area. This OPP EPO was addressed in previous Crux EPs - Crux Installation and Cold Commissioning EP (2200-010-HE-5880-00002).
Impacts to the continental slope demersal fish communities KEF will be limited to <1% of the total area of the KEF.	NA		This OPP EPO was addressed in previous Crux EPs - Crux Installation and Cold Commissioning EP (2200-010-HE-5880-00002).
No direct loss of coral communities (coral colony) at Goeree Shoal, Eugene McDermott Shoal and Vulcan Shoal will occur as a result of the Crux project.	Yes	(EPO 7.1) No impact to the water quality outside of the Mixing Zone Boundary from discharge of produced water. (EPO 7.2) Potential precipitation of toxicants from the PW discharge will not exceed toxicant default guideline values for sediment quality (ANZG) outside the impact zone for sediment, except where pre-operations baseline monitoring potentially shows exceedance already (ANZG). (EPO 7.3) Ensure that produced water discharge do not result in contaminant levels in water and sediment that could reasonably lead to bioaccumulation at levels compromising ecosystem integrity or the safe consumption of aquatic resources.	These activity specific EPOs provide a clear means of protecting the receiving environment within defined mix zones boundaries, which when read in conjunction with the related EPSs and MC, establishes measurable levels for management of the relevant environmental aspects. Because this EPO prescribes a level of protection that restricts impact to an area that does not extend geographically, to the adjacent Shoals and Banks, then it is considered to have met the level of performance set during the development of the OPP. This change to the EPO continues to contribute environmental outcomes which demonstrate that the environmental impacts and risks will be managed to an acceptable level and as low as reasonably practicable.
No collisions between vessels and marine fauna resulting in mortality or injury of species listed as threatened or migratory under the EPBC Act will occur within the Crux project area.	Yes	(EPO 2.2) No injury or mortality of threatened, migratory or cetacean species associated with the Activities.	
No adverse interactions between Shell's activities within the Crux project area and other marine users.	Yes	(EPO 1.1) No adverse interactions between the activity and other marine users within the Activity Area. Displacement of other marine users is restricted to: • temporary displacement within the Activity Area. • exclusion from gazetted PSZs.	
Displacement of other marine users within the Crux project area restricted to: • temporary displacement from project activities (e.g. from pipelaying vessels and drilling activities), and • exclusion from gazetted Petroleum Safety Zones (e.g. 500 m exclusion around the Crux platform).	Yes	(EPO 1.1) No adverse interactions between the activity and other marine users within the Activity Area. Displacement of other marine users is restricted to: • temporary displacement within the Activity Area. • exclusion from gazetted PSZs.	
Other marine users will be provided with information on the timing, nature and scale of aspects of the Crux project through Shell's consultation program.	Yes	N/A	No equivalent EPO - addressed through consultation process, as described in Section 5 of EP, and EPS as described in Table G-2.
Light Emissions			

[120] If there are any inconsistencies between the environmental performance outcomes stated in this table, and those included in Section 9 of this EP, the latter take precedence.

Aspect / OPP EPO	EP achieves equivalent, or better, level of environmental performance?	EP EPO[120]	Evaluation of change (where applicable)
No mortality or injury of threatened and migratory MNES species as a result of artificial light emissions from the Crux project.	Yes	(EPO 2.2) No injury or mortality of threatened, migratory or cetacean species associated with the Activities.	
Underwater Noise			
No mortality or injury of threatened and migratory MNES species as a result of underwater noise from the Crux project.	Yes	(EPO 2.2) No injury or mortality of threatened, migratory or cetacean species associated with the Activities.	
Atmospheric Emissions			
No significant decline in air quality at residential or sensitive populations as a result of atmospheric emissions from the Crux project.	Yes	(EPO 9.1) Atmospheric emissions will be consistent with national and international mechanisms for the management of emissions.	
Atmospheric emissions associated with all drilling rigs, vessels and the Crux platform to comply with MARPOL Annex VI requirements.	Yes	(EPS 9.11) Vessels are required to have this valid documentation, as required by vessel class, size and type: • EIAPP certificate • IAPP certificate • IEE certificate • SEEMP (EPS 9.12) Waste from incineration managed in accordance with MARPOL Annex VI. (EPS 9.13) ODS managed in accordance with MARPOL Annex VI to reduce the risk of an accidental release of ODS to air, as required by vessel class, size and type. (EPS 9.10) Use only low-sulfur fuel (≤0.5 m/m S) or an IMO approved alternative measure (e.g. EGCS fitted) to reduce sulfur oxide emissions	
Atmospheric emissions associated with the project will be consistent with national and international mechanisms for the management of GHG emissions for the life of the project.	Yes	(EPO 9.1) Atmospheric emissions will be consistent with national and international mechanisms for the management of emissions.	
Greenhouse Gas Emissions			
Emissions at the Crux facility will not exceed 0.5 Mt CO2-e in any single operating year.	Yes	(EPS 10.2) Undertake the activity in a manner that is compliant with the national requirements set out in the Safeguard Mechanism.	This EPS is equivalent to or stronger than the OPP EPO because the Safeguard Mechanism provided for, among other things, a decline rate to facilities' baselines to enable predictable and gradual emissions reductions over time, on a trajectory consistent with achieving Australia's emissions reductions targets.
Emissions at the Crux facility will not exceed an average of 0.4 Mtpa CO2-e over a 5-year period.	Yes	(EPS 10.2) Undertake the activity in a manner that is compliant with the national requirements set out in the Safeguard Mechanism.	
Emissions at the Crux facility will comply with the Australian government safeguard mechanism baseline.	Yes	(EPS 10.2) Undertake the activity in a manner that is compliant with the national requirements set out in the Safeguard Mechanism.	
Shell Australia will ensure that programs are developed and implemented, in conjunction with the wider Shell Group and others, to actively support the global transition to a lower carbon future by net displacement of higher carbon intensity energy sources relating to third party GHG emissions.	Yes	(EPS 10.2) Undertake the activity in a manner that is compliant with the national requirements set out in the Safeguard Mechanism. (EPO 10.1) Shell group supports customers to reduce their GHG emissions through; • target to reduce the net carbon intensity of the energy products we sell by 9-12% by 2024, 9-13% by 2025, 15-20% by 2030, and 100% by 2050; • investing in low carbon solutions, Shell Group is currently investing $10-15 billion in low-carbon energy solutions between 2023 and the end of 2025. (EPO 10.3) Undertake downstream processing at the Prelude FLNG facility in a manner that is compliant with the national requirements set out in the Safeguard Mechanism.	
Invasive Marine Species			
No IMS of concern established in the natural environment as a result of the Crux project.	Yes	(EPO 6.1) No IMS of concern introduced in the Activity Area as a result of the activities.	

Aspect / OPP EPO	EP achieves equivalent, or better, level of environmental performance?	EP EPO[120]	Evaluation of change (where applicable)
No introduction of IMS to the marine environment from ballast water exchange operations undertaken or biofouling by vessels.	Yes		
Waste Management			
No mortality or injury of threatened and migratory MNES species as a result of unplanned waste discharge to sea during the Crux project.	Yes	(EPO 2.2) No injury or mortality of threatened, migratory or cetacean species associated with the Activities.	
Liquid Discharges			
No measurable impacts to sediment quality or water quality in the region from liquid discharges during the Crux project.	Yes	(EPO 2.2) No injury or mortality of threatened, migratory or cetacean species associated with the Activities. (EPO 7.1) No impact to the water quality outside of the Mixing Zone Boundary from discharge of produced water. (EPO 7.2) Potential precipitation of toxicants from the PW discharge will not exceed toxicant default guideline values for sediment quality (ANZG) outside the impact zone for sediment, except where pre-operations baseline monitoring potentially shows exceedance already (ANZG). (EPO 7.3) Ensure that produced water discharge do not result in contaminant levels in water and sediment that could reasonably lead to bioaccumulation at levels compromising ecosystem integrity or the safe consumption of aquatic resources.	This is consistent or better performance than the Crux OPP EPO because the Crux OPP EPO applies to 'the region', whereas impacts not exceeding significant levels (as defined by the EPBC significant impact guidelines) are not spatially restrained from the source of the discharge.
PFW discharges from the Crux platform will meet relevant ANZECC & ARMCANZ guidelines 95% species protection levels for sediment and water quality and/or be within natural variation or background concentration beyond the predicted mixing zone(s) under normal operations.	Yes	(EPO 7.1) No impact to the water quality outside of the Mixing Zone Boundary from discharge of produced water. (EPO 7.2) Potential precipitation of toxicants from the PW discharge will not exceed toxicant default guideline values for sediment quality (ANZG) outside the impact zone for sediment, except where pre-operations baseline monitoring potentially shows exceedance already (ANZG). (EPO 7.3) Ensure that produced water discharge do not result in contaminant levels in water and sediment that could reasonably lead to bioaccumulation at levels compromising ecosystem integrity or the safe consumption of aquatic resources.	
Direct impacts to benthic habitats from the Crux project will be limited to < 0.1% of the total project area.	Yes	(EPO 4.2) Direct impacts to benthic habitats from the Crux infrastructure installation and subsea maintenance activities will be limited to <25 hectares of the total Project Area.	This OPP EPO was addressed in previous Crux EPs - Crux Installation and Cold Commissioning EP (2200-010-HE-5880-00002).
No mortality or injury of threatened and migratory MNES species as a result of liquid discharges during the Crux project.	Yes	(EPO 2.2) No injury or mortality of threatened, migratory or cetacean species associated with the Activities.	
Impacts from liquid discharges from the Crux project on the continental slope demersal fish communities KEF will be limited to <1% of the total area of the KEF.	NA		This OPP EPO was addressed in previous Crux EPs - Crux Installation and Cold Commissioning EP (2200-010-HE-5880-00002).
No direct loss of coral communities (coral colony) at Goeree Shoal, Eugene McDermott Shoal and Vulcan Shoal will occur as a result of liquid discharges from the Crux project.	Yes	(EPO 2.2) No injury or mortality of threatened, migratory or cetacean species associated with the Activities.	
No direct loss of coral communities on the outcropping reef feature will occur as a result of the discharge of drill fluids and cuttings for future tie-back wells within the Crux in-field development area.	NA		Not relevant to the scope covered by the EP. No tie-back well drilling activities within the scope covered by the EP.
Unplanned Spills			
No emergency events associated with the unplanned release of Crux condensate or vessel fuel to the marine environment during the Crux project.	Yes	(EPO 4.3) No incidents of spills or the release of equipment, materials or waste to the ocean from the activity.	

Table G-2: Concordance with the Crux Gas Field Development OPP – Environmental Performance Standards (EPSs)

Aspect / OPP Key Management Controls	EP achieves equivalent, or better, level of environmental performance?	EP Environmental Performance Standard[121]	Evaluation of change (where applicable)
Physical Presence, Vessel Movements and Seabed Disturbance			

All vessels operating within the project area will adhere to the navigation safety requirements contained within the International Regulations for Preventing Collisions at Sea 1972 (COLREGS), Chapter 5 of The International Convention for the Safety of Life at Sea 1974 (SOLAS Convention), International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW Convention), the Navigation Act 2012 and any subsequent Marine Orders, which specify standards for crew training and competency, navigation, communication, and safety measures.	Yes	(EPS 1.3) Vessels will be equipped and crewed in accordance with the *Navigation Act 2012* (Cth) (as applicable for vessel size, type and class), including implementing:
		• Marine Order 21 (Safety and emergency procedures), including:
		  ○ safety measures such as manning and watchkeeping.
		• Marine Order 27 (Safety of navigation and radio equipment), including:
		  ○ radio equipment and communications.
		  ○ navigation safety measures and equipment.
		  ○ danger, urgency and distress signals and messages.
		• Marine Order 30 (Prevention of Collisions), including:
		  ○ lights and signals as applicable to vessel class per COLREGS requirements.
		• Marine Order 71 (Masters and Deck Officers), including:
		  ○ all master, mate and watchkeeper officer duties undertaken by crew certified as applicable to vessel class per STCW Convention) requirements.	

Maintenance of a minimum 1 km buffer from shoals within the in-field development area (Figure 5-3).	Yes	(EPS 2.2) Vessels shall not operate within 1 km of named Shoals adjacent to the Activity Area.	
Vessels will adhere to the requirements of the EPBC Regulations Part 8.1 – Interacting with cetaceans, (except in emergency conditions or when manoeuvring is not possible, such as in the case of pipelay activities), which include: • implement a caution zone of 150 m for dolphins and 300 m for whales • vessels will not knowingly approach closer than 100 m to a whale and 50 m for a dolphin (i.e. no approach zone) • make sure a vessel does not drift or approach within 50 m of a dolphin or 100 m of a whale • vessels will not knowingly travel > 6 knots within the caution zone of a whale or dolphin, and • there will not knowingly be no more than three vessels within 300 m of a whale (i.e. caution zone).	Yes	(EPS 3.2) Vessel interactions with EPBC Act listed species to follow the EPBC Regulations 2000 – Part 8 Division 8.1 (Regulations 8.05 and 8.06). In particular: • Vessels will not deliberately approach closer than 50 m to a dolphin, turtle or whale shark; 100 m for an adult whale; 300 m for a whale calf; and 150 m for a dolphin calf. • If the whale, dolphin, turtle, or whale shark shows signs of being distressed, vessels will immediately withdraw from the caution zone at a constant speed of ≤6 knots (except in emergency conditions or when manoeuvring is not possible).	
All areas of the seabed disturbed by installation activities will be surveyed prior to installation. (The Crux NNM platform location and export pipeline corridor have been surveyed as part of the baseline environmental studies for the Crux project and no sensitive seabed features were observed).	N/A	N/A	Not relevant to the scope covered by the EP.
Validate that the Crux platform, export pipeline and subsea integration system facilities are laid according to planned locations within allowable tolerances.	N/A	N/A	Not relevant to the scope covered by the EP.
An anchoring plan will identify suitable areas for anchors to be placed within the in-field development area and will confirm no anchoring on shoals or within the associated 1 km buffer.	Yes	(EPS 4.1) No vessel anchoring associated with the activities, except in emergency events. (EPS 2.2) Vessels shall not operate within 1 km of named Shoals adjacent to the Activity Area.	

[121] If there are any inconsistencies between the control measures or environmental performance standards stated in this table, and those included in Section 9 of this EP, the latter take precedence.

Aspect / OPP Key Management Controls	EP achieves equivalent, or better, level of environmental performance?	EP Environmental Performance Standard[121]	Evaluation of change (where applicable)
If future tie-backs are proposed within 2 km of the shoals or on the outcropping reef feature within the Crux in-field development area, then additional studies will be undertaken to further characterise the benthic habitats within the proposed disturbance area. The studies will inform an assessment of the acceptability of the impacts, particularly with regard to disturbance of any hard seabed substrates that contain high biodiversity value.	N/A	N/A	Not relevant to the scope covered by the EP.
Australian Hydrographic Service will be advised of project activities and installed infrastructure to facilitate issuing Notices to Mariners.	Yes	(EPS 1.1) Active PSZ notification and infrastructure locations issued through AHO. (EPS 1.2) AHO is notified, at least four weeks prior, to enable a 'Notice to Mariners' to be issued before activities under this EP commence.	
Development and implementation of a project decommissioning plan which considers environmental impacts and risks.	N/A	N/A	Not relevant to the scope covered by the EP.
Prior to the end of operating life, a comparative assessment of potential decommissioning options will be undertaken to inform the development of a Decommissioning EP that will be submitted to NOPSEMA. The comparative assessment will consider the merits of each option in the context of health, safety and environmental protection, technological feasibility, local capacity, regulatory compliance, public participation and economic stewardship within a broader ALARP framework to inform selection of the preferred decommissioning strategy.	N/A	N/A	Not relevant to the scope covered by the EP, which covers first 5 years of operations.
The Decommissioning EP will present the outcomes of the comparative assessment and include an ALARP and acceptability assessment of the preferred option. The acceptability assessment will consider ESD, industry standard at the time and stakeholder expectations. The Decommissioning EP will be implemented for the duration of the decommissioning activities.	N/A	N/A	Not relevant to the scope covered by the EP.
Light Emissions			
External lighting on offshore facilities/infrastructure will be minimised through design to that required for navigation, safety of deck operations and security considerations, except in the case of an emergency.	Yes	(EPS 2.3) Lighting will be limited to levels required for safe operations and navigation, with operational lighting directed downward onto the working area where practicable.	
Flaring during operations is optimised to enable the safe and economically efficient operation of the facility.	Yes	(EPS 10.1) Net GHG emissions on the Crux and Prelude facilities managed to comply with the safeguard mechanism and reported annually to the Clean Energy Regulator, as required by the NGER Act. (EPS 9.5) Environment critical equipment for Flare Tip Ignition System (ECE-IC9), will be managed in accordance with the Operation Environmental Critical Elements and Performance Standards Manual, which provide the functional performance criteria and required tasks to validate that the ECE's perform their required functions e.g., maintain flare tip integrity and ignition system functionality to minimise potential for venting, incomplete combustion of waste products and smoke emissions. Monitoring is in place to ensure flare/pilots are lit and ignition system is available to light the flare in a timely manner. (EPS 9.6) LP flare combustion efficiency will be validated to be 98% or greater during normal operating conditions within 18 months of start-up. (EPS 10.11) The Crux Operating Procedures are available and provides panel operators the steps to be implemented during planned plant shutdowns and start-ups to minimise GHG emissions to ALARP. (EPS 10.8) Crux facility annual GHG goals will be set and performance against it tracked and managed. (EPS 10.9) Crux facility annual abatement goals will be set and performance against it tracked and managed. (EPS 10.3) Flaring emissions for hot commissioning, 2nd stage well clean-up and SURU activities will not exceed the limit of 0.224 MtCO2-e (Appendix H.3).	Relevant to the activities of this EP, specific controls that will (directly or indirectly) drive optimisation of flaring have been established.

Aspect / OPP Key Management Controls	EP achieves equivalent, or better, level of environmental performance?	EP Environmental Performance Standard[121]	Evaluation of change (where applicable)
		(EPS 10.5) Establish and track goals for GHG emissions during 1st stage well clean-up, hot commissioning, 2nd stage well clean-up and SURU. Manage performance against these through monthly GHG performance reviews and associated recommended measures to further minimise GHG emissions and/or reduce risk of potential future goal or limit (EPS) exceedance. (EPS 10.6) Produce second stage well clean-up to Crux platform permanent systems.	
Underwater Noise			
Any VSP activities conducted at the development well will comply with 'Standard Management Procedures' set out in EPBC Act Policy Statement 2.1 – Interaction between Offshore Seismic Exploration and Whales: Industry Guidelines (or the contemporary requirements at the time of the activity), specifically: • pre-start-up visual observations. Visual observations for the presence of whales by a suitably trained crew member will be carried out at least 30 minutes before the commencement of VSP. • start-up and normal operating procedures, including a process for delayed start-up, should whales be sighted. Visual observations by trained crew should be maintained continuously. • night time and low visibility procedures.	N/A	N/A	Not relevant to the scope covered by the EP.
Pile driving activities conducted for the Crux platform foundations will comply with 'Standard Management Procedures' set out in EPBC Act Policy Statement 2.1 – Interaction between Offshore Seismic Exploration and Whales: Industry Guidelines, specifically: • pre-start-up visual observations. Visual observations for the presence of whales by a trained marine mammal observer will be carried out at least 30 minutes before the commencement of pile driving. • start-up and normal operating procedures, including a process for delayed start-up, should whales be sighted. Visual observations by a trained marine mammal observer should be maintained continuously. • shut-down procedures. Piling will be stopped should whales come within 500 m of the pile driving barge. • night time and low visibility procedures. • in addition to the 'Standard Management Procedures' identified above, Shell will commit to at least one trained marine mammal observer being present on the pile driving barge for the duration of pile driving activities for the Crux platform foundations.	N/A	N/A	Not relevant to the scope covered by the EP.
Maintenance of a minimum 1 km buffer from shoals within the infield development area.	Yes	(EPS 2.2) Vessels shall not operate within 1 km of named Shoals adjacent to the Activity Area.	
Atmospheric & Greenhouse Gas Emissions			
All drilling rigs, vessels and Crux platform (as appropriate to vessel class) will comply with International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI (Prevention of Air	Yes	(EPS 9.11) Vessels are required to have this valid documentation, as required by vessel class, size and type:	

Aspect / OPP Key Management Controls	EP achieves equivalent, or better, level of environmental performance?	EP Environmental Performance Standard[121]	Evaluation of change (where applicable)
Pollution from Ships), the Navigation Act 2012, the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and subsequent Marine Orders. which requires vessels to have a valid IAPP Certificate (for vessels > 400 tonnage) and use of low sulphur fuel, when possible.		• EIAPP certificate • IAPP certificate • IEE certificate • SEEMP (EPS 9.12) Waste from incineration managed in accordance with MARPOL Annex VI. (EPS 9.13) ODS managed in accordance with MARPOL Annex VI to reduce the risk of an accidental release of ODS to air, as required by vessel class, size and type. (EPS 9.10) Use only low-sulfur fuel (≤0.5 m/m S) or an IMO approved alternative measure (e.g. EGCS fitted) to reduce sulfur oxide emissions	
Complete and submit annual National Greenhouse and Energy Reporting (NGER) reports during the operations stage of the project for the Kyoto Protocol listed (or applicable post-Kyoto agreement at the time of operations) GHG emissions on a CO_2 equivalency basis for each facility (as defined in Section 9 of the National Greenhouse and Energy Reporting Act 2007 and National Greenhouse and Energy Reporting Regulations 2008) by fuel type, and the relevant requirements of the National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015.	Yes	(EPS 10.2) Net GHG emissions on the Crux and Prelude facilities managed to comply with the safeguard mechanism and reported annually to the Clean Energy Regulator, as required by the NGER Act.	
In the event that the Safeguard Mechanism baseline for the project is exceeded, Shell will follow requirements outlined under the Safeguard Mechanism and, where required, purchase and surrender Australian carbon credit units.	Yes	(EPS 10.2) Net GHG emissions on the Crux and Prelude facilities managed to comply with the safeguard mechanism and reported annually to the Clean Energy Regulator, as required by the NGER Act.	
GHG and National Pollutant Inventory reporting records (or contemporary requirements at the time of the activities) will be complied with during the project.	Yes	(EPS 9.11) Report types and amounts of relevant NPI substances as required by the National Pollutant Inventory (NPI) Measure 1998.	
Flaring during operations is optimised to enable the safe and economically efficient operation of the facility.	Yes	(EPS 2.1) Full restarts of GTGs will be from backflow of pipeline gas in accordance with operating procedure. (EPS 10.1) Net GHG emissions on the Crux and Prelude facilities managed to comply with the safeguard mechanism and reported annually to the Clean Energy Regulator, as required by the NGER Act. (EPS 9.5) Environment critical equipment for Flare Tip Ignition System (ECE-IC9), will be managed in accordance with the Operation Environmental Critical Elements and Performance Standards Manual, which provide the functional performance criteria and required tasks to validate that the ECE's perform their required functions e.g., maintain flare tip integrity and ignition system functionality to minimise potential for venting, incomplete combustion of waste products and smoke emissions. Monitoring is in place to ensure flare/pilots are lit and ignition system is available to light the flare in a timely manner. (EPS 9.6) LP flare combustion efficiency will be validated to be 98% or greater during normal operating conditions within 18 months of start-up. (EPS 10.11) The Crux Operating Procedures are available and provides panel operators the steps to be implemented during planned plant shutdowns and start-ups to minimise GHG emissions to ALARP. (EPS 10.8) Crux facility annual GHG goals will be set and performance against it tracked and managed. (EPS 10.9) Crux facility annual abatement goals will be set and performance against it tracked and managed. (EPS 10.3) Flaring emissions for hot commissioning, 2nd stage well clean-up and SURU activities will not exceed the limit of 0.224 MtCO2-e (Appendix H.3). (EPS 10.5) Establish and track goals for GHG emissions during 1st stage well clean-up, hot commissioning, 2nd stage well clean-up and SURU. Manage performance against these through monthly GHG performance review and associated recommended measures to further minimise GHG emissions and/or reduce risk of potential future goal or limit (EPS) exceedance. (EPS 10.6) Produce second stage well clean-up to Crux platform permanent systems.	
Selection of gas turbine generators during design process considers energy efficient (i.e. low emission) equipment, in alignment with the selected concept.	Yes	(EPS 9.1) Power generation GTG configuration optimised so that two GTGs will operate with a spinning reserve for each, while the third remains on cold standby. This configuration will continue unless it is later found not to manage impact and risk to ALARP. (EPS 9.2) Operate GTGs using fuel gas during normal operations. (EPS 9.3) During normal operations, the GTGs will operate with a High-Efficiency Particulate Air (HEPA) inlet air filtration system with differential pressure alarm to minimise any performance/ efficiency degradation.	

Aspect / OPP Key Management Controls	EP achieves equivalent, or better, level of environmental performance?	EP Environmental Performance Standard[121]	Evaluation of change (where applicable)
		(EPS 9.4) The InSight System will monitor long-term efficiency of the Crux GTGs as a predictive maintenance indicator. Data will be used to establish and implement condition-based maintenance trigger within two years of start-up to inform scheduling and execution of planned maintenance such as water washing in accordance with the CMMS.	
Tri-ethylene glycol off gas will not be vented but sent to the flare for combustion as long as the flare is ignited.	Yes	(EPS 10.1) Net GHG emissions on the Crux and Prelude facilities managed to comply with the safeguard mechanism and reported annually to the Clean Energy Regulator, as required by the NGER Act.	
During operations of the Crux facility, regular reviews of GHG opportunities will be reviewed and adopted where appropriate.	Yes	(EPS 10.1) Net GHG emissions on the Crux and Prelude facilities managed to comply with the safeguard mechanism and reported annually to the Clean Energy Regulator, as required by the NGER Act. (EPS 10.8) Crux facility annual GHG goals will be set and performance against it tracked and managed. (EPS 10.9) Crux facility annual abatement goals will be set and performance against it tracked and managed. (EPS 10.5) Establish and track goals for GHG emissions during 1st stage well clean-up, hot commissioning, 2nd stage well clean-up and SURU. Manage performance against these through monthly GHG performance review and associated recommended measures to further minimise GHG emissions and/or reduce risk of potential future goal or limit (EPS) exceedance.	
Invasive Marine Species			
Ballast water exchange operations will comply with the International Maritime Organisation (IMO) International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004 (as appropriate to vessel class), Australian Ballast Water Management Requirements, *Protection of the Sea (Harmful Antifouling Systems) Act 2006* (Cth) and *Biosecurity Act 2015* (Cth), including: • all ballast water exchanges conducted > 12 nautical miles from land. • vessel Ballast Water Management Plan stipulating that ballast. • water exchange records will be maintained. • completion of Department of Agriculture and Water Resources. • Ballast Water Management Summary sheet for any ballast water discharge in Australian waters).	Yes	(EPS 6.5) Ballast water discharges are aligned with the Australian Ballast Water Management Requirements (DAWE 2020), the Biosecurity Act 2015 (Cth) and the International Convention for the Control and Management of Ships' Ballast Water and Sediments (as appropriate for size, type and class of vessel).	
Biofouling management for vessels in accordance to the IMO Guidelines for the Control and Management of Ships Biofouling to Minimise the Transfer of Invasive Aquatic Species.	Yes	(EPS 6.2) Vessels (as appropriate for size, type and class) entering Australian territorial seas [12 nm limit] from international locations, prior to entering the Activity Area, will apply the Australian Biofouling Management Requirements (DAFF 2023), including: • an effective biofouling management plan and record book; or • vessel cleaned of all biofouling within 30 days prior to arriving in Australian waters; or • implementation of an alternative biofouling management method. (EPS 6.3) Vessels (as appropriate for size, type and class) entering the Activity Area directly from international locations will implement the following requirements derived from the Australian National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee 2009): • conduct a biofouling risk assessment using an industry recognised IMS inspector; and • undertake IMS risk reduction measures as guided by an industry recognised IMS inspector if a vessel is not considered low risk; and only vessels classified as low risk will be permitted entry into the Activity Area.	
The International Convention on the Control of Harmful Anti-fouling Systems on Ships will be complied with, including vessels (of appropriate class) having a valid International Anti-Fouling System Certificate.	Yes	(EPS 6.2) Vessels (as appropriate for size, type and class) will have an antifoul coating applied in accordance with the International Convention on the Control of Harmful Antifouling Systems on Ships and the *Protection of the Sea (Harmful Anti-fouling Systems) Act 2006* (Cth), including Marine Order 98 (Marine Pollution – Anti-fouling Systems) including (as appropriate for size, class and type): • a valid international Anti-fouling system certificate or • anti-fouling declaration.	
Compliance with the Commonwealth Biosecurity Act 2015, WA Fish Resources Management Act 1994 and	Yes	(EPS 6.2) Vessels (as appropriate for size, type and class) entering Australian territorial seas [12 nm limit] from international locations, prior to entering the Activity Area, will apply the Australian Biofouling Management Requirements (DAFF 2023), including:	

Aspect / OPP Key Management Controls	EP achieves equivalent, or better, level of environmental performance?	EP Environmental Performance Standard[121]	Evaluation of change (where applicable)
Aquatic Resources Management Act 2016, NT Fisheries Act and associated regulations.		• an effective biofouling management plan and record book; or • vessel cleaned of all biofouling within 30 days prior to arriving in Australian waters; or • implementation of an alternative biofouling management method. (EPS 6.3) Vessels (as appropriate for size, type and class) entering the Activity Area directly from international locations will implement the following requirements derived from the Australian National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee 2009): • conduct a biofouling risk assessment using an industry recognised IMS inspector; and • undertake IMS risk reduction measures as guided by an industry recognised IMS inspector if a vessel is not considered low risk; and • only vessels classified as low risk will be permitted entry into the Activity Area. (EPS 6.4) Locally sourced vessels (as appropriate for size, type and class) entering the Activity Area from Australian domestic locations, will implement the following requirements derived from the Australian National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee 2009): • conduct a biofouling risk assessment using an industry recognised IMS inspector or using a Shell endorsed IMS risk assessment tool; and • undertake IMS risk reduction measures if a vessel is not considered low risk (either guided by an IMS inspector or using risk assessment tool outcomes); and • only vessels classified as low risk will be permitted entry into the Activity Area. (EPS 11.2) Quarantine risk material is managed and disposed of in accordance with relevant requirements of the *Biosecurity Act 2015* (Cth).	
Alignment with the National biofouling management guidance for the petroleum production and exploration industry, and the WA Department of Primary Industries and Regional Development Biofouling Biosecurity Policy.	Yes	(EPS 6.2) Vessels (as appropriate for size, type and class) entering Australian territorial seas [12 nm limit] from international locations, prior to entering the Activity Area, will apply the Australian Biofouling Management Requirements (DAFF 2023), including: • an effective biofouling management plan and record book; or • vessel cleaned of all biofouling within 30 days prior to arriving in Australian waters; or • implementation of an alternative biofouling management method. (EPS 6.3) Vessels (as appropriate for size, type and class) entering the Activity Area directly from international locations will implement the following requirements derived from the Australian National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee 2009): • conduct a biofouling risk assessment using an industry recognised IMS inspector; and • undertake IMS risk reduction measures as guided by an industry recognised IMS inspector if a vessel is not considered low risk; and • only vessels classified as low risk will be permitted entry into the Activity Area. (EPS 6.4) Locally sourced vessels (as appropriate for size, type and class) entering the Activity Area from Australian domestic locations, will implement the following requirements derived from the Australian National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee 2009): • conduct a biofouling risk assessment using an industry recognised IMS inspector or using a Shell endorsed IMS risk assessment tool; and • undertake IMS risk reduction measures if a vessel is not considered low risk (either guided by an IMS inspector or using risk assessment tool outcomes); and • only vessels classified as low risk will be permitted entry into the Activity Area.	
Maintenance of a minimum 1 km buffer from shoals within the infield development area.	Yes	(EPS 2.2) Vessels shall not operate within 1 km of named Shoals adjacent to the Activity Area.	
The Crux platform and jacket will not be wet towed to the Crux infield development area.	N/A	N/A	Not relevant to the scope covered by the EP.
Waste Management			
All discharge of waste from vessels will comply with relevant MARPOL 73/78, Navigation Act 2012 and Protection of the Sea (Prevention of Pollution) Act 1983 and subsequent Marine Order requirements (as appropriate for vessel classification).	Yes	(EPS 8.2) Vessel bilge and slops effluent will be discharged via an OIW separator compliant with MARPOL Annex I (and Marine Order 91: Marine pollution prevention – oil) requirements (≤15 mg/L). (EPS 8.6) Marine assurance will be undertaken for vessels, including a check for valid and in date IOPP certificates (as required by vessel class requirements and type) and ISPP Certificate (or equivalent voluntary statement of compliance audits where relevant) (as required by vessel class, size and type). (EPS 8.5) Vessels to comply with Marine Orders 94 and 95 (Marine pollution prevention – packaged harmful substances/garbage), specifically:	

Aspect / OPP Key Management Controls	EP achieves equivalent, or better, level of environmental performance?	EP Environmental Performance Standard[121]	Evaluation of change (where applicable)
		• no planned disposal of domestic waste, solid wastes or maintenance wastes overboard from vessels (other than planned discharges permitted by this EP). • food wastes discharges macerated to < 25 mm particle size.	
Waste management procedures will be implemented for the Crux project that: • provide for waste segregation and storage • safe handling and transport of waste, and • appropriate waste classification and disposal, recycling and landfill.	Yes	(EPS 11.4). Waste management procedures are in place and implemented which supports good practice and prevents accidental discharge by focusing on: • waste segregation and storage • safe handling and transport of waste • appropriate waste disposal classification (e.g. re-use, recycling, landfill). The disposal of non-hazardous and hazardous wastes will be tracked to confirm they are disposed of at an appropriately licensed waste facility.	The effective implementation of the waste management procedure is expected to result in no incidents of spills or the release of equipment, materials or waste to the ocean from the activity.
The disposal of non-hazardous and hazardous wastes will be tracked to confirm they are disposed of at an appropriately licensed waste facility.	Yes	(EPS 11.4). Waste management procedures are in place and implemented which supports good practice and prevents accidental discharge by focusing on: • waste segregation and storage • safe handling and transport of waste • records of all waste to be disposed, treated or recycled shall be maintained, and shall include (though not limited to) quantity of waste, waste type and disposal/recycle location waste streams shall be appropriately handled, tested, monitored and managed according to their hazard and recyclability class.	The effective implementation of the waste management procedure is expected to result in no incidents of spills or the release of equipment, materials or waste to the ocean from the activity.
The management and disposal of any quarantine risk material will be in accordance with relevant requirements of the Biosecurity Act 2015.	Yes	(EPS 11.2) Quarantine risk material is managed and disposed of in accordance with relevant requirements of the *Biosecurity Act 2015* (Cth).	
Liquid Discharges			
Utility Discharges - All planned discharges from vessels will comply with relevant requirements of MARPOL 73/78, the Navigation Act 2012, Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and any subsequent Marine Orders requirements (as appropriate for vessel classification).	Yes	(EPS 8.2) Vessel bilge and slops effluent will be discharged via an OIW separator compliant with MARPOL Annex I (and Marine Order 91: Marine pollution prevention – oil) requirements (≤15 mg/L). (EPS 8.6) Marine assurance will be undertaken for vessels, including a check for valid and in date IOPP certificates (as required by vessel class requirements and type) and ISPP Certificate (or equivalent voluntary statement of compliance audits where relevant) (as required by vessel class, size and type). (EPS 8.5) Vessels to comply with Marine Orders 94 and 95 (Marine pollution prevention – packaged harmful substances/garbage), specifically: • no planned disposal of domestic waste, solid wastes or maintenance wastes overboard from vessels (other than planned discharges permitted by this EP). • food wastes discharges macerated to < 25 mm particle size.	The marine assurance system is administered by Shell's marine team and, amongst other relevant requirements, ensures contract vessels comply with MARPOL, Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Cth) and Marine Order 91. The benefits outweigh the costs associated with implementing this control. Marine Order 97 requires specified marine vessels to possess the applicable pollution prevention and energy efficiency certificates. These certificates include Engine International Air Pollution Prevention Certificate (EIAPP), IAPP and an International Energy Efficiency (IEE) Certificate. In addition, all vessels >400 t (gross) are required to carry a Ship Energy Efficiency Management Plan (SEEMP). These requirements are also recognised and enforced in the Shell Marine Assurance Process and procedures.
Utility Discharges - The Crux platform deck drainage shall be managed to reduce impacts on the environment.	Yes	(EPS 8.3) Topsides deck drainage will be discharged via an oil-water separator (V-26501), except by design, where drain boxes discharge clean water directly overboard in the event of heavy rains or further wash water which is considered clean.	
Utility Discharges - Oily bilge water from machinery space drainage is treated to a maximum concentration of 15 ppm oil-in-water prior to discharge from vessels, as specified in MARPOL 73/78 (Annex I).	Yes	(EPS 8.2) Vessel bilge and slops effluent will be discharged via an OIW separator compliant with MARPOL Annex I (and Marine Order 91: Marine pollution prevention – oil) requirements (≤15 mg/L).	

Aspect / OPP Key Management Controls	EP achieves equivalent, or better, level of environmental performance?	EP Environmental Performance Standard[121]	Evaluation of change (where applicable)
Utility Discharges - Offshore discharge of sewage from vessels will be in accordance with Marine Order 96.	Yes	(EPS 8.6) Marine assurance will be undertaken for vessels, including a check for valid and in date IOPP certificates (as required by vessel class requirements and type) and ISPP Certificate (or equivalent voluntary statement of compliance audits where relevant) (as required by vessel class, size and type).	
Food wastes will be macerated to < 25 mm particle size whilst operational prior to discharge to sea, in accordance with Marine Order 95.	Yes	(EPS 8.5) Vessels to comply with Marine Orders 94 and 95 (Marine pollution prevention – packaged harmful substances/garbage), specifically: • no planned disposal of domestic waste, solid wastes or maintenance wastes overboard from vessels (other than planned discharges permitted by this EP). • food wastes discharges macerated to < 25 mm particle size.	
Containment around liquid hydrocarbon storage tanks will be installed on the Crux platform to reduce the potential for minor accidental releases of chemicals/hydrocarbons to the environment.	Yes	(EPS 8.4) Containment installed around liquid hydrocarbon storage tanks.	
For chemicals planned to be used in production and process (including in the subsea facilities and well) and for hydrotesting, and which will be discharged to the marine environment, will be selected in accordance with the Chemical Management Process for chemical selection and assessment of effects on the environment.	Yes	(EPS 7.20) Chemicals that are planned for discharge to sea meet the following criteria: • are substitution warning free and rated Gold, Silver, D, or E through the Offshore Chemical Notification Scheme (OCNS), or are considered to Pose Little or No Risk to the Environment (PLONOR) (listed by the Oslo and Paris Convention for the Protection of the Marine Environment of the North-east Atlantic [OSPAR] Commission),or have a complete ALARP assessment. • are screened against the IChEMS register with: o no use, importation or discharge or chemicals listed in Schedule 7 unless exempted under Commonwealth Legislation. o a complete ALARP assessment for chemicals listed in Schedule 6.	
An evaluation will be undertaken prior to hydrotesting of the Crux export pipeline to inform the selection of the discharge location of the pipeline hydrotest water (i.e. Crux versus Prelude end of the pipeline). The evaluation will include a comparison of environmental impacts between the two discharge locations, to determine which location has the lowest environmental impact. The evaluation will also consider safety and technical factors as part of the decision-making process.	N/A	N/A	Not relevant to the scope covered by the EP.
An environmental monitoring program and adaptive management framework will be developed for PFW. The monitoring program will include: • continuous monitoring, whilst available, of PFW discharge volume (online flow meter) and dispersed oil-in-water (online oil-in-water analyser) • chemical characterisation of PFW – DTA will be completed when a suitably representative PFW sample of normal operations can be taken, and then on a risk-based approach thereafter • additional monitoring as a result of trigger actions, and • periodic environment monitoring within the in-field development area.	Yes	(EPS 7.1) Produced water dispersed oil content of the discharge shall not exceed 30 mg/L (daily average) during start-up and operations. (EPS 7.4) PW discharge will be monitored via DCS by an operator with assistance of a PW dispersed OIW high alarm. (EPS 7.21) PW discharge will not exceed the relevant threshold concentration set by Direct Toxicity Assessment (DTA) at the edge of the mixing zone boundaries set for PC80, PC95 and PC99. Until mixing zone boundaries are set by DTA results and outcomes of the mixing zone verification study, mixing zone boundaries will be: • PC80 at 100m of the platform. • PC95 at 500m of the platform. • PC99 at 1000m of the platform. (EPS 7.25) Implement adaptive management actions in accordance with the AMF (step 6).	
The oil-in-water concentration of PFW will be continuously monitored by an online analyser, while available, which will be fitted with an alarm that activates if the oil-in-water concentration is > 30 mg/L.	Yes	(EPS 7.1) Produced water dispersed oil content of the discharge shall not exceed 30 mg/L (daily average) during start-up and operations. (EPS 7.3) Produced water dispersed oil content shall not exceed 95 mg/L (daily average) during second stage well clean-up or well clean-ups associated with well workovers or interventions, for up to 36 discharge hours per well. (EPS 7.2) Review produced water dispersed oil content performance following 12 months of commencing NNM Phase 1, but not more than 24 months following start-up. Purpose of the review is to take actions to reduce EPS 7.1 toward the operational target 20 mg/L (daily average). (EPS 7.4) PW discharge will be monitored via DCS by an operator with assistance of a PW dispersed OIW high alarm. (EPS 7.10) During routine operations, the OIW analyser shall be validated in accordance with the CMMS.	Crux OPP key management control addressed through numerous subdivided controls/EPS in the EP, including EPS 7.1 which specifies the dispersed oil-in-water concentration limits for PW and associated monitoring/measurement records to validate performance.

Aspect / OPP Key Management Controls	EP achieves equivalent, or better, level of environmental performance?	EP Environmental Performance Standard[121]	Evaluation of change (where applicable)
Calibration of the online analyser will be undertaken regularly during the initial start-up phase.	Yes	(EPS 7.11) During initial facility start-up, the OIW analyser will be validated monthly until confidence in the system's accuracy is achieved.	During initial facility start-up the analysers will be validated on a regular basis (calibration is performed only at commencement).
Calibration of the online analyser will be undertaken regularly during the initial start-up phase.	Yes	(EPS 7.11) During initial facility start-up, the OIW analyser will be validated monthly until confidence in the system's accuracy is achieved.	During initial facility start-up the analysers will be validated on a regular basis (calibration is performed only at commencement).
No planned discharge of whole SBM will occur during development drilling.	N/A	N/A	Not relevant to the scope covered by the EP.
When using SBM, the solids control equipment will reduce the residual base fluid on cuttings content prior to discharge overboard. Residual base fluid on cuttings will be less than 10% w/w averaged over all well sections using SBM.	N/A	N/A	Not relevant to the scope covered by the EP.
If drilling for future tie-backs is proposed within 2 km of the shoals within the Crux in-field development area then additional modelling will be undertaken. The concept select for any future tie-backs will use the results of the modelling to inform selection, to achieve acceptable impacts.	N/A	N/A	Not relevant to the scope covered by the EP.
Should new regionally relevant information become available that provides scientific evidence that 2 km is not a suitably conservative buffer to protect drill cuttings and fluid impacts on coral communities at the shoals as related to tie-backs, Shell will apply an adaptive management approach informed by further validation modelling.	N/A	N/A	Not relevant to the scope covered by the EP.
Unplanned Spills			
Vessel specific controls will align with MARPOL 73/78, the Navigation Act 2012, the Protection of the Sea (Prevention of Pollution from Ships Act 1983 and subsequent Marine Orders (as appropriate for vessel classification), which includes managing spills aboard, emergency drills and waste management requirements.	Yes	(EPS 11.3) Vessels have and implement a valid SOPEP (appropriate to class) to respond to spills. (EPS 8.6) Marine assurance will be undertaken for vessels, including a check for valid and in date IOPP certificates (as required by vessel class requirements and type) and ISPP Certificate (or equivalent voluntary statement of compliance audits where relevant) (as required by vessel class, size and type). (EPS 8.5). Vessels to comply with Marine Orders 94 and 95 (Marine pollution prevention – packaged harmful substances/garbage), specifically: • no planned disposal of domestic waste, solid wastes or maintenance wastes overboard from vessels (other than planned discharges permitted by this EP). • food wastes discharges macerated to < 25 mm particle size.	

All vessels operating within the project area will adhere to the navigation safety requirements contained within the COLREGS, Chapter 5 of the SOLAS Convention, STCW Convention, the Navigation Act 2012 and any subsequent Marine Orders, which specify standards for crew training and competency, navigation, communication, and safety measures.	Yes	(EPS 1.3) Vessels will be equipped and crewed in accordance with the *Navigation Act 2012* (Cth) (as applicable for vessel size, type and class), including implementing:
		• Marine Order 21 (Safety and emergency procedures), including:
		  ○ safety measures such as manning and watchkeeping.
		• Marine Order 27 (Safety of navigation and radio equipment), including:
		  ○ radio equipment and communications
		  ○ navigation safety measures and equipment
		  ○ danger, urgency and distress signals and messages.
		• Marine Order 30 (Prevention of Collisions), including:
		  ○ lights and signals as applicable to vessel class per COLREGS requirements.	

Aspect / OPP Key Management Controls	EP achieves equivalent, or better, level of environmental performance?	EP Environmental Performance Standard[121]	Evaluation of change (where applicable)
		• Marine Order 71 (Masters and Deck Officers), including: ○ all master, mate and watchkeeper officer duties undertaken by crew certified as applicable to vessel class per STCW Convention) requirements.	
Offshore Vessel Inspection Database or equivalent reviewed prior to mobilisation of vessels.	Yes	(EPS 8.6) Marine assurance will be undertaken for vessels, including a check for valid and in date IOPP certificates (as required by vessel class requirements and type) and ISPP Certificate (or equivalent voluntary statement of compliance audits where relevant) (as required by vessel class, size and type).	
Australian Hydrographic Service notified of location of installed infrastructure to facilitate inclusion on nautical charts.	Yes	(EPS 1.1) Active PSZ notification and infrastructure locations issued through AHO.	
Australian Hydrographic Service advised of project activities and installed infrastructure to facilitate issuing Notices to Mariners.	Yes	(EPS 1.2) AHO is notified, at least four weeks prior, to enable a 'Notice to Mariners' to be issued before activities under this EP commence.	
Accepted WOMP in place for all wells, in accordance with the OPGGS Act requirements. The WOMP will outline the barriers in place throughout the construction and operation of the well to prevent a loss of well control. For development drilling, the WOMP will include: • maintaining overbalance in the well through the use of weighted drilling fluids, • installation of a BOP during drilling operations of the bottom hole sections, and • regular testing of BOP	Yes	N/A	
Accepted EPs and OPEPs in place for all petroleum activities appropriate to the nature and scale of the credible hydrocarbon spill risks. The BROPEP includes an Operational and Scientific Monitoring Program will be initiated and implemented as appropriate to the nature and scale of the spill and the existing environment, as informed by a net environmental benefit assessment. The BROPEP shall consider: • relief well planning and preparedness • interim source control (e.g. capping stacks for subsea well blowouts) • oiled wildlife response, and • operational and scientific monitoring.	N/A	N/A	Addressed by EP and BROPEP submissions
Stakeholder consultation throughout the Crux project, including consultation consistent with the requirements of the OPGGS (E) Regulations for all subsequent petroleum activities and associated EPs.	N/A	N/A	Subject of this EP. No equivalent control/ EPS - addressed through consultation process, as described in Section 5 of EP.

Where vessel dynamic positioning systems are required, they shall be in working order whilst within the Crux platform petroleum safety zone at all times.	Yes	(EPS 1.3) Vessels will be equipped and crewed in accordance with the *Navigation Act 2012* (Cth) (as applicable for vessel size, type and class), including implementing:
		• Marine Order 21 (Safety and emergency procedures), including:
		  ○ safety measures such as manning and watchkeeping.
		• Marine Order 27 (Safety of navigation and radio equipment), including:
		  ○ radio equipment and communications
		  ○ navigation safety measures and equipment
		  ○ danger, urgency and distress signals and messages.
		• Marine Order 30 (Prevention of Collisions), including:	

Aspect / OPP Key Management Controls	EP achieves equivalent, or better, level of environmental performance?	EP Environmental Performance Standard[121]	Evaluation of change (where applicable)
		○ lights and signals as applicable to vessel class per COLREGS requirements. • Marine Order 71 (Masters and Deck Officers), including ○ all master, mate and watchkeeper officer duties undertaken by crew certified as applicable to vessel class per STCW Convention) requirements.	
Development and implementation of a maintenance management system for the Crux platform, export pipeline and subsea infrastructure.	Yes	(EPS 12.5) Subsea pipeline, riser, SSIVs and hydrocarbon containing infrastructure to be inspected in accordance with the risk-based inspection schedule and maintained in accordance with the CMMS to ensure condition remains fit for purpose. (EPS 12.6) RESDV is maintained in accordance with the CMMS. (EPS 12.7) SCSSV is maintained in accordance with the CMMS.	
Development of simultaneous operations (SIMOPS) plans where interactions with other activities (e.g. Prelude operations, backfill installations) may credibly occur.	Yes	(EPS 12.8) Shell will implement the Manual of Permitted Operations (MOPO) to manage simultaneous operations.	
Concrete coating of the majority of the export pipeline reduces the risk of a dropped object damaging the pipeline.	N/A	N/A	Inherent in Activity description for previous EPs. Not relevant to the scope covered by this EP.
The Crux platform will have controls/systems in place that will assist with the early detection of spills/leaks from the NNM platform, including: • fire and gas system, • satellite monitoring of the Crux platform location, and • continuous process control monitoring system (assist in detection of significant leaks).	Yes	(EPS 12.9) Operator Start of Shift Orientation (SoSO) rounds will be implemented to maintain situational awareness of the facility.	
Assess feasible design and monitoring controls that will assist with the early detection of spills/leaks from the Crux platform. Controls that are considered compatible with the NNM philosophy will be implemented, unless it can be demonstrated that the 'cost' is grossly disproportionate to the benefit gained.	Yes	(EPS 12.5) Subsea pipeline, riser, SSIVs and hydrocarbon containing infrastructure to be inspected in accordance with the risk-based inspection schedule and maintained in accordance with the CMMS to ensure condition remains fit for purpose. (EPS 12.9) Operator Start of Shift Orientation (SoSO) rounds will be implemented to maintain situational awareness of the facility.	
Selection of key material will take corrosion into account.	N/A	N/A	EP scope does not involve design considerations of material selection.
Pigging of the Crux gas export pipeline will be undertaken as required throughout operations to detect defects, assess integrity and enable risk-based management of the pipeline.	Yes	(EPS 12.5) Subsea pipeline, riser, SSIVs and hydrocarbon containing infrastructure to be inspected in accordance with the risk-based inspection schedule and maintained in accordance with the CMMS to ensure condition remains fit for purpose.	
Fuel type will be considered in the construction vessel contracting process where alternatives to marine diesel are being considered.	N/A	N/A	Scope does not involve construction, and all vessels are diesel fuelled (MDO or MGO).

Table G-3 Concordance with Crux Gas Field Development OPP - Description of the Project and Alternatives Analysis

OPP Section	OPP Overview	EP Description	Refinement or modification	New activity or infrastructure	Significance of change to overall environmental impact or risk described in accepted Crux OPP
5.4	Crux Final Investment (FID) as outline in the Crux OPP states a decision will be made in 2020	The Crux FID Decision was made in May 2022 for the Crux Project.	Yes	No	The Crux FID decision was made later than planned. There were no significant overall impacts to risk or environment from this change.

OPP Section	OPP Overview	EP Description	Refinement or modification	New activity or infrastructure	Significance of change to overall environmental impact or risk described in accepted Crux OPP
Table 5-1	Crux infrastructure designed to withstand a minimum period of 20 years. However, subject to future investment decisions, operations may extend platform and pipeline life.	The Crux Facility design life is 20 years. The Operating Plan (production forecast) for the EP is 15 years (and subject to annual review), and this has been used for emissions estimates.	Yes	No	There is no change in the EP for design life or extension of operations relative to the Crux OPP. This EP, however, introduces the Operating Plan of 15 years, and this used for emission calculations. The Operating Plan is subject to extension based on actual reservoir reserves, efficiencies in the recovery of hydrocarbons and the potential for future developments and subsea tiebacks to extend the operating life. No significant impacts to risks or environment are presented by this change.
5.5.1.2	Crux platform design nominates low shear valves for OIW reduction for PW.	Low shear valves have been removed from the permanent design of the platform. They will be purchased, stored, and made available should they be suitable. Additional treatment has been designed for oil removal by modification of the degasser to include dissolved gas flotation.	Yes	No	In the Crux OPP, a low-shear level control valve was nominated as selected treatment technology to maximise the size of oil droplets in the produced water streams. It was decided during detailed engineering design of the facility that the low shear valves will be purchased, but not installed and kept as back-up. The reason for this is because engineering assessments concluded that due to produced water service and high pressure drop, these low shear valves will potentially experience cavitation resulting in risk of rapid valve degradation, with potential for failure and loss of containment. Additionally, whilst low-shear valves may reduce shearing, the resultant oil droplet size is not significantly improved as the valve is required to operate in a high pressure drop (high shear) service. For start-up, two anti-cavitation valves were instead selected and installed to mitigate against cavitation risks. Cavitation will be assessed through physical observation and sound monitoring when operations commence and continued with surveillance and PTM during the unmanned mode. In addition, Shell have purchased and will keep the low shear valves as spares which can be installed during commissioning and startup, if required to address separation performance. This design change is considered ALARP and acceptable as additional produced water treatment (dissolved gas flotation) has been included as a modification to the degasser, providing additional direct treatment capability to separate small oil droplets from the produced water and therefore comply with the basis of design. This engineering solution was not previously considered in the OPP. There are no significant changes to risk or environmental impact.
5.5.1.2	As a NNM platform, the intent is that the Crux platform will be operated remotely from the Prelude FLNG facility.	Remote monitoring from Prelude FLNG and Integrated Operations Centre (IOC).	Yes	No	The design has enabled remote operations from either the Prelude FLNG facility or the Integrated Operations Centre (IOC) (i.e., an additional remote operations centre) to support flexibility. There are no increased risks or environmental impacts associated with this change.
5.8.2.3	Disposal to ocean [of produced water] via piping terminated ~+8 m above sea level.	This EP outlines that produced water discharge to sea from a height of ~+20 m above sea level (not +8 m).	Yes	No	Detailed engineering assessed the piping system that should be used for produced water discharge and multi-disciplinary assessment concluded that the discharge height would be ~20 metres. This change does not present an increase in risk or environmental impacts to those outlined in the Crux OPP.

Appendix H Detailed GHG Assumptions

This Appendix includes eight (8) separate assumption sheets:

H.1: Detailed GHG Assumptions (Emissions Summary Table 9-70 Expanded)

H.2: Detailed GHG Assumptions (Completions – 1st Stage Well Cleanup Flaring)

H.3: Detailed GHG Assumptions (HP Flaring – Hot Commissioning, Start-up, Operations)

H.4: Detailed GHG Assumptions (Operations)

H.5: Detailed GHG Assumptions (Prelude FLNG Processing of Crux and Prelude Energy)

H.6: Detailed GHG Assumptions (Infield Scope 3 Emissions)

H.7: Detailed GHG Assumptions (Supply Chain, Transport, and Third-Party End Use)

H.8: GHG Forecasts and Activity Durations Concordance Table

The following general assumptions apply to all GHG data provided in Appendix H and in EP:

- Variance within the EP and lifecycle periods may occur.
- The data is based on current Operating Plan, which may change.
- Operating Plans have inbuilt assumptions on utilisation rates and outcome probabilities.
- The Operating Plan is based on mid-case production outcomes and probabilities, which may change based on actual level of reservoir and/or systems performance.
- While assumptions made have been robustly considered, actual GHG emissions may vary based on operational factors and changes to Operating Plan.
- Operating Plan and forecasts are reviewed regularly and may change which will change forecasts.
- GHG emissions estimates will be reviewed after the first NGER reporting period.
- Completions and Year 1 GHG emissions forecasts may extend into Years 1 or 2, affecting estimates for subsequent years.
- Data extracted from detailed emissions model - due to rounding of this data - some totals may not appear to be exact.

H.1 Detailed GHG Assumptions (Emissions Summary Table 9-70 Expanded)

GHG Emissions Estimate / Detailed Assumptions (~MtCO2-e)	Completions Phase Forecast[122]	Year 1[123]	Year 2	Year 3	Year 4	Year 5	5 Year Total[124]	Lifecycle Total	Lifecycle Average
	1st stage cleanup and associated support	Hot Comm, Start-up (including 2nd stage cleanup), Operation	Operation				All EP Phases	15 Year Lifecycle	
Direct Emissions (Scope 1)									
Flare systems, power generation and fugitive emissions. Detailed Assumptions: Appendix H:3: HP Flaring. Appendix H:4: Operations.	-	0.24[125]	0.08	0.08	0.07	0.08	0.55	1.3	0.09
Indirect Emissions (Scope 3) – Crux Energy									
Well Completions 1st stage cleanup (flaring). Detailed Assumptions: Appendix H:2: Well Completions – 1st Stage Well Cleanup Flaring	0.05	0	0	0	0	0	0.05	0.05	-
Marine Vessels, Aviation and Temporary Diesel Generation. Detailed Assumptions: Appendix H:6: Infield Scope 3 Emissions	0.03	0.03	0.01	0.03	0.01	0.01	0.13	0.22	0.01
Prelude FLNG Processing (Crux Only)* Detailed Assumptions: Appendix H:5: Prelude Processing of Crux and Prelude Energy	-	0.43	1.46	1.48	1.95	2.15	7.48	24.8	1.7
Supply Chain, Transport, & Third-Party End Use (Crux Only)^ Detailed Assumptions: Appendix H:7: Supply Chain, Transport, and Third-Party End Use	-	2.62	6.7	7.2	9.0	10.1	35.6	100.8	6.7
Total Crux Energy Indirect Emissions (Scope 3)	0.08	3.1	8.1	8.8	10.95	12.3	43.2	125.8	8
Total Crux Energy Direct and Indirect Emissions (Scope 1 and 3)	0.08	3.3	8.2	8.8	11.0	12.3	43.8	127.1	8
Indirect Emissions (Scope 3) – Crux and Prelude Energy									
***Total Prelude FLNG Processing (Prelude & Crux).** Detailed Assumptions: Appendix H:5: Prelude Processing of Crux & Prelude Energy	-	2.31	2.93	2.57	2.96	2.97	13.73	33.1	2.2
^Total Supply Chain, Transport, Third-Party End Use (Prelude & Crux). Detailed Assumptions: Appendix H:7: Supply Chain, Transport, and Third-Party End Use	-	13	16	14	15	15	74	150	10
Total Crux and Prelude Energy Indirect Emissions (Scope 3)	0.08	15.8	18.7	16.9	18.4	18.3	88.1	183.5	12.24
Total Crux and Prelude Energy Direct and Indirect Emissions (Scope 1 and 3)	**0.08**	**16**	**19**	**17**	**18**	**18**	**89**	**184.9**	**12.33**

[122] This is a phase specific forecast. Some, or all, of these emissions may occur within the Year 1 timeframe.
[123] Includes hot commissioning activity, second stage clean-up, start-up and first year operations (export to Prelude FLNG). Start-up flaring assumptions are detailed in Appendix H:3.
[124] Fabrication and transport scope 3 emissions are excluded, as these GHG emissions are primarily embedded/entrained in infrastructure. Consequently, completed or discontinued GHG emissions are not included in evaluation.
[125] Includes flaring during hot commissioning (~0.00367 $MtCO_2$-e or 3,679 tCO_2-e); flaring during startup (~0.22 $MtCO_2$-e or 220,542 tCO_2-e), and operational flaring (~0.004 $MtCO_2$-e or 4,068 tCO_2-e). Refer Appendix H.3 for details relating to the Year 1 flaring component, Appendix H.4 for remainder of operations emissions.

H.2 Detailed GHG Assumptions (Completions – 1st Stage Well Cleanup Flaring)

Completions Phase Flaring GHG Emissions (1st Stage Well Cleanup)

Assumption	CU W1	CU W2	CU W3	CU W4	CU W5
Duration (days)	1	1	1	1	1
Rate (MMscfd)	90	90	90	90	90
MMscf Flared	90	90	90	90	90
Tonnes Flared	2,340	2,340	2,340	2,340	2,340
Flaring Contingency (tonnes)	936	936	936	936	936
Tonnes flared	3,276	3,276	3,276	3,276	3,276
Flared CO_2 (tCO_2-e)	8,845	8,845	8,845	8,845	8,845
Flared CH_4 (tCO_2-e)	436	436	436	436	436
Flared N_2O (tCO_2-e)	85	85	85	85	85
Fugitive CO_2 (tCO_2-e)	9	9	9	9	9
Fugitive CH_4 (tCO_2-e)	641	641	641	641	641
Cumulative tCO_2-e (MtCO2-e)	**10,015 (0.01)**	**20,031 (0.02)**	**30,046 (0.03)**	**40,062 (0.04)**	**50,077 (0.05)**

Total GHG	tCO_2-e	$MtCO_2$-e
CO_2	44,269	0.044
CH_4	5,832	0.005
N_2O	426	0.0004
Total	**50,077**	**0.05**

NGER Refers to F2024L01063 (August 2024) National Greenhouse and Energy Reporting (Measurement) Determination 2008

Flaring as per NGER Section 3.86 Method 1.

Fugitive emissions as per Subdivision 3.3.2.3.1; 3.46AB Method 1.

H.3 Detailed GHG Assumptions (HP Flaring – Hot Commissioning, Start-up, Operations)

Forecast Assumptions - Hot Commissioning, Start-up and Operations HP Flaring

#	Activity	MMscf	Events	Volume (m^3)	Tonnes Flared	CO_2	CH_4	N_2O	tCO_2-e	$MtCO_2$-e
Hot Commissioning GTGs										
1	Fuel gas function testing [7 days @ 0.5MMSCFD]. Assumptions: To enable first start-up of fuel gas from pipeline gas based on minimum superheater flow requirements. 1 scf = 0.028 m^3 and density = 0.910 kg/ m^3.	3.5	1	98,000	89	241	12	2	255	0.0003
2	GTG Commissioning [22 days @ 1.5MMSCFD]. Assumptions: 2 x GTG commissioning ~14 days at ~45% load each. Assume 1 scf = 0.028 m^3 and density = 0.910 kg/m^3.	33	1	924,000	841	2,270	112	22	2,404	0.002
3	Re-Start Fuel Gas [7 days @ 2MMSCFD]. Assumptions: Post GTG commissioning positive isolation removal, LP FG will be supplied to all users as TEG circulation commences and other start-up activities are performed (e.g. start-up of Produced Water system). Assume 1 scf = 0.028 m^3 and density = 0.910 kg/m^3.	14	1	392,000	357	963	47	9	1,020	0.001
Hot Commissioning Sub-Total		50.5	-	1,414,000	1,287	3,474	171	33	3,679	0.0037
Startup (Open Crux Wells)										
4	Open Wells and Pressurize Topsides [10 days @ 38MM scfd]. Assume 1 scf = 0.028 m^3 and density = 0.910 kg/m^3.	380	1	10,640,000	9,862	26,142	1,288	252	27,682	0.028
5	Operate until 1st ESD Test [8 days @ 3MM scfd]. Assume 1 scf = 0.028 m^3 and density = 0.910 kg/ m^3.	24	1	672,000	612	1,651	81	16	1,748	0.002
6	1st ESD Test [1 event @ 6.7MM scf]. Assume 1 scf = 0.028 m^3 and density = 0.910 kg/ m^3.	6.7	1	187,600	171	461	23	4	488	0.0005
7	Restart FG post ESD Test and Operate Platform [15 days @ 2MM scfd]. Assume 1 scf = 0.028 m^3 and density = 0.910 kg/ m^3.	30	1	840,000	764	2,064	102	20	2,185	0.002
8	Re-Open Wells and Re-Pressurise Topsides [3 days @ 38MM scfd]. Assume 1 scf = 0.028 m^3 and density = 0.910 kg/ m^3.	114	1	3,192,000	2,905	7,843	386	76	8,305	0.008
9	Open Supply to Prelude [4 days @ 85MM scfd]. Assume 1 scf = 0.028 m^3 and density = 0.910 kg/ m^3.	340	1	9,520,000	8,663	23,391	1,152	225	24,768	0.025
10	Flaring - Restarts during SURU (in addition to operations restarts). Assume 1 scf = 0.028 m3 and density = 0.910 kg/ m^3.	4.75	9	1,197,000	1,089	2,941	145	28	3,114	0.003
11	Contingency flaring to manage minimum flowrates [18 days @ 50MM scfd]. Assume 1 scf = 0.028 m^3; density = 0.910 kg/ m^3.	900	1	25,200,000	22,932	61,916	3,050	596	65,563	0.066
12	Contingency - extended commissioning (2-weeks @ 85MM scfd). Assume 1 scf = 0.028 m^3 and density 0.910 kg/m^3.	1,190	1	33,320,000	30,321	81,867	4,033	788	86,688	0.087
Startup Sub-Total		2,989	-	84,768,600	77,139	208,776	10,260	2,006	220,542	0.2205
Hot Commissioning and Startup Total		**3,040**	**-**	**86,182,600**	**78,426**	**211,751**	**10,431**	**2,039**	**224,220**	**0.224**

Operational Flaring Assumptions (HP Flaring assumptions except for initial startup)

#	Activity	Frequency	Flared Gas (MMscf)
1	Flaring - Restarts during Normal Operations (3-hours @ 38MM scfd). Restarts require flaring of 38MM scfd for 3-hours to ensure gas dehydration is on-spec (4.75MMscf / restart).	10 per year	4.75
2	Flaring - Blowdown / Emergency Depressurisation. 15 min blowdown @ 695,542 kg/hr. Assumes 4 full unplanned blowdowns per year (highly conservative to cover expected range of uncertainty).	4 per year	7
3	Flaring - Restarts during Planned Shutdown for Maintenance (3-hours @ 38MM scfd). Restarts require flaring of 38MM scfd for 3-hours to ensure gas dehydration is on-spec (4.75MMscf / restart).	1 per maintenance shutdown	4.75

Lifecycle Timeline of HP Flaring Input Assumptions

#	Activity	No. of Normal Restarts (Per Year)	# Additional Restarts (Start-up Phase)	No. of ESD Blowdown (Per Year)	Flaring Quantity (MMscf)	Flaring Quantity (%) (Hot Comm/Startup)
1	Hot Commissioning & Start-up (Year 1 of lifecycle)	3	9	1	3,099	98%
2	NNM Operations Phase 1 (Year 2 of lifecycle)	10 Note 1	21 Note 2	4	174	-
3	NNM Operations Phase 1/ 2 (10 years in lifecycle)	10 Note 1	0	4	74	-
4	Planned Shutdown for Maintenance Campaign (3 years in lifecycle)	11	0	4	79	-

Note 1: The forecast frequency of ten (10) restarts in normal operations is assumed based on the probability of safety functions such as faults/trips and process upsets that may eventuate during an operating year to prevent potential for escalations and emergencies. This forecast is based on the findings of an Integrated Reliability, Availability and Maintainability (RAM) Study. Shell takes a conservative view in business planning to try and give a realistic view of the expected performance of an asset. Internal goals will be set consistent with EPS/GHGEMP which aim to improve significantly on these assumptions.

Note 2: Additional restarts allowance is built-into the Operating Plan based on risks such as: (i) management of minimum Crux export pipeline flowrates (ii) difficulty in achieving gas export water specifications, (iii) hydrate formation in the platform topsides or export pipeline requiring depressurisation activities, (iv) instrumentation having false alarms resulting in platform depressurisation (for example, fie and gas alarms). The basis for the assumed trips/restarts is recorded in a SURU Duration and Availability Report and includes conservatism based on P90 (or worst case) probability outcomes. This probability basis is considered a conservative and robust basis for a new facility to progress toward safe and steady production. The probability analysis developed by Shell uses Primavera Risk Analysis (PRA), which is the same tool used for all project schedule and cost analysis. The steps followed to perform this analysis is extensive. It requires the development of a deterministic schedule based on demand profile, workshops to identify and rank all risk scenarios that has an impact on SURU duration, management of identified risks in a risk register and running statistical analysis. The PRA outputs are benchmarked to ensure the plan is complaint with Shell global standards for the start-up and ramp up of a major hazard facility. Shell takes a conservative view in business planning to try and give a realistic view of the expected performance of an asset. Internal goals will be set consistent with EPS/GHGEMP which aim to improve significantly on these assumptions.

H.4 Detailed GHG Assumptions (Operations)

5-Year Summary

GHG FORECAST (tCO_2-e)				Year 1 (Notes 6,11,12)					Year 2 (Notes 5,12)					Year 3 (Notes 5,12)					Year 4 (Notes 5,11,12)					Year 5 (Notes 7,12)				
				Energy	CO_2	CH_4	N_2O	CO_2-e	Energy	CO_2	CH_4	N_2O	CO_2-e	Energy	CO_2	CH_4	N_2O	CO_2-e	Energy	CO_2	CH_4	N_2O	CO_2-e	Energy	CO_2	CH_4	N_2O	CO_2-e
EP Group	**Equipment**	**#**	**Notes**	**GJ/y**	**tCO_2-e**				**GJ/y**	**tCO_2-e**				**GJ/y**	**tCO_2-e**				**GJ/y**	**tCO_2-e**				**GJ/y**	**tCO_2-e**			
Power Generation	GTG Power Generation	A	1	106,902	5,495	11	3	5,509	447,939	23,024	45	13	23,082	492,963	25,338	49	15	25,402	403,369	20,733	40	12	20,786	502,524	25,830	50	15	25,895
Flaring - Pilot & Purge	Pilot Gas LP and HP Flare	B	2	589	37	2	0	39	2,273	142	7	1	150	2,439	152	8	1	161	2,020	126	6	1	134	2,431	152	7	1	161
	Purge Gas to LP Flare Header	C	2	171	11	1	0	11	661	41	2	0	44	709	44	2	0	47	587	37	2	0	39	706	44	2	0	47
Flaring - Offgas (TEG)	TEG Regen Offgas	D	2	42,749	2,888	142	28	3,058	453,885	30,660	1,510	295	32,466	499,507	33,742	1,662	325	35,729	408,723	27,609	1,360	266	29,235	502,393	33,937	1,672	327	35,935
	Rich TEG Flash Drum Offgas	E	2	10,082	884	44	9	936	87,887	7,707	380	74	8,161	96,720	8,482	418	82	8,981	79,142	6,940	342	67	7,349	98,358	8,625	425	83	9,133
Flaring - Offgas (PW)	PW Degasser Offgas	F	2	692	85	4	1	90	10,502	1,287	63	12	1,363	11,558	1,416	70	14	1,500	9,457	1,159	57	11	1,227	11,772	1,443	71	14	1,528
	PW DGF Fuel Gas	G	2	62	4	0	0	4	855	53	3	1	57	917	57	3	1	61	760	48	2	0	50	917	57	3	1	61
Flaring - Pilot & Purge	Purge Gas to HP Flare Header	H	2	1,875	117	6	1	124	7,240	453	22	4	479	7,767	486	24	5	514	6,434	402	20	4	426	7,741	483	24	5	512
Flaring - HP	Flare Blowdown HP Flare Tip	I	2	3.4E+06	215,592	10,620	2,076	228,288	193,894	12,127	597	117	12,841	82,887	5,184	255	50	5,489	88,173	5,515	272	53	5,839	82,887	5,174	255	50	5,479
Diesel Consumers	Black Start Diesel Generator	J	2	1,496	105	0	0	105	1,496	105	0	0	105	1,496	105	0	0	105	1,496	105	0	0	105	1,496	105	0	0	105
Fugitive Emissions	NGER Leakage - General	K	3	-	21.6	1,639	0	1,661	-	21.6	1,639	0	1,661	-	21.6	1,639	0	1,661	-	21.6	1,639	0	1,661	-	21.6	1,639	0	1,661
	NGER Leakage - PW	L	4	-	0	21	0	21	-	0	75	0	75	-	0	75	0	75	-	0	75	0	75	-	0	75	0	75
Total				**3.6E+06**	**225,238**	**12,489**	**2,118**	**239,845**	**1.2E+06**	**75,621**	**4,343**	**519**	**80,483**	**1.2E+06**	**75,028**	**4,205**	**492**	**79,725**	**1.0E+06**	**62,695**	**3,815**	**415**	**66,926**	**1.2E+06**	**75,871**	**4,223**	**496**	**80,590**

GHG FORECAST ($MtCO_2$-e)				Year 1 (Notes 6,11,12)					Year 2 (Notes 5,12)					Year 3 (Notes 5,12)					Year 4 (Notes 5,11,12)					Year 5 (Notes 7,12)				
				Energy	CO_2	CH_4	N_2O	CO_2-e	Energy	CO_2	CH_4	N_2O	CO_2-e	Energy	CO_2	CH_4	N_2O	CO_2-e	Energy	CO_2	CH_4	N_2O	CO_2-e	Energy	CO_2	CH_4	N_2O	CO_2-e
EP Group	**Equipment**	**#**	**Notes**	**GJ/y**	**$MtCO_2$-e**				**GJ/y**	**$MtCO_2$-e**				**GJ/y**	**$MtCO_2$-e**				**GJ/y**	**$MtCO_2$-e**				**GJ/y**	**$MtCO_2$-e**			
Power Generation	GTG Power Generation	A	1	0.1069	0.0055	0.0000	0.0000	0.0055	0.4479	0.0230	0.0000	0.0000	0.0231	0.4930	0.0253	0.0000	0.0000	0.0254	0.4034	0.0207	0.0000	0.0000	0.0208	0.5025	0.0258	0.0001	0.0000	0.0259
Flaring - Pilot & Purge	Pilot Gas LP and HP Flare	B	2	0.0006	0.0000	0.0000	0.0000	0.0000	0.0023	0.0001	0.0000	0.0000	0.0002	0.0024	0.0002	0.0000	0.0000	0.0002	0.0020	0.0001	0.0000	0.0000	0.0001	0.0024	0.0002	0.0000	0.0000	0.0002
	Purge Gas to LP Flare Header	C	2	0.0002	0.0000	0.0000	0.0000	0.0000	0.0007	0.0000	0.0000	0.0000	0.0000	0.0007	0.0000	0.0000	0.0000	0.0000	0.0006	0.0000	0.0000	0.0000	0.0000	0.0007	0.0000	0.0000	0.0000	0.0000
Flaring - Offgas (TEG)	TEG Regen Offgas	D	2	0.0427	0.0029	0.0001	0.0000	0.0031	0.4539	0.0307	0.0015	0.0003	0.0325	0.4995	0.0337	0.0017	0.0003	0.0357	0.4087	0.0276	0.0014	0.0003	0.0292	0.5024	0.0339	0.0017	0.0003	0.0359
	Rich TEG Flash Drum Offgas	E	2	0.0101	0.0009	0.0000	0.0000	0.0009	0.0879	0.0077	0.0004	0.0001	0.0082	0.0967	0.0085	0.0004	0.0001	0.0090	0.0791	0.0069	0.0003	0.0001	0.0073	0.0984	0.0086	0.0004	0.0001	0.0091
Flaring - Offgas (PW)	PW Degasser Offgas	F	2	0.0007	0.0001	0.0000	0.0000	0.0001	0.0105	0.0013	0.0001	0.0000	0.0014	0.0116	0.0014	0.0001	0.0000	0.0015	0.0095	0.0012	0.0001	0.0000	0.0012	0.0118	0.0014	0.0001	0.0000	0.0015
	PW DGF Fuel Gas	G	2	0.0001	0.0000	0.0000	0.0000	0.0000	0.0009	0.0001	0.0000	0.0000	0.0001	0.0009	0.0001	0.0000	0.0000	0.0001	0.0008	0.0000	0.0000	0.0000	0.0001	0.0009	0.0001	0.0000	0.0000	0.0001
Flaring - Pilot & Purge	Purge Gas to HP Flare Header	H	2	0.0019	0.0001	0.0000	0.0000	0.0001	0.0072	0.0005	0.0000	0.0000	0.0005	0.0078	0.0005	0.0000	0.0000	0.0005	0.0064	0.0004	0.0000	0.0000	0.0004	0.0077	0.0005	0.0000	0.0000	0.0005
Flaring - HP	Flare Blowdown HP Flare Tip	I	2	3.4487	0.2156	0.0106	0.0021	0.2283	0.1939	0.0121	0.0006	0.0001	0.0128	0.0829	0.0052	0.0003	0.0000	0.0055	0.0882	0.0055	0.0003	0.0001	0.0058	0.0829	0.0052	0.0003	0.0000	0.0055
Diesel Consumers	Black Start Diesel Generator	J	2	0.0015	0.0001	0.0000	0.0000	0.0001	0.0015	0.0001	0.0000	0.0000	0.0001	0.0015	0.0001	0.0000	0.0000	0.0001	0.0015	0.0001	0.0000	0.0000	0.0001	0.0015	0.0001	0.0000	0.0000	0.0001
Fugitive Emissions	NGER Leakage - General	K	3	-	0.0000	0.0016	0.0000	0.0017	-	0.0000	0.0016	0.0000	0.0017	-	0.0000	0.0016	0.0000	0.0017	-	0.0000	0.0016	0.0000	0.0017	-	0.0000	0.0016	0.0000	0.0017
	NGER Leakage - PW	L	4	-	0.0000	0.0000	0.0000	0.0000	-	0.0000	0.0001	0.0000	0.0001	-	0.0000	0.0001	0.0000	0.0001	-	0.0000	0.0001	0.0000	0.0001	-	0.0000	0.0001	0.0000	0.0001
Total				**3.613**	**0.225**	**0.012**	**0.002**	**0.240**	**1.207**	**0.076**	**0.004**	**0.001**	**0.080**	**1.197**	**0.075**	**0.004**	**0.000**	**0.080**	**1.000**	**0.063**	**0.004**	**0.000**	**0.067**	**1.211**	**0.076**	**0.004**	**0.000**	**0.081**

NOTES

1. Solar Centaur 40, Fuel Gas. NGAF Table 5; NGER Division 2.3.2 Method 1 Section 2.20.
2. NGER Section 3.86 Method 1. ~33 tpa over 200 \hours (periodic testing); 48 hours per unplanned shutdown (x3 pa).
3. NGER Subdivision 3.3.6B.1, 3.73F Method 1.
4. Produced water fugitive emissions is calculated in accordance with NGER Division 3.3.6D - 3.73NB Method 2.
5. Heat and Mass Balance (HMB) Case 1: Reference (Years 2,3,4).
6. Heat and Mass Balance (HMB) Case 3: Rich Gas Early Life Peak Condensate (Year 5).
7. Heat and Mass Balance (HMB) Case 2: Day 1 (Year 1).
8. Heat and Mass Balance (HMB) Case 4: Mid Life Peak Gas & Liquid.
9. Heat and Mass Balance (HMB) Case 5: Mid Life Peak Gas & Liquid (Years 6,7,8,9,10,11,12).
10. Heat and Mass Balance (HMB) Case 6: Late Life Minimum Turndown (Years 13,14,15).
11. Campaign Maintenance/Temporary Diesel Generation (Years 1,4,8,12)
12. General Note: Energy consumption estimates supplied however production rates and utlisation assumptions withheld.

5-Year and Lifecycle Totals Summary

Timeframe	5 Year Total (tCO_2-e)				Average	15 Year Lifeccyle Total (tCO_2-e)				Average
Emission Group	**CO_2**	**CH_4**	**N_2O**	**CO_2-e**	**CO_2-e**	**CO_2**	**CH_4**	**N_2O**	**CO_2-e**	**CO_2-e**
Power Generation (A)	1.0E+05	195	59	1.0E+05	20,135	3.4E+05	653	196	3.4E+05	22,449
Flare System (B+C+D+E+F+G+H+I)	4.1E+05	20,364	3,981	4.4E+05	87,550	9.2E+05	45,119	8,820	9.7E+05	64,659
Diesel Consumers (J)	523	1	1	525	105	1,568	2	4	1,575	105
Fugitive Emissions (K+L)	108	8,515	-	8,622	1,724	324	32,416	-	32,739	2,183
Total (tCO_2-e)	5E+05	29,075	4,041	547,569	109,514	1.3E+06	78,190	9,021	1E+06	89,396
Timeframe	**5 Year Total (MtCO2-e)**				**Average**	**15 Year Lifecycle Total (MtCO2-e)**				**Average**
Emission Group	**CO_2**	**CH_4**	**N_2O**	**CO_2-e**	**CO_2-e**	**CO_2**	**CH_4**	**N_2O**	**CO_2-e**	**CO_2-e**
Power Generation (A)	0.10	0.00	0.00	0.10	0.02 (18%)	0.34	0.00	0.00	0.34	0.02 (25%)
Flare System (B+C+D+E+F+G+H+I)	0.41	0.02	0.00	0.44	0.09 (80%)	0.92	0.05	0.01	0.97	0.06 (72%)
Diesel Consumers (J)	0.001	7.5E-07	1.5E-06	0.001	0.000 (0.1%)	0.002	2.2E-06	4.5E-06	0.002	0.0001 (.12%)
Fugitive Emissions (K+L)	0.0001	0.009	0.0E+00	0.009	0.002 (1.6%)	0.0003	0.032	0.0E+00	0.033	0.002 (2.44%)
Total (tCO_2-e)	0.51	0.03	0.004	0.55	0.11 (100%)	1.25	0.08	0.01	1.3	0.09 (100%)

H.5 Detailed GHG Assumptions (Prelude FLNG Processing of Crux and Prelude Energy)

GHG Emissions Estimate	Average (~$MtCO_2$-e/year)	Total 5 Years) (~$MtCO_2$-e)	Total (Lifeycle) (~$MtCO_2$-e)
Indirect Emissions (Prelude FLNG)			
Crux Energy	1.7	7.48	24.8
Crux Energy & Prelude Energy Total (Crux %)	2.2 (75%)	13.73 (54%)	33.1 (75%)

Data extracted from detailed emissions model - due to rounding of this data - some totals may not appear to be exact.

*Combustion CH4 = 0.0051 * Fuel Total Mass; Combustion N2O = 0.0015 * Fuel Total Mass; Combustion Other = 2.6415 * Fuel Total Mass.*

*Vent CO2 = Acid Gas Total Mass; Vent CH4 = 28 * 0.02% * C1 in Total Feed; Fugitives = Total Feed ^(0.5199) x 15.790044.*

Includes the Crux reservoir CO_2 vent assumed 10.6 mol%.

*Non-Stream Day Diesel = tHC * 3.2413; Non-Stream Day LNG = tHC * 2.73; Non-Stream Day Fuel Gas = tHC *2.6481; Non-Stream Day Flaring = Flaring (tHC) * 2.8590; Non-Stream Day Venting = (tHC) * 1.*

H.6 Detailed GHG Assumptions (Infield Scope 3 Emissions)

These figures are estimates only. The actual consumption of fuel varies based on factors such as the nature of actual activity being undertaken by vessels, helicopters, metocean conditions, schedules, production outcomes, maintenance outcomes, etc. While Shell may influence via contracting approaches, in-field day to day operations including fuel consumption is under the control of vessel masters and pilots.

GHG Emissions (Marine Vessels, Aviation and Temporary Diesel Generation) tCO_2-e and $MtCO_2$-e			COMPLETIONS		HOT COMM, STARTUP, OPERATIONS					5-YEAR		LIFECYCLE		5-YEAR		LIFECYCLE	
					1	2	3	4	5	Total	Average	Total	Average	Total	Average	Total	Average
Phase	**Equipment**	**Key Assumptions**	**tCO2-e**	**MtCO2-e**	**tCO2-e**					**tCO2-e**				**MtCO2-e**			
Completions	Diesel combustion for power generation	10 months at 15 kL/day diesel oil with energy content 38.6 GJ/kL until GTG operational (included contingency 4 months) plus 1 month contingency. NGAF Table 8; NGER Division 2.4.1 Method 1 Section 2.41.	13,413	0.0134	-	-	-	-	-	13,413	-	-	-	0.0134	-	-	-
	Flaring during first stage well clean-up	Refer Appendix H.2.	50,077	0.0501	-	-	-	-	-	50,077	-	-	-	0.0501	-	-	-
	ASV	10 months at 12 kL/day diesel oil with energy content 38.6 GJ/kL plus 2 months contingency. NGAF Table 8; NGER Division 2.4.1 Method 1 Section 2.41.	11,869	0.0119	-	-	-	-	-	11,869	-	-	-	0.0119	-	-	-
	Support vessels	240 days at 8 kL/day diesel oil with energy content 38.6 GJ/kL over 12 months. NGAF Table 8; NGER Division 2.4.1 Method 1 Section 2.41.	5,203	0.0052	-	-	-	-	-	5,203	-	-	-	0.0052	-	-	-
	Helicopters	183 flights at 4 kL/day aviation kerosene with energy content 36.8 GJ/kL. NGAF Table 9.	1,886	0.0019	-	-	-	-	-	1,886	-	-	-	0.0019	-	-	-
Total			**82,448**	**0.08**	**-**	**-**	**-**	**-**	**-**	**82,448**	**-**	**-**	**-**	**0.082**	**-**	**-**	**-**
Hot Comm, Startup, Operations	Diesel combustion for power generation	Diesel Generator assumptions 1200 kW. 15 kL/day diesel oil with energy content 38.6 GJ/kL. NGAF Table 8; NGER Division 2.4.1 Method 1 Section 2.41.			4,877	-	9,755	-	-	14,632	2,926	39,020	2,601	0.01	0.003	0.039	0.0026
	ASV	12 kL/day diesel oil with energy content 38.6 GJ/kL. NGAF Table 8; NGER Division 2.4.1 Method 1 Section 2.41.			5,853	-	3,902	-	-	9,755	1,951	19,510	1,301	0.01	0.002	0.020	0.0013
	W2W	8 kL/day diesel oil with energy content 38.6 GJ/kL. NGAF Table 8; NGER Division 2.4.1 Method 1 Section 2.41.			6,503	5,539	6,330	6,330	6,330	31,032	6,206	62,681	4,179	0.03	0.006	0.063	0.0042
	Support/IMR vessels	8 kL/day diesel oil with energy content 38.6 GJ/kL over 12 months. NGAF Table 8; NGER Division 2.4.1 Method 1 Section 2.41.			7,912	3,956	6,330	3,956	3,956	26,111	5,222	70,420	4,695	0.03	0.005	0.070	0.0047
	Helicopters	4 kL/day aviation kerosene with energy content 36.8 GJ/kL. NGAF Table 9.			3,721	2,641	2,480	3,018	3,018	14,877	2,975	31,640	2,109	0.01	0.003	0.032	0.0021
Total					**28,867**	**12,135**	**28,797**	**13,304**	**13,304**	**96,407**	**19,281**	**223,272**	**14,885**	**0.096**	**0.019**	**0.223**	**0.015**

NGER Refers to F2024L01063 (August 2024) National Greenhouse and Energy Reporting (Measurement) Determination 2008.

NGAF refers to Australian National Greenhouse Accounts Factors 2024.

Data extracted from detailed emissions model - due to rounding of this data - some totals may not appear to be exact.

H.7 Detailed GHG Assumptions (Supply Chain, Transport, and Third-Party End Use)

Calculated using Shell Product Value Chain Intensity Metrics (in alignment with GHG Protocol Corporate Value Chain Scope 3 Accounting and Reporting Standard (WRI/WBCSD 2011); associated Technical Guidance for Calculating Scope 3 Emissions (WRI/WBCSD 2013) and ISO 14040:2006 Life Cycle Assessment Principles and Framework (ISO 2006) based on Crux Financial Investment Decision (FID) Estimate. These included the following factors in $kgCO_2$-e/kg product: LNG Shipping (0.068); LNG Regasification (0.02); LNG/Gas Pipeline (0.024); LNG Power Station (2.83); LPG Refinery (0.22); LPG Distribution (0.03); LPG End Use (3.05); Condensate Refinery (0.22); Condensate Distribution (0.03); Condensate End Use (3.05).

Supply Chain, Transport, and Third-Party End Use ($MtCO_2$-e)	1	2	3	4	5	5 Year Total	5 Year Average	Lifecycle Total	Lifecycle Average
Crux Energy - LNG	1.85	4.72	5.14	6.43	7.25	25.4	5.1	73.8	4.9
Crux Energy - LPG	0.12	0.31	0.34	0.42	0.48	1.7	0.3	5.1	0.3
Crux Energy - Condensate	0.64	1.63	1.76	2.14	2.33	8.5	1.7	21.9	1.5
Crux Energy - Total	**2.62**	**6.66**	**7.24**	**8.99**	**10.06**	**35.6**	**7.1**	**100.8**	**6.7**
Prelude Energy - LNG	7.39	6.23	4.85	4.47	3.61	26.6	5.3	33.9	2.3
Prelude Energy - LPG	0.96	0.81	0.63	0.58	0.47	3.4	0.7	4.5	0.3
Prelude Energy - Condensate	2.51	2.04	1.56	1.42	1.14	8.7	1.7	11	0.7
Prelude Energy - Total	**10.85**	**9.09**	**7.04**	**6.47**	**5.21**	**38.7**	**7.7**	**49.4**	**3.3**
Crux and Prelude Energy - LNG	9.24	10.96	9.99	10.90	10.86	52	10.4	107.6	7.2
Crux and Prelude Energy - LPG	1.08	1.12	0.97	1.00	0.94	5.1	1.0	9.6	0.6
Crux and Prelude Energy - Condensate	3.15	3.67	3.32	3.56	3.47	17.2	3.4	32.9	2.2
Crux and Prelude Energy - Total	**13.47**	**15.75**	**14.28**	**15.45**	**15.27**	**74.2**	**14.8**	**150**	**10**

H.8 GHG Forecasts and Activity Durations Concordance Table

Appendix H.8 illustrates the indicative relationship between Table 6-3 (Indicative Duration of Activities) with summarised key GHG forecast assumptions from Appendix H.1 to H.7.

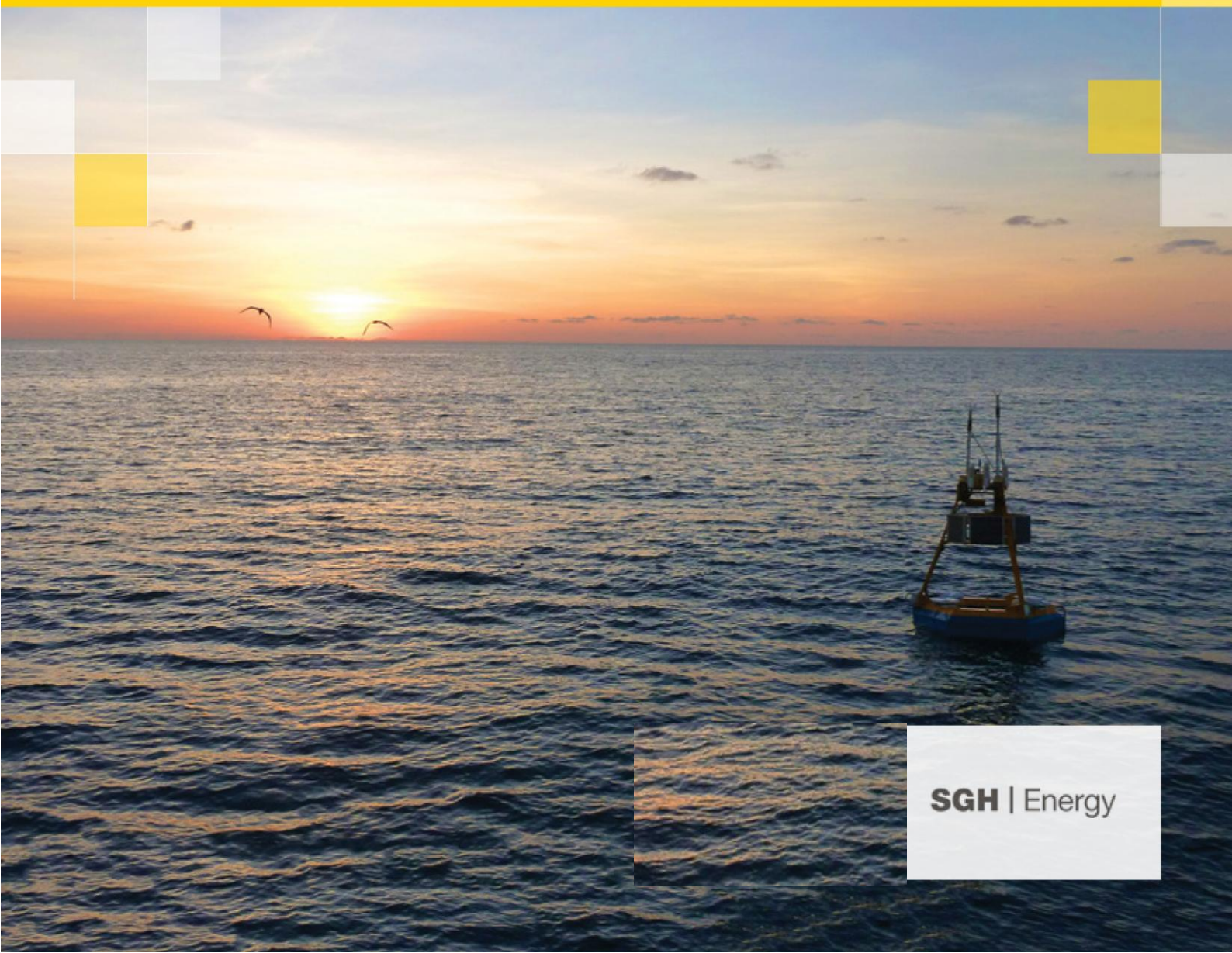
Key Activities	Duration	Activity Summary	GHG Assumptions – Durations Summary (Appendix Ref)	Duration Month (Approximate)
				1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18+
Well completions *(Sections 6.8, 6.12)* (*Table 6-1)*	3 to 10 months	- Wireline/Coiled Tubing Unit mobilised. - Well perforation. - First stage clean-up. - Tie-in/hookup xmas trees to topsides. - Ongoing cold commissioning activities*.	INDIRECT EMISSIONS (SCOPE 3) - 1st stage well cleanup flaring - 5 days at 90 MMscfd per well (Appendix H.2). - Temporary gensets (1200 kW) ~10 months at 15 kL/day diesel oil plus contingency of 1 month work of consumption (Appendix H.2). - ASV ~10 months at 12 kL/day diesel oil plus contingency of 2 months consumption (Appendix H.2). - Support vessels 240 days at 8 kL/day diesel oil (Appendix H.2). - Helicopters 183 flights at 4 kL/day aviation kerosene. Total GHG emissions 82,782 tCO2-e (0.08 MtCO2-e). Appendix H.1, Appendix H.6, Table Table 9-70 and Table 9-73.	Perforation, first stage clean-up. / Second stage clean-up + contingency.
Hot commissioning *(Sections 6.9, 6.12)* (*Table 6-1)*	1 to 5 months	- Export Pipeline Pressurisation - Pressurisation of topsides and fuel gas commissioning. - Backflow of gas to hot commission GTGs. - Pressurisation of the topsides with hydrocarbon gas. - Final checks, inspections, and sampling prior to start-up. - Ongoing cold commissioning activities* - Contingency: Early opportunity for backflow - Contingency: Replace backflow gas with well gas.	DIRECT EMISSIONS (SCOPE 1) - High pressure flaring to hot commission GTGs: function testing 7 days at 0.5 MMscfd; commissioning 22 days at 1.5 MMscfd; restart 7 days at 2 MMscfd). Appendix H.3. Total GHG emissions from flaring in hot commissioning 3,679 tCO2-e (~0.0037 MtCO2-e). Appendix H.3. Note: Combined flaring for hot commissioning and start-up is 0.224 MtCO2-e (Appendix H.3) as per EPS 10.3. INDIRECT EMISSIONS (SCOPE 3) - Refer startup.	Potential early backflow opportunity or hot commissioning on non-deviated well(s). / GTG / Contingency.
Start-up *(Sections 6.10, 6.12)* (*Table 6-1)*	9 to 24 months	- Systematic energisation, start-up of facilities. - Production from Crux wells with forward flow to Prelude FLNG. - Second stage clean-up. - Systems testing. - Early operations (some stability starting to reduce personnel). - Ongoing cold commissioning activities*	DIRECT EMISSIONS (SCOPE 1) - High pressure flaring to startup: Open wells 10 days @ 38 MMscfd; 1st ESD test 1 event at 6.7 MMscfd; restart and operate 15 days at 2 MMscfd; reopen wells and repressurise 3 days @ 38 MMscfd; open supply to export 4 days @ 85 MMscfd. Appendix H.3. - High pressure flaring after startup: Three restarts 4.75 MMscfd; contingency to manage minimum flowrates 18 days @ 50 MMscfd; contingency for extended commissioning 2 weeks @ 85 MMscfd. Appendix H.3. - High pressure flaring (unplanned) as per operational flaring assumptions Appendix H.3. Total GHG emissions from flaring during startup 220,542 tCO2-e (~0.22 MtCO2-e). Appendix H.3. Note: Combined flaring for hot commissioning and start-up is 0.224 MtCO2-e (Appendix H.3) as per EPS 10.3. INDIRECT EMISSIONS (SCOPE 3) - Diesel Generator (1200 kW) 120 days at 15 kL/day diesel oil. Appendix H.6. - ASV 180 days at 12 kL/day diesel oil. - W2W 300 days at 8 kL/day diesel oil. - Support Vessel/IMR 365 days at 8 kL/day diesel oil. - Helicopters 365 days at 4 kL/day aviation kerosene. Total GHG emissions 28,867 tCO2-e (0.03 MtCO2-e). Appendix H.1, Appendix H.6, Table Table 9-70 and Table 9-73.	Start-up. / Contingency (+15 months).

Operations *(Sections 6.11, 6.12)* (*Table 6-1)*	Life of field	- NNM Phase 1. - NNM Phase 2. - Planned and unplanned platform visits. - Maintenance campaigns / turnarounds. - Well interventions/workovers (intermittent). - Shutdowns and restarts.	DIRECT EMISSIONS (SCOPE 1) Annual durations with assumptions specified in: Appendix H.1 (Summary) Appendix H.3 (HP Flaring) Appendix H.4 (Detailed Operations) INDRECT EMISSIONS (SCOPE 3) Annual durations with assumptions specified in: Appendix H.5 (Prelude FLNG Processing of Crux and Prelude Energy) Appendix H.6 (Infield Scope 3 Emissions) Appendix H.7 (Supply Chain, Transport, and Third-Party End Use)																	Operations (ongoing)

*Ongoing cold commissioning activities include activities such as pipe spool tie-ins, leak testing, pressure testing, flushing, cleaning, filling, and systems performance and functionality testing.

Appendix I Produced Water Adaptive Monitoring Framework (AMF)

Crux Produced Water Adaptive Management Framework (AMF)



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Crux Produced Water Adaptive Management Framework (AMF)

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REVISION HISTORY					
Ver.	**Change Description**	**Date**	**Originator**	**Reviewed by**	**Approved by**
01	Issued for Approval	05/06/2025	Crux Environment Lead	Crux Environment Approvals Advisor Crux Environment Engineer Crux Engineering and Integration Manager Crux Senior Systems Engineer Crux Lead Process Engineer VP Prelude/Crux Crux Project Director Senior Legal Council Corporate Relations Lead	Business Opportunity Manager
02	Issued for Approval	29/08/2025	Crux Environment Lead	Regulatory Case Development Manager Crux Environment Lead Environment and Carbon Manager – TA2 Substructure Delivery Manager Topsides Delivery Manager Subsea and Pipelines Delivery Manager CSU/ORA Manager Crux HSSE Manager Corporate Relations Advisor Crux Project Director Senior Legal Counsel Vice President Prelude/Crux	Business Opportunity Manager
03	Issued for Approval	21/10/2025	Crux Environment Lead	Regulatory Case Development Manager Crux Environment Lead Environment and Carbon Manager – TA2 Substructure Delivery Manager Topsides Delivery Manager Subsea and Pipelines Delivery Manager CSU/ORA Manager Crux HSSE Manager Corporate Relations Advisor Crux Project Director Senior Legal Counsel Vice President Prelude/Crux	Business Opportunity Manager

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1 Introduction

The Crux Produced Water Adaptive Management Framework (AMF) sets out Shell Australia's initial strategy for managing the environmental risks and uncertainties associated with produced water (PW) discharges from the Crux platform. This first version of the AMF has been developed to align with the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations and the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018; 2023), while also meeting Shell's internal requirements for water stewardship under the SEAM Standards and the International Water Stewardship Standard (AWS, 2019).

The AMF adopts a structured, stepwise approach to adaptive management, incorporating:

- A conceptual model
- Definition of environmental values
- Definition of management goals (EPOs) and water/sediment quality objectives (EPSs)
- Selection of relevant indicators and guideline values,
- Monitoring and evaluation of water and sediment quality,
- Implementation of EPS[1], and adaptive management actions.

Key monitoring methods used in the AMF include, Direct Toxicity Assessment (DTA), chemical characterisation, mechanistic toxicity modelling, and sediment monitoring. It also introduces mercury-specific monitoring and management measures, reflecting its importance as a potential contaminant of concern.

The AMF is designed to be iterative and responsive, with built-in mechanisms for continuous improvement. Monitoring results and new information will inform future updates, ensuring that environmental risks are managed to ALARP and acceptable levels throughout the Crux lifecycle. The AMF supports the broader Crux Completions, Commissioning, Start-up, and Operations Environment Plan and demonstrates Shell's commitment to responsible environmental management.

2 Context

The AMF, consistent with the approach defined in the Australian and New Zealand Governments (ANZG) Guidelines for Fresh and Marine Water Quality (2018), is a continuous cycle of improvement. It involves setting environmental performance outcomes (EPOs), developing and implementing management measures and measuring results. The results from monitoring are then fed back into new EPOs, management measures, and actions, which will be detailed in subsequent EP 5 yearly revisions submitted to NOPSEMA. This approach ensures that management measures are updated appropriately based on new information and changing conditions, allowing for more effective and responsive management of the PW discharge.

The steps outlined in the ANZG Water Quality Management Framework have been adapted to suit the OPGGS (Environment) regulatory regime, as part of Shell's AMF for Crux (Figure 1, ANZG 2018).

[1] Environmental Performance Standards (EPSs) and associated Measurement Criteria (MC) that include references to specific sections of the EP are provided solely for the convenience of the reader. These references are intended to facilitate ease of understanding and navigation. It is important to note that these references are not part of the EPS or MC itself, and the referenced information does not form part of the EPS or MC itself.

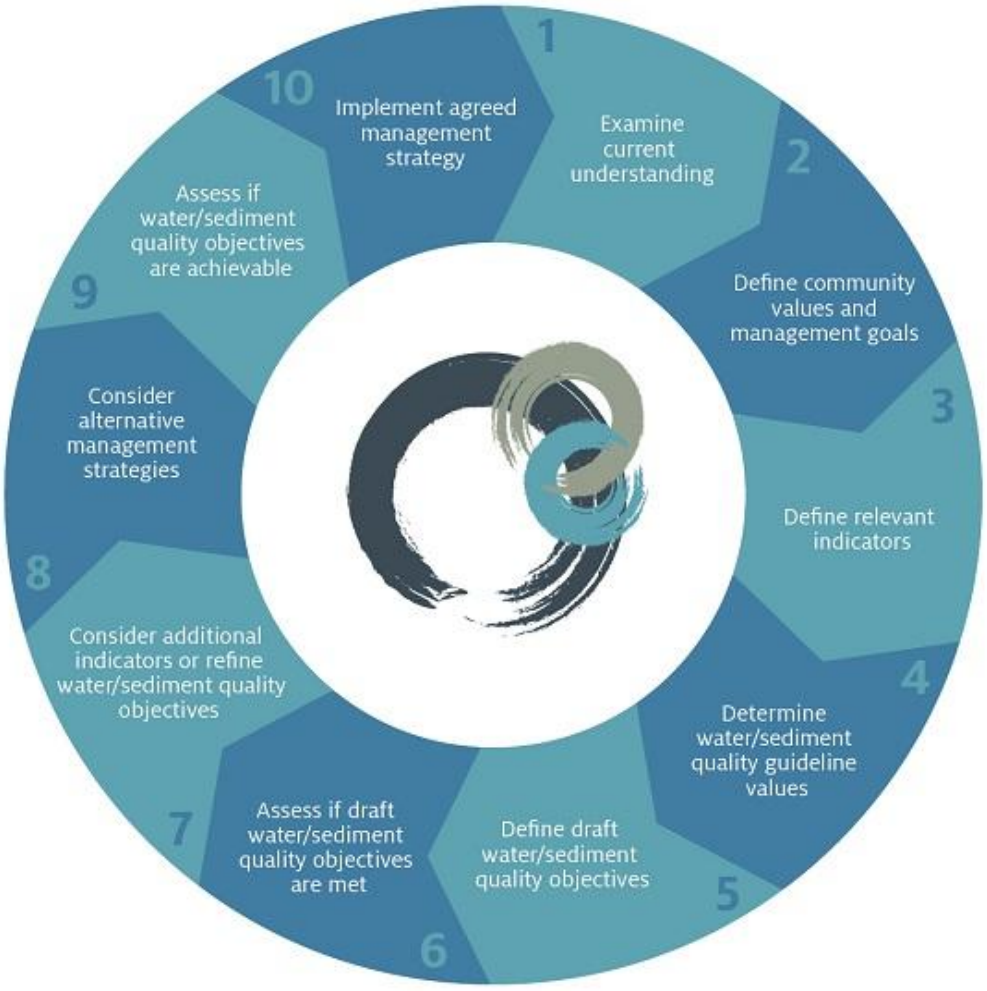

Figure 1 Crux Produced Water Adaptive Management Framework – Based off Water Quality Management Framework (ANZG 2018)

Shell requires a water stewardship management plan which adopts of the principles from the AWS (2019), where relevant. These principles and their consideration include;

- Adopt Good Water Governance - The AWS outcome of Good Water Governance ensures responsible sharing of water resources in the interests of users and the natural environment in line with the principles of water stewardship.

  Crux actively demonstrates the outcomes of good water governance through existing engagements with relevant persons associated with preparing this AMF and EP and local authorities as required through the EP consultation process. The management of water resources in the offshore environment is limited to discharge water quality. As a result, Good Water Governance is not further considered in this AMF;

- Implement a Sustainable Water Balance – not relevant for the Crux activity due to offshore location and no importation of water;

- Ensure Good Water Quality - There are several liquid discharges associated with operating the Crux facility, all of which are regulated by NOPSEMA via the in-force EP, including this AMF. The AMF conforms with the ANZG Water Quality Management Framework, and the EP (refer to EP section 9.9) provides a detailed environmental risk and impact evaluation to determine the environmental management frameworks and commitments that need to be implemented to comply with the OPGGS Regulations. The EP, supported by this AMF, demonstrates that risks are reduced to ALARP and acceptable levels for PW, whilst stipulating good practice in understanding and risk assessing water quality, and continuous improvement through the

adaptive management steps (steps 6-9 below). The outcome of Good Water Quality is therefore a consideration of the AMF and is addressed within Section 3;

- Focus on Important Water-related Areas (IWRA) – not relevant for the Crux activity due to offshore location and no importation of water. It is not an important water-related area;
- Ensure Safe Water Sanitation and Hygiene for all (WASH) – this applies. Crux ensures that the facility and operations are compliant and in accordance with national regulations and requirements that ensure safe access to water, hygiene and sanitation. The Crux facility already meets the requirements of the WASH principle and therefore it is not further considered in this AMF.

3 Water Quality Management Framework

3.1 Step 1: Examine Current Understanding

ANZG (2018) recommends the development of a conceptual model of key processes. Shell has developed a conceptual model of the Crux PW discharge (Figure 2) to assist in defining the key cause-effect pathways in Figure 4 below. This is further supported by a mercury conceptual model (Figure 3) which addresses bioaccumulation and mercury methylation pathways.

The following details the key assumptions of the conceptual model developed. Noting some assumptions are less conservative than those outlined in the EP. This is because the conceptual model is attempting to build a picture of what likely cause-effect pathways and impacts will be, including any uncertainties and assumptions within the model.

- Overall toxicity from the PW will result in there being no impacts to water or sediment quality beyond 1km (Bakke et al 2013, Crux OPP PW model, Smit et al 2024).
- Impacts to water and sediment quality will not be significant (low uncertainty).
- There may be some precipitates that form associated with the PW discharge. These precipitates may settle on the seabed surrounding the platform but are not predicted to cause impacts to the ecosystem integrity (low uncertainty).
- Production chemicals injection which partition into PW will not occur (high uncertainty).
- If formation water breakthrough happens at all, it is likely to be well below the maximum design case (low uncertainty).
- Onshore lab sampling mercury analysis accuracy (medium uncertainty).
- There may be some metals, such as mercury in the PW discharge. Levels of mercury are not predicted to be of environmental concern such that it may lead to impacts to ecosystem integrity or detectable biomagnification through the trophic chain (moderate uncertainty). It is expected that these levels will be very low, non-detectable in the sediments around the platform (low uncertainty).
- Australia's releases or emits approximately 10 t Hg / year to the environment. A majority of this (~70%) is mercury emitted to the atmosphere from non-ferrous metal smelting and refining, alumina production, and fossil fuel electricity generation. Mercury releases to marine and fresh waters are an otherwise small component of overall emissions, being 179 ± 66 kg/year (mean ± standard deviation, sum of all industries). Of the industry releases, oil and gas extraction is the fifth highest annual median emissions by industry group to water at 6.9 kg/year (1.8–68 kg/year), behind sewerage and drainage services (53 kg/year, 28–143 kg/year) (Koppel, 2025).
- Mercury releases are higher than diffuse sources of deposition and background mercury concentrations. Deposition from atmospheric sources to the ocean around the Crux development are expected to be ~7 µg/m2/year (equivalent to 7 g/km2/year) total mercury (MacFarlane et al. 2022). Background seawater mercury concentrations are likely very low. Surface concentrations are typically 0.2–1 ng/L (filtered total mercury). This is equivalent to approximately 180 g/km2 in a body of water 1 km long x 1 km wide by 0.18 km deep (Koppel, 2025). Mercury concentrations in sediments of the north west shelf are ~1-10 µg/kg (dry weight). Ensure any analytical laboratory can detect these concentrations to properly assess baselines and be able to detect change during operations.
- There is no universal relationship between mercury inputs to an environment and resulting impact to fish tissue concentrations due to the complexity of mercury speciation changes and food web dynamics (Gissi et al. 2022). For a mercury release, the risk of biomagnification is dependent on the released species and its ability to be methylated by microorganisms in the receiving environment because mono and di-methylmercury (methylmercury herein), rather than inorganic forms of mercury, readily transfer from prey to predator in marine food webs (Lavoie et al. 2013).
- Methylmercury releases have been shown to lead to a rapid increase in mercury tissue concentrations for organisms in the receiving environment (Harris et al. 2007). For elemental or

mineralised mercury releases, there are examples of extremely high release masses but negligible bioaccumulation and biomagnification (Rua-Ibarz et al. 2016).

- Mercury methylation in pelagic systems are suspected to be associated with particulate organic matter, but this is understudied compared to sediment systems (Motta et al. 2022).
- Low mercury concentrations may have high variability in laboratory results. Using an average (median or mean) value rather than individual measurements provides a more robust assessment of environmental concentrations and change.
- Three key impact pathways for mercury identified are:
  - 1. **Water and sediment quality**: Elevated mercury concentrations in sediment and water preventing impacting ecosystem services / preventing natural recovery / causing toxicity to individuals / overall degrading long-term sediment or water quality
  - 2. **Toxicity:** Direct toxicity impacts to organisms in the receiving environment. Any toxicity impacts are likely to be to the most sensitive species (microalgae or zooplankton) given the low concentration of mercury expected in the discharge stream.
  - 3. **Biomagnification**: Biomagnification in the local food web resulting in elevated tissue concentrations in high trophic organisms leading to potential toxicity. (Koppel, 2025).
- Overall, significant impacts from this activity's proposed release are not anticipated based on previous cases of mercury releases; however, the magnitude of the maximum release is not trivial compared to natural sources, meaning consideration of risk and controls are warranted (Koppel, 2025).
- PW precipitates that do settle on the seabed from PW, could chemically change through natural processes (high uncertainty).
- No impacts to neighbouring Shoals are predicted from the PW discharge (low uncertainty).
- In the event production chemicals which could enter the PW stream are used, there will be additional toxicity added to the PW discharge (low uncertainty). It is uncertain if the effects will be synergistic or otherwise (moderate uncertainty).

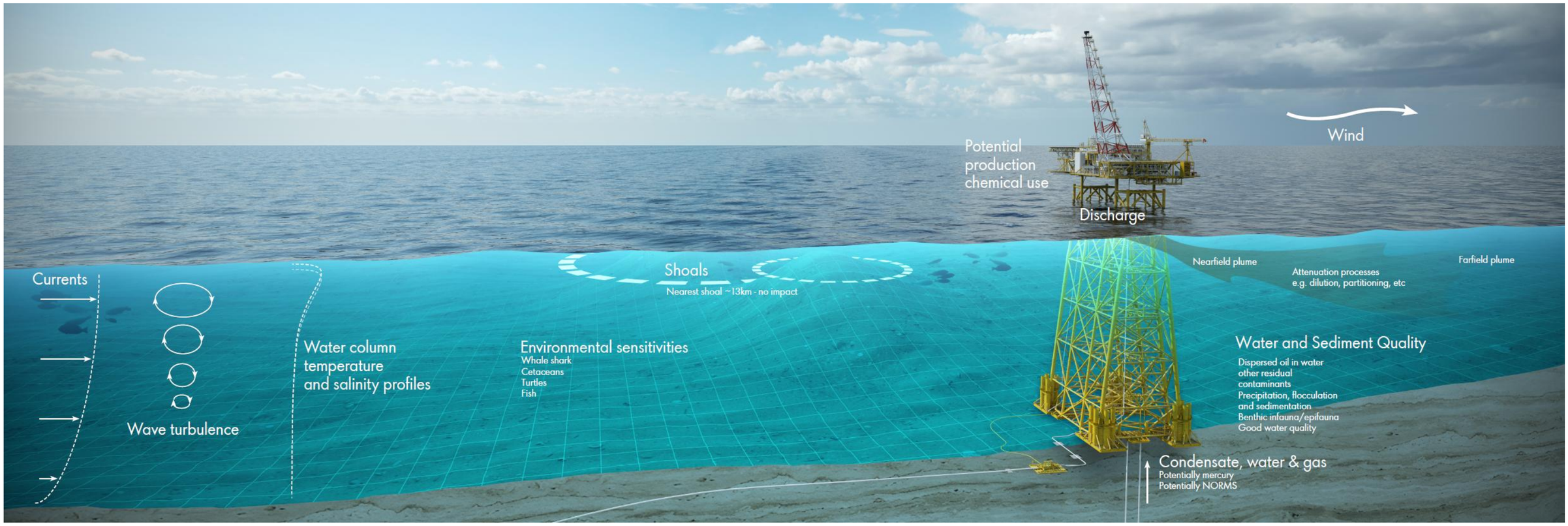

Figure 2 Crux Conceptual Model

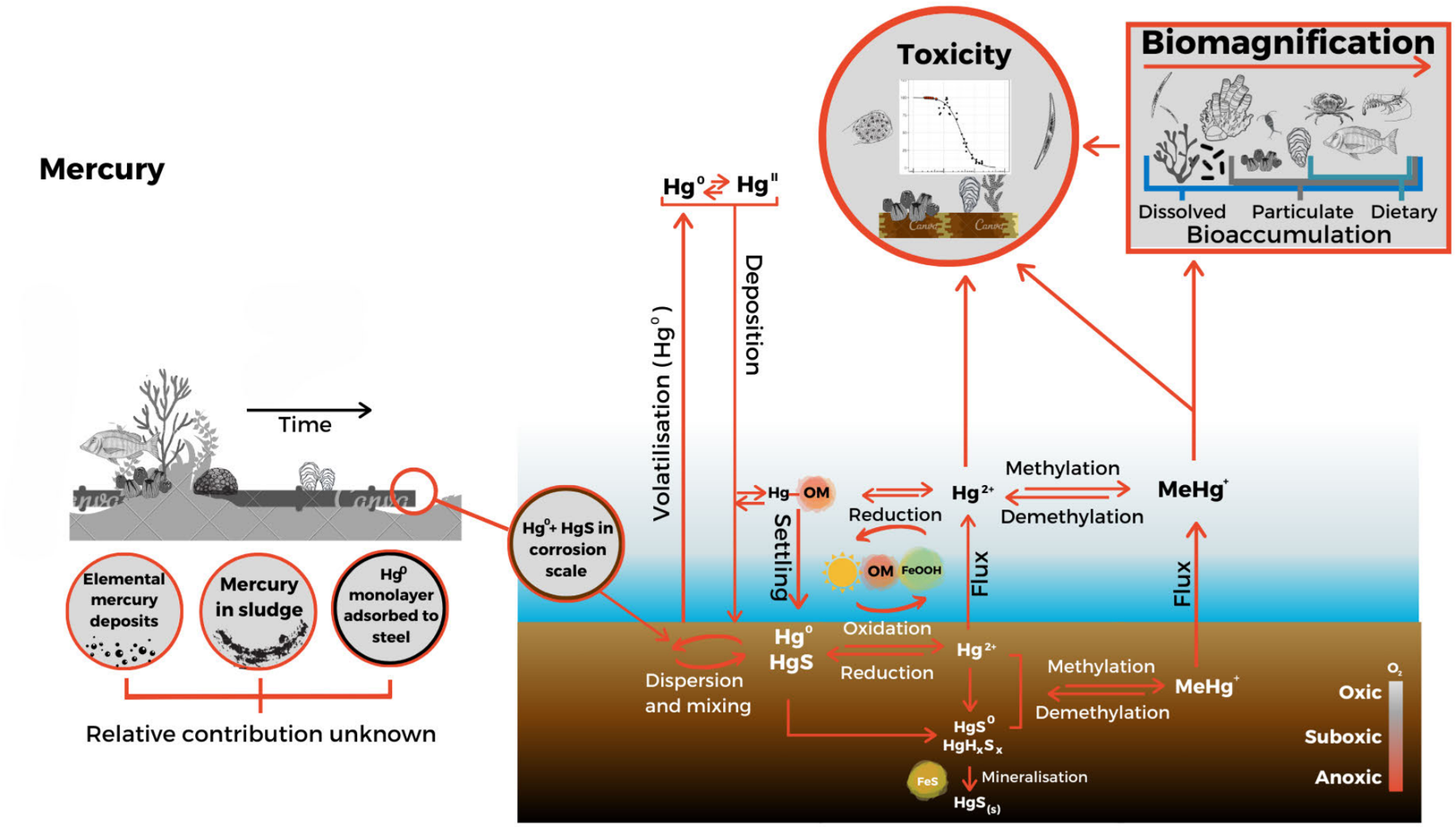

Figure 3 Produced water discharge conceptual model (AIMS, 2024)

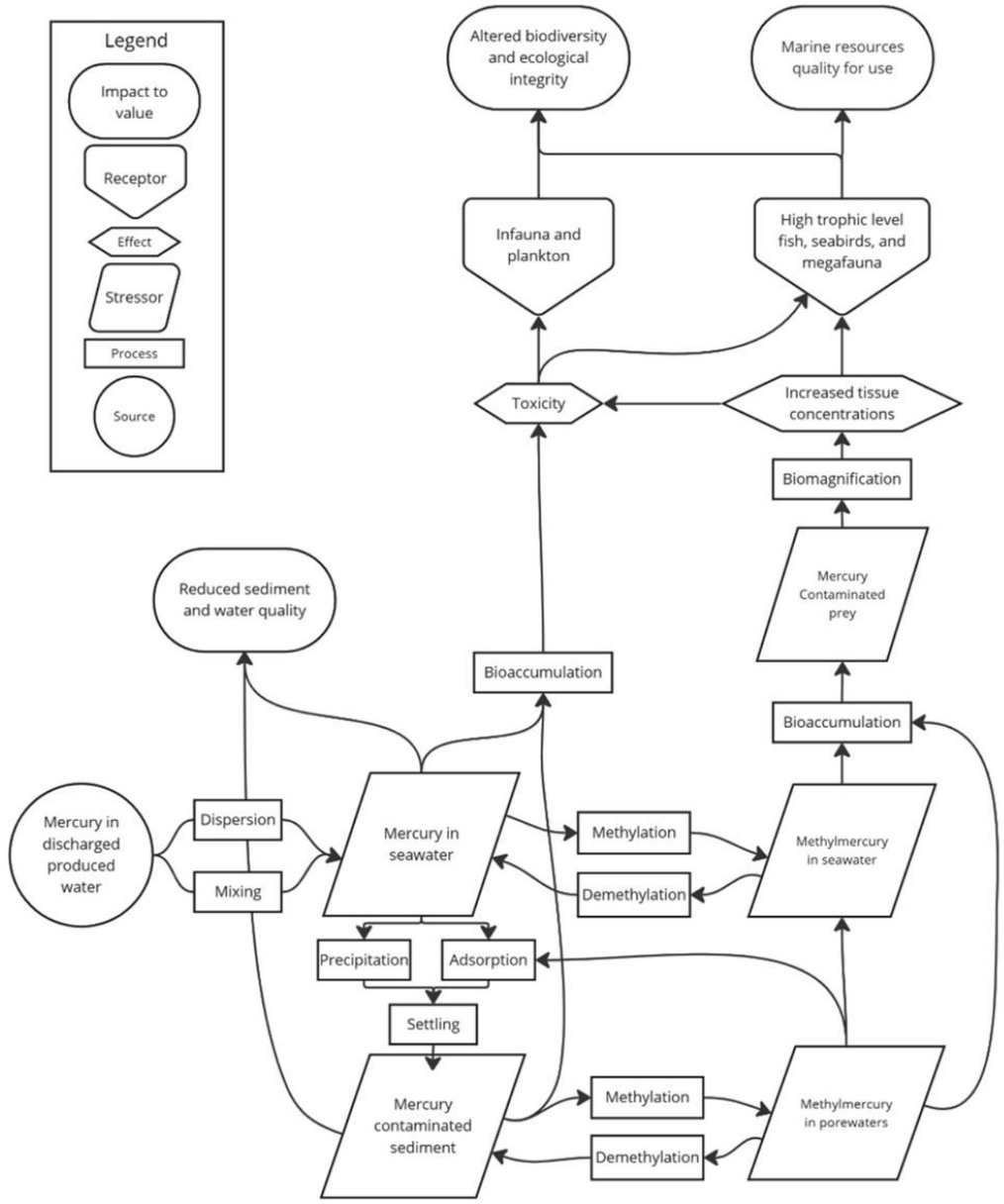

Figure 4 Causal pathways linking mercury release from produced water discharge to impacts to receptors. (Koppel, 2025)

3.2 Step 2: Define Community Values and Management Goals

Defined community values, considered that same as 'environment values and sensitivities' as defined in the OPPGGS (Environment) Regulations, have all been set and informed by 'acceptable levels of impact' as detailed in Section 8.1 of the EP, which includes considerations of the principles of ESD. In addition, consultation with relevant persons in preparing the EP has been used to inform these, noting no comments were made directly around defined acceptable levels which relate to PW. Below details the relevant acceptable levels for various community values from the EP.

Management goals set, which are set to protect defined community values, are considered equivalent to relevant EPO's set-out in the EP and are replicated in this section for ease of reference.

3.2.1 Community Values

Community values (or environmental values) relevant for the PW discharge are listed in the 'subcategory' column of Table 1 below. These are a subset of the complete list of community values described in Section 8.2 of the EP.

Of particular note in section 7.5.3.1 of the EP, in relation to some mercury related adaptive management triggers associated with increasing the level of confidence in predicted impacts occurring as a result of the PW discharge and repeated here for convenience;

"*Mercury concentrations in commercially important fish species within the Browse Basin, including areas adjacent to the Crux platform site, were assessed as part of the Applied Research Program (ARP)5 baseline monitoring program conducted in December 2015. The study focused on goldband snapper (Pristipomoides multidens), red emperor (Lutjanus sebae), and spangled emperor (Lethrinus nebulosus), with fish samples collected from nine sites across the region using commercial fish traps and baited remote underwater video systems. Fish fillets were analysed for mercury and other trace metals using accredited laboratory methods, with results compared against the Australia New Zealand Food Standards Code (FSANZ) maximum allowable level of 1.0 mg/kg wet weight.*

Across all sites, mercury concentrations in goldband snapper ranged from 0.03 to 0.38 mg/kg (mean 0.244 ± standard error of the mean (SEM) 0.153 mg/kg), while red emperor ranged from 0.08 to 0.53 mg/kg (mean 0.250 ± SEM 0.146). Spangled emperor, sampled at one site, showed mercury levels of just 0.003 mg/kg ± SEM 0.002 (Babcock et al 2017). These values are well below the FSANZ threshold and are considered safe for human consumption. No evidence of anthropogenic mercury contamination was found, and the measured concentrations are consistent with natural background levels typically observed in marine environments. The results provide a robust baseline for mercury in key commercial fish species in the region and confirm that fish from the Browse Basin are safe for consumption with respect to mercury. This baseline will support future monitoring and impact assessments where required in future."

Table 1 Subset of Table 8-4 (from EP): Summary of Acceptable Levels

Receptor		Acceptable Level of Impact	Justification
Category	**Subcategory**		
Physical features, values and sensitivities	Water quality	No significant impacts to water quality. Impact not expected to result in a substantial change in water quality, which may adversely impact biodiversity, ecological integrity[2], social amenity or human health.	The area influenced by produced water and other activity discharges is expected to be limited to within 1 km of the discharge locations. The potential magnitude of impacts to water quality is expected to be very low. Given the offshore location and absence of particularly sensitive marine ecosystems within the Activity Area, potential impacts restricted to 1 km of the discharge location are considered acceptable.
	Sediment quality	No significant impacts to sediment quality. Impact not expected to result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity[2], social amenity or human health may be adversely affected.	Sediment quality within the Activity Area is characteristic of the region. Activity discharges may result in changes in sediment quality in the vicinity of discharge locations. However, accumulation of persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity[2], social amenity or human health may be adversely affected is not predicted. This level of impact is considered acceptable.
Natural features, values and sensitivities	Marine bioregions	No significant impacts to benthic habitats and communities. Impacts to non-sensitive benthic communities limited to a maximum of 5% of the Project Area (as defined in the OPP). No significant adverse effect on demersal or pelagic communities, populations, habitats or spatial distribution of a species. No substantial adverse effect on a population of a marine species or cetacean including its lifecycle and spatial distribution. No known or potential pest species become established in the Commonwealth Marine Area.	With the exception of banks and shoals, the benthic and pelagic habitats and communities within the Activity Area are widely represented in the Timor Sea. Impacts to non-sensitive benthic communities limited to <5% of the Project Area (as defined in the OPP) which do not result in substantial adverse effects on marine species are considered acceptable.
	BIAs	No significant impacts to functional values of BIAs. Impacts do not modify, destroy, fragment, isolate or disturb an important or substantial area of habitat that results in an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area.	Impacts to BIAs that do not reduce the functional values of BIAs or adversely affect an important or substantial area of habitat are considered acceptable.
	Shoals and banks	No direct impacts to named banks and shoals. No loss of coral communities at named banks or shoals as a result of indirect/offsite impacts[3]. No known or potential pest species become established in the Commonwealth marine area.	The shoals and banks of the Timor Sea are considered of high environmental value. Shell considers direct impacts to these features unacceptable. No direct or indirect impacts to shoals and banks are expected as a result of the activity, except in the event of a worst-case unplanned incident such as a large-scale hydrocarbon spill. Shell considers any large-scale hydrocarbon spill to be unacceptable.
	Threatened, migratory, marine and cetacean species	No mortality or injury of cetaceans. Management of aspects of the activity must align with Conservation Advice, recovery plans and threat abatement plans. No significant impacts to EPBC Act listed threatened, migratory, marine or cetacean species.	Impacts that are below the significant impact thresholds are considered acceptable. Shell considers significant impacts to MNES to be unacceptable. Impacts that are below the significant impact threshold defined are considered as acceptable.
Socioeconomic features, values and sensitivities	Fishing industry	No negative impacts to targeted fisheries resource stocks that result in demonstrated loss of income for commercial fisheries. Temporary displacement of fishing activities within the Activity Area (excluding PSZs) is acceptable. Permanent exclusion of fishing activities from PSZs is acceptable.	Shell considers impacts or restricted access to targeted fish stocks that measurably reduces the potential revenue for commercial fishers, charter operators or other benefits provided to traditional fishers (intersects the MoU Box) to be unacceptable. In a regional context, commercial, recreational and traditional fishing is typically concentrated mostly in coastal/shallow waters and minimum fishing effort is known to occur within the Activity Area, given its remoteness offshore. Shell considers the displacement of other users (e.g. commercial, recreational and traditional fishers) from relatively small areas of the open ocean environment in the Activity Area to be acceptable and necessary from a safety and security perspective.

[2] In the context of the petroleum activity, a change to ecological integrity is considered to take into account broadscale, long-term impacts to the ecosystem. With regards to the Commonwealth marine environment, the Activity Area is located in open offshore waters and the seabed is generally characterised by soft sediments and typical of the region

[3] As defined in the matters of National Environmental Significance: Significant Impact Guidelines 1.1 (DoE 2013).

3.2.2 Management Goals

The management goals for the PW discharge all aim to ensure impacts on defined community values remain below the defined acceptable levels of impact in the EP Table 8-4.

These management goals aim to protect defined community values listed in section 3.2.1.

EPO #	EPO	Measurement Criteria
2.2	No injury or mortality of threatened, migratory or cetacean species associated with the Activities.	Reports of injury or mortality of EPBC listed threatened, migratory or cetacean species associated with the Activities sent to NOPSEMA and DECEEW in accordance with requirements outlined in [EP] Table 10 15.
7.1	No impact to the water quality outside of the Mixing Zone Boundary from discharge of produced water.	Monitoring and other supporting records of implementation of the AMF.
7.2	Potential precipitation of toxicants from the PW discharge will not exceed toxicant default guideline values for sediment quality (ANZG) outside the impact zone for sediment, except where pre-operations baseline monitoring potentially shows exceedance already (ANZG).	Sediment quality monitoring results within and outside the impact zone. Monitoring and other supporting records of implementation of the AMF.
7.3	Ensure that produced water discharge do not result in contaminant levels in water and sediment leading to bioaccumulation at levels compromising ecosystem integrity or the safe consumption of aquatic resources.	Water quality monitoring results as per AMF. Sediment quality monitoring results as per AMF Benthic fauna monitoring results adjacent to the platform, where triggered by the AMF (Trigger #4). Fish monitoring results adjacent to the platform, where triggered by the AMF (Trigger #5). Monitoring and other supporting records of implementation of the AMF.

3.2.3 Pre-Operations background investigations

This focuses on a one-off characterisation of the existing condition of environmental values that may be impacted by the PW discharge. This is detailed within the Crux Installation and Cold Commissioning Environment Plan (2200-010-HE-5880-00002) and is repeated here for ease of reference.

Table 2 Table 10-5 (from EP4): Pre-operations Background Investigations.

Study/Activity	Objectives	Timing	Study Design Parameters
Water Quality Sediment Quality	To collect data which describes the existing physical and chemical sediment and water quality characteristics at locations within the Activity Area, with a view to: Establish a pre-operations sediment and water quality baseline dataset against which post-impact studies can be compared.	Executed post installation of Crux infrastructure, but prior to start-up.	All relevant 'natural resources' will be considered in the context of Section 270 of the OPGGS Act (Title Surrender). Any further baseline studies will align with the most relevant and contemporary standards and best practices from a sampling and analysis perspective, i.e. the appropriate offshore standards and guidance material will be used (e.g. Przeslawski et al. [2024] and Przeslawski and Foster [2024]).

Epibenthic Fauna	Establish the spatial extent, distribution, benthic cover and/or abundance and community composition within targeted benthic habitats (at a suitable taxonomic resolution to differentiate communities). Set a pre-operations baseline for epibenthic fauna in which post-impact studies can be compared.		Sampling sites will concentrate around potential areas of impact from the proposed activities and along the pipeline route based on nature and scale. There will be sufficient replication built into the pre-operations baseline and subsequent impact survey designs to ensure that intra- and inter- site variability is sufficiently characterised and understood. This will allow for robustness in the corresponding statistical assessments when determining if a meaningful change has taken place over a specified time period. Decontamination and QA/QC processes relating to sampling equipment and processing will be clearly defined and documented.

3.2.4 Operational and Adaptive Management Indicators

The operational discharge of PW indicators has been selected to inform as many of the management goals and associated community values as was deemed necessary and practical.

The indicators outlined in this section will also be used to inform adaptive management triggers and action. Additional adaptive management indicators, plus associated triggers and actions of PW are further detailed in steps 6 and 8 in particular.

A focus of the operational monitoring is the PW is on mercury which may be present in the discharge. The risk of mercury in the PW is best managed through multiple lines of evidence that can inform on both toxicity and biomagnification impacts to receptors and values (Koppel and Cresswell 2025).

Given the remote location of Crux, there may be issues associated with meeting standard lab holding times from samples taken on the platform or infield. This has previously been investigated by Shell and others for certain analytes and found not to cause issues with result accuracy (Gallotta et al. 2010, Trefry et al. 2015). However, where there is ongoing uncertainty associated with result quality being adversely affected by this issue, further testing will be carried out to address confidence issues with the results.

Table 3 Operational and Adaptive Management Indicators

Parameter to be Monitored	Causal Pathway Element	Lines of Evidence Selected	Frequency	Relevant Management Goal/s and Objectives	Monitoring Equipment/Methodology/Comments
Crux Platform					
Flow	Pressure	Physical	Online	EPO 7.1, EPO 7.2, EPO 7.3	Flow meter Engineering calculations Proactive Technical Monitoring
Dispersed oil in water concentration	Stressor	Chemical	Online analyser - 24-hour average	EPO 7.1	Analyser Laboratory Proactive Technical Monitoring
Rates of production chemical injection (if initiated)	Pressure	Physical	Online	EPO 2.2, EPO 7.1, EPO 7.2.	Flow Meter Engineering calculations Proactive Technical Monitoring
Chemical characterisation (including total and dissolved mercury)	Stressor	Chemical	Quarterly[4] (with 2 spp and full DTA tests)	EPO 2.2, EPO 7.1, EPO 7.2, EPO 7.3	ANZG 2018. Measured at same time as DTA and characterisation samples. Used to validate predicted partitioning behaviour and loadings in EP. Supports adaptive triggers and actions.
Direct Toxicity Assessment (DTA) – full suite (min 9 spp)	Ecosystem Receptor	Toxicity	Annual[4]	EPO 2.2, EPO 7.1, EPO 7.2, EPO 7.3	Including with production chemicals included, if this were to occur (ANZG 2018). Done in accordance with Warne *et al* 2018. Supports adaptive triggers and actions.
2 species Direct Toxicity Assessment (2 spp DTA)	Ecosystem Receptor	Toxicity	Three times per year[4]	EPO 2.2, EPO 7.1, EPO 7.2, EPO 7.3	Including with production chemicals included, if this were to occur (ANZG 2018). Done in accordance with Warne *et al* 2018. Supports adaptive triggers and actions.
Mechanistic toxicity modelling	Ecosystem Receptor	Toxicity	Quarterly[4] (with 2 spp and full DTA tests)	EPO 2.2, EPO 7.1, EPO 7.2, EPO 7.3	Using chemical characterisation results. It will be used as a further line of evidence for toxicity of the produced water.
PW plus seawater mixing experiment (precipitation, flocculation and sedimentation (PFS) study)	Stressor	Chemical	Once, within two years of start-up or annually[4] (if triggered), during the life of this in-force EP.	EPO 2.2, EPO 7.1, EPO 7.2, EPO 7.3	In accordance with ANZG 2018. This would help determine how key contaminants partition between the dissolved and particulate phases, including whether they remain in solution or adsorb to sediments. Potential contaminants in the PW discharge could only be introduced into sediments around the platform through precipitations of soluble contaminants and flocculation and sedimentation of the particles in the PW plume. Includes settling velocity and particle size distribution to confirm potential for precipitation and flocculation. Particles >40 µm with the potential to settle are identified. Supports adaptive triggers and actions.
In Field - Surrounding Crux Platform					
Sediment monitoring	Stressor	Chemical	Once, or annually[4] (if triggered), during the life of this in-force EP.	EPO 2.2, EPO 7.2, EPO 7.3	In accordance with ANZG 2018. Compared against mercury site-specific GV derived under trigger #3. Supports adaptive triggers and actions.
Diffusive gradient thin films (DGT) test measure mercury accumulation	Stressor	Chemical	Once, or annually[4] (if triggered), during the life of this in-force EP.	EPO 2.2, EPO 7.2, EPO 7.3	DGT can be deployed to recovered sediments that are elevated in mercury (or other analytes) to measure the labile porewater concentration which can be directly assessed against the existing 99% species protection DGV for water quality. This will inform against toxicity impacts. This supports adaptive triggers and actions, including the establishment of a site specific GV for sediments if required.
Mixing zone verification	Stressor	Physical	Once off during the life of this EP in-force.	EPO 2.2, EPO 7.1, EPO 7.2, EPO 7.3	In accordance with ANZG 2018.
Biomagnification Infauna and Fish Monitoring	Biological	Bioaccumulation	Annually[4] (if triggered), during the life of in-force EP.	EPO 2.2, EPO 7.3	Collected from within impact and mixing zones and compared with reference sites and/or baseline concentrations or reference sites. Mercury concentrations assessed against dietary and ecological thresholds. Supports adaptive triggers and actions.

[4] Reference to 'annual', 'three times per year' or 'quarterly' are all subject to minor variation/change (~10%) because of circumstances outside Shell's control such as, such as unforeseen weather events, vessel or equipment availability, response to an unplanned outage etc. Further, all quarterly topsides monitoring is planned to be carried out as part of maintenance campaigns which are also subject to the same factors.

3.2.4.1 Produced Water Chemical Characterisation

Full chemical characterisation of PW samples will be conducted quarterly, aligned with DTA testing, to identify constituents likely contributing to toxicity and support adaptive management actions, where triggered. This will include estimation of relative toxic units to support interpretation of toxicity trends. Integrating this analysis into the quarterly topsides assessment will improve the robustness of trend evaluation and enable timely adaptive management responses when trigger thresholds are exceeded. Where specific parameters consistently return nil results over multiple stable sampling rounds, and where third-party subject matter experts advise that their continued inclusion is not an efficient use of resources, these parameters may be removed from future analyses.

Table 4 Produced Water Chemical Characterisation Analytes and Limit of Reporting (LOR)

	Analyte	Reference Method	LOR
1	pH	APHA 4500H	0.1 pH units
2	Conductivity	APHA 2510 B	2 µS/cm
3	Salinity	Calculation	2 mg/L
4	Biochemical Oxygen Demand (cBOD)	APHA 5210	5 mg/L
5	Total Organic Carbon	APHA 5310 B	200 µg/L
6	Total Dissolved Carbon	APHA 5310 B	200 µg/L
7	Total Kjeldahl Nitrogen	APHA 4500 Norg	50 µg/L
8	Ammonia, low level	APHA 4500 NH3	10 µg/L
9	Cyanide (total)	ISO14403:2002	4 µg/L
10	Sulphide	APHA 4500 S2-	100 µg/L
11	Dissolved Metals†	USEPA6020A & APHA	0.1-10 µg/L
12	Dissolved Mercury	3112B	0.05 µg/L
13	Oil and Grease + Hydrocarbons	APHA 3112	5mg/L
14	NOR (Ra-226, Ra-228, Pb-210, Po-210, Th-232, -total)*[5]	APHA 5520	0.05-0.1 Bq/L
15	NOR (U-232, -235, -238, -total)*[6]		0.05-0.1 Bq/L
16	VOC (incl. BTEXN, other MAH, and organic solvents)		0.5-20 µg/L
17	VOC scan for 8260 and unknowns	USEPA 8260	various
18	Speciated phenols	USEPA 8260	0.5-50 µg/L
19	PAH-low level (selected ion monitoring mode)	USEPA 8270	0.005-0.02 µg/L
20	SVOC scan for 8270 and unknowns	USEPA 8270	various
21	TRH C6-C40	USEPA 8270	10-50 µg/L
22	TRH Silica Gel >C10-C40 - low level	USEPA 8260/8270	10-50 µg/L
23	Carboxylic acids	USEPA 8270	1000 µg/L
25	Methanol, Ethanol		1000 µg/L
26	Glycols		2000 µg/L
27	Phosphonates		

†Al, As, Ba, Be, B, Cd, Cr, Co, Cu, Fe, Pb, Mn, Mo, Ni, Se, U, Zn

[5] Annual only.
[6] Annual only.

3.2.4.2 Direct Toxicity Assessment (DTA)

The primary method for determining and monitoring the potential environmental effects of the PW discharge will be Direct Toxicity Testing (DTA), often also referred to as Whole of Effluent Toxicity (WET) testing. ANZG (2018) recommends DTA as a useful technique for assessing the effects of mixtures of compounds in ambient waters (ANZG 2023), and it is readily applicable to the assessment of potential effects attendant to the Crux PW discharge. DTA is a well-established approach in ecotoxicology that has generally been adapted from conventional single-chemical toxicity testing approaches, using similar methods, species selection and extrapolation to receiving waters (Mount 1986). DTA differs from single-chemical toxicity testing in that the combined effects of, and interactions between, a number of compounds of unknown identity and concentration are assessed, as opposed to the effects of just one chemical (ANZG 2023).

The major benefit of DTA is that it can assess the toxicity of waters, in which the number of unidentified components may number thousands, and their behaviour, or interactions, cannot be predicted (de Vlaming et al 2000). The effects of complex mixtures cannot usually be predicted by determining the toxicity of individual components, which typically change with time and are often not fully known (Holdway 1992). Thus, DTA enables a greater understanding of potential impacts to aquatic environments, which in turn aids in adaptive management actions which may be considered for adoption (Van Dam and Chapman 2001).

Full suite DTA of PW will be carried out annually commencing approximately 12 months after PW is first discharged for the duration this EP revision is in force. This will occur at a suitable point sometime within the calendar year. An additional three reduced suite (2 species) DTA tests will be undertaken each year (ie four DTA tests per calendar year). Chemical characterisation of PW samples will be undertaken coincident with each DTA (ie approximately quarterly), commencing ~6 months after PW is first discharged, for the duration this EP revision is in force. This will be an early warning indicator, to show temporal trends in changing toxicity, for a future potential EPO exceedance supporting potential adaptive management actions (ANZG 2023).

Chemical characterisation of PW will be undertaken by a National Association of Testing Authorities (NATA) accredited laboratory unless not deemed appropriate in order to monitor to the required low level of detection and accuracy needed for mercury lab analysis.

The sampling and analytical methodologies for DTA are often commercial-in-confidence documents of the various analytical laboratories (ANZG 2023), though general guidance on the requirements for undertaking effective DTA is available in publications such as Hall and Golding (1998) and Van Dam and Chapman (2001).

Key considerations for the collection of PW samples are:

- All samples should be collected from the nearest practicable topside location to the point of discharge.
- The volumes of PW to be collected for DTA will need to advised by the analytical laboratories and/or monitoring contractor/s.
- For DTA, bulk samples of seawater from the receiving environment are typically collected (for serial dilutions of PW within the analysing laboratory). However, given the remote offshore location and unmodified locations toxicants, this additional logistical complexity is not warranted. Of more importance will be the properties of the receiving water versus lab water, especially organic carbon concentrations.

DTA generates data on the toxicity of the PW upon the test species and, via serial dilutions in the laboratory, determines the extent to which the toxic effects of PW declines with decreasing PW concentrations.

Warne et al (2018) provide guidance in relation to the number and types of species selected for DTA and it is understood this guidance will soon be updated. In order to derive SSD it is expected that:

- The minimum acceptable amount of data is considered to be six species that belong to at least four different taxonomic groups. However, toxicity data for more species and more taxonomic groups is encouraged.
- Datasets that have 6–8 species are considered ‘adequate’.
- Datasets that contain data for 8–14 species that belong to at least four taxonomic groups are considered ‘good’
- Datasets that contain data for at least 15 species belonging to at least four taxonomic groups are termed ‘preferred’.

The number of species utilised within the DTA of the Crux PW will depend upon the availability of species cultured by the analysing laboratory at the time of PW toxicity assessment, and the outcome of a cost-benefit analysis of the use of greater numbers of test species, taking account of the degree of ecological risk posed by the PW discharge. For full suite DTA of the Crux PW, it is considered appropriate to conduct assessments

on at least 9 species, but 15 species is currently preferred, subject to practical constraints of suitable tests being available and at a reasonable expense. This will occur from four taxonomic groups for high (9 spp) and very high (15 spp) reliability guidelines value (Warne et al. 2018, Fisher et al. 2025a, Fisher et al. 2025b). The species selected will be representative of the types of species at risk of impact from the Crux PW discharge i.e. tropical marine species, or species which are representative of tropical marine species as far as reasonably practicable. Selection of species for quarterly DTA will consider taxonomic breadth (e.g., plants and animals) as well as different endpoints (growth, reproduction and development) to ensure the tests capture a range of different modes of action. To the extent practicable, a core subset of at least six species will be used for all DTAs to support ready temporal comparisons of PW toxicity and ensure the derivation of robust SSD.

Control chart approaches will be used to track changes in toxicity over time. Control charts are used routinely as a QC for direct toxicity testing (USEPA, 2000, 2002). They are typically constructed from EC50 estimates obtained from reference toxicant data collected alongside DTA. Control limits are then defined based on estimated 95% confidence intervals from a time series of control data and used to verify that the current testing round falls within these limits. A similar approach will be adapted to develop control limits to assess if there are significant deviations in discharge toxicity over time and will be useful as an adaptive management trigger (step 6).

3.2.4.3 Derivation of site-specific dilution factor

Rigorous analysis of the DTA data is required to ensure that they are of sufficient quantity and quality to be applied to the derivation of a SSD and site-specific dilution factor (Warne et al 2018, Warne et al 2025 (in press)). The methodology for establishing a site-specific dilution factor in Warne et al (2025) will be adopted.

The application of this methodology leads to the determination of a single toxicity value for each species for inclusion in the calculation of an SSD. Warne et al (2018) recommended the generation of SSDs using the statistical software Burrlioz 2.0 (Barry and Henderson, 2014), though a more contemporary method (*shinyssdtools;* e.g. Fisher et al, 2019; Dalgarno 2021; Fox et al, 2024; Thorley et al, 2025) is now available for SSD calculations. The software used to generate SSDs fits a statistical distribution to an empirical cumulative frequency distribution of the input DTA data. Using the SSD plot, the software calculates the percentage concentration of the original effluent which is protective of a given proportion of species (i.e. PC99, PC95 and PC80). From this, it is possible to calculate the dilutions required to meet the target species protection level (i.e., the site-specific dilution factor).

3.2.4.4 Mixing zone prediction

Once the site-specific dilution factor has been defined, the numerical modelling outputs of PW dilution with distance from the point of discharge (detailed in section 9.9.1.4, (RPS 2024) of the EP) are then interrogated to determine the greatest distance (determined from '95% of the time' from the mode) at which the target species protection levels (PC80, PC95 and PC99) is predicted to be reached. This distance is designated as the mixing zone boundary for the discharge, with a mixing zone defined by ANZG (2018) as 'an explicitly defined area around an effluent discharge where some, or all, water quality objectives may not be met'. A mixing zone boundary for PC80, PC95 and PC99 will be established based on DTA results of the PW. Current mixing zone boundaries are established in EPS 7.21. This is what the mixing zone verification study will be checked against and these two measures assist in ensuring that EPO 7.1 is achieved, including provision of an early warning indicator, because the mixing zone boundary triggers are less for adaptive management triggers set-out in Table 6.

Consistent with ANZG (2023), where the DTA results are consistent, an averaging approach of PC80, PC95 and PC99 may be appropriate to establish the mixing zone boundary and EPS 7.21. Where the DTA results are variable, it may be necessary to adopt a conservative approach and use the most sensitive of the DTA results (i.e. that resulting in the highest required dilution rate), so long as there is evidence it was representative, to set the mixing zone boundary.

3.2.4.5 Mixing zone verification

As the mixing zone boundary prediction (section 3.2.4.4) of the PW mixing zone is based upon numerical modelling of discharge dispersion, field monitoring of actual plume dispersion will be conducted to verify the veracity of the RPS 2024 model outputs. The details of the monitoring will be dependent on the results of early topsides monitoring of PW and input from SME consultants and learnings from other relevant campaigns, as relevant, but is expected to include:

- Interrogation of data on the chemical characterisation results of the PW to identify potential 'fingerprints' for the PW.

- In-situ measurements and sampling of the PW plume with increasing distance from the point of discharge, to determine the spatial changes in these fingerprints.
- If no changes in physical properties (e.g. temperature, salinity, acidity) of the PW can be reliably identified during the field monitoring, then it may be necessary to inject dye into the PW stream so that it can be determined whether the sampling is being undertaken within the PW plume.
- The in-situ measurements and sampling commence at the smallest practicable distance from the point of discharge and continue to beyond the edge of the predicted mixing zone.
- In-situ measurements of physical parameters within the immediate vicinity of the point of PW discharge are typically made using multiparameter probes ('sondes') deployed (if practical and safe to do so) from the platform topsides. Measurements at distances radiating away from the point of discharge may be made using sondes attached to a Remotely Operated Vehicle (ROV), an Autonomous Underwater Vehicle (AUV), or similar.
- Similarly, samples of water from the PW plume may be able to be collected using a discrete water sampler deployed from the platform topsides, and using an array of water samplers attached to an ROV, AUV or similar. If this is not safely practicable, a vessel-based monitoring program may be undertaken.
- To maximise the potential for in-situ measurements and water sampling to be undertaken in the least-diluted part of the plume, they need to be undertaken at:
    - Various depths through the water column (to account for the degree of buoyancy of the PW plume).
    - Various lateral distances across the plume (to account for lateral dispersion of the plume).

  Sampling, as far as reasonably practicable, is carried out in conditions that are predicted to be most conservative in resultant dilution, with the measured dilutions of chemical parameters compared against dilutions predicted from model outputs under equivalent conditions. This provides an indication of the extent to which the model accurately predicts the dilution of PW and, in turn, the degree of accuracy of the predicted mixing zone boundary. This will be carried out as a once off following PW discharge starting, occurring at some point whilst this EP revision is in force.

  If the degree of dilution of the PW is substantially different to that predicted by the modelling, this may indicate the need to revise the modelling done and associated mixing zone boundary.

3.2.4.6 Sediment Monitoring

Limiting the changes to water quality (i.e. through the effective monitoring and management of the Crux PW discharge), which is the pathway to impacts upon sediment quality, provides a high degree of confidence that no detectable environmental impacts will occur outside of the mixing zone boundary. Potential contaminants in the PW discharge could only be introduced into sediments around the platform through precipitations of soluble contaminants and flocculation and sedimentation of the particles in the PW plume. Conservatively, the impact zone for sediment is set at 1km consistent with the Crux OPP PW EPOs. The impact zone has been established to ensure the acceptable levels of impacts are met for sediment quality. It has been established based on professional judgement which was also informed by original PW modelling results from the Crux OPP, the EPs PW modelling results, peer reviewed literature (e.g. Bakke et al. 2013) and acceptable levels of impact outlined. Sediment quality may be slightly impacted at locations immediately around the platform over a longer timeframe (e.g. tens of years) but is considered unlikely over duration of this EP revision is in force.

A post-installation, pre-operations baseline survey to determine whether detectable changes to sediment quality will have occurred as a result of installation activities. The array of sampling sites for this survey will be based upon the array implemented for the pre-installation Crux baseline survey[7] with some modifications required if the presence of subsea infrastructure precludes sampling at certain sites. The physico-chemical parameters for which analyses will be undertaken will comprise those analytes with the potential to have been influenced by installation activities, and those with the potential to be influenced by the PW discharge (i.e. a subset of the analytes listed in Table 1).

[7] Sample locations are to be aligned along four transects radiating outward from the base of the Crux Facility substructure (jacket); at distances of 100 m, 250 m, 500 m, 1000 m and 2000 m along north-west to south-east and north-east to south-west axes (respectively along, and across, the prevailing tidal current axis). Four reference sites to monitor the prevailing background conditions during future monitoring surveys are also to be sampled; one in each corner of the AC-L10 Production Licence lease area. These sites are considered sufficiently distant from field activities that any differences in sediment analytical results between surveys are likely indicators of natural changes, or of inter-annual variability in laboratory performance.

Monitoring of seabed sediments will be undertaken at least once for the duration this EP revision is in force. The sampling array will replicate that implemented in the pre-operations baseline survey. The toxicant concentrations measured from the <2 mm sediment fraction of a sediment sample, where practicable, around the platform and references sites will be compared with the sediment DGVs and GV-High. The <63 µm sediment particle size fraction (clay and silt) is considered a suitable representation of the sediment materials that are mostly readily resuspended or potentially ingested by organisms. Therefore, it is recommended that the binding of contaminants by this fine sediment fraction be considered when more detailed investigations of contaminant bioavailability are required for site-specific assessments. The results of these surveys will show if any toxicants in the sediment impact zone exceed the toxicant DGVs or GV-highs for sediment quality. Additionally, they will indicate if there are trends, if annual sediment monitoring were triggered, of increasing toxicant concentrations that might eventually lead to exceedances of the DGVs at early warning triggers or outside the impact zone over time.

Table 5 Sediment Analytes and Practical Quantitation Limits (PQLs)

Analyte	PQL
Moisture	1%
Particle Size Distribution (PSD)	<4 µ, 4-62 µ, 62-250 µ, 250-500 µ, 500-2000 µ, >2000 µ
Total Organic Carbon (TOC)	10-100 mg/kg
Total Metals	
Aluminium	50 mg/kg
Arsenic	1 mg/kg
Barium	1 mg/kg
Cadmium	0.1 mg/kg
Chromium	1 mg/kg
Copper	1 mg/kg
Iron	50 mg/kg
Lead	1 mg/kg
Mercury	0.01 mg/kg
Nickel	1 mg/kg
Zinc	1 mg/kg
Hydrocarbons	
Total Recoverable Hydrocarbons (TRH)	3-5 mg/kg
Polycyclic Aromatic Hydrocarbons (PAHs, where TRHs detected)	0.004-0.005 mg/kg
Volatile hydrocarbons: Benzene, Toluene, Ethylbenzene, Xylenes and Naphthalene (BTEXN)	0.2 mg/kg
Heterocyclic Aromatic Compounds	Species dependent
Oil & Grease	100 mg/kg
Nutrients	
Total Nitrogen (TN)	20 mg/kg
Nitrite + Nitrate (NOx)	0.1 mg/kg
Total Kjeldahl Nitrogen (TKN)	20 mg/kg
Total Phosphorus (TP)	2 mg/kg
Radionuclides[8]	

[8] Ongoing monitoring can default to gross alpha and beta and only trigger testing for individual radionuclides where elevations are detected.

Radium-226 (Ra-226)	
Radium-228 (Ra-228)	
Thorium-228 (Th-228)	
Potassium – 40 (K-40)	
Lead – 210 (Pb-210)	
Uranium-238 (U-238)	
Total alpha	500 Bq/L
Total beta	500 Bq/L

For quality assurance/quality control (QA/QC) purposes, consistent with ANZG field sampling and laboratory analysis, the following sediment samples will be required, in addition to the primary samples:

- Triplicate sediment samples (two additional samples at each site) at sites along the predominant plume direction, with one of the samples sent to a secondary analytical laboratory.
- Duplicate split sediment samples (one additional sample at each site) at a minimum of 10% of the primary sampling sites).

The following water samples will also be required for QA/QC purposes:

- One trip blank sample of deionised water provided by the primary analytical laboratory. This will accompany the field sample containers throughout the survey and be analysed on arrival back at the laboratory to assess whether contamination has occurred from the sample containers or during sample transportation.
- One field blank sample effected by exposing laboratory-supplied deionised water to the atmosphere during sample collection. This will be used to identify and quantify any airborne contaminants present (e.g. exhaust emissions).
- One rinsate blank on each of the sampling days, to be effected by pouring laboratory-supplied deionised water over the sampling equipment after it has been decontaminated between sample sites and catching the rinse water in a glass jar for laboratory analysis.

Future sediment monitoring frequencies will be informed by the initial sediment monitoring campaign and outcomes of the PFS study. This would help determine how key contaminants partition between the dissolved and particulate phases, including whether they remain in solution or adsorb to sediments.

3.2.4.7 Diffusive Gradients in Thin films (DGT)

Diffusive Gradients in Thin films (DGT) will be deployed during sediment sampling campaigns to measure mercury in porewater. Results may be used to help establish a site-specific GV for mercury sediment quality where triggered. For mercury in particular, deploying passive samplers such as DGT devices provides an additional indicator of the bioavailable fraction of mercury in porewater. DGT samplers accumulate labile mercury species over time, offering a time-integrated measure of mercury that is readily available for uptake by biota. This information helps predict mercury's methylation and bioaccumulation potential in-situ, strengthening the weight of evidence on bioaccumulation risk. Such passive sampling and geochemical modelling can reveal if mercury is remaining in dissolved, more bioavailable forms or if it is largely sequestered in particulate/precipitate forms. Time-integrated measure of labile mercury in sediment porewater confirms whether mercury is in bioavailable form and provides a time-averaged labile analyte concentration in seawater with improved limits of detection compared to bulk water sampling.

3.2.4.8 Precipitation, Flocculation and Sedimentation (PFS) study

A Precipitation, Flocculation and Sedimentations (PFS) study involving settling velocity and particle size distribution analysis will also be undertaken to determine the potential for mercury to impact sediment quality. The study will also address the form(s) and fate of mercury potentially reaching the seabed, which is required to inform an assessment of the risks of bioaccumulation and of impacts to ecological integrity. This will be carried out as a once off study or as triggered (Table 3).

3.2.4.9 Derivation of Site-Specific Sediment Default Guideline Value for Mercury

To ensure the AMF reflects local environmental conditions and provides robust protection against mercury-related risks, in a tiered response approach, consistent with ANZG (2018) guidance and international best

practice, where triggered a site-specific sediment guideline value (GV) for mercury will be developed. This will be established by measuring mercury fluxes/concentrations from sediments to pore and overlying waters directly using the DGT technique. Porewater and overlying water concentrations can then be compared to existing WQGV. Given the significant effort and cost associated with establishing a site-specific guideline value, this will only occur if the sediment deposition pathway is shown to be a credible risk. To support this, the AFM adopts early warning triggers based on elevations against a pre-operations baseline data, to inform when a site specific sediment GV is required.

3.2.4.10 Biomagnification Infauna and Fish Monitoring

To assess the potential for mercury biomagnification through the marine food web in the Crux Platform, Shell will implement two biological monitoring programs, when triggered, focused on benthic infauna and higher trophic fish species. These programs are designed to provide ecologically relevant data on mercury bioaccumulation and biomagnification, using established sampling and analytical methods consistent with ANZG (2018) guidance and international best practice.

Infauna Monitoring Approach

Benthic infauna (or mesocosm studies), such as polychaetes and bivalves, are key indicators of sediment-associated mercury bioavailability due to their close interaction with porewater and sediment particles. Sampling will be conducted annually, when triggered, along the predominant plume direction, targeting representative species known to inhabit depositional zones. Specimens will be collected using grab samplers or corers, sorted and identified to appropriate taxonomic resolution, and analysed for total mercury concentrations using accredited laboratory methods.

This approach is supported by studies showing that infauna can accumulate mercury from sediment and porewater, with trophic magnification factors (TMFs) for methylmercury ranging from 1.3 to 1.7 depending on species and environmental conditions (Lavoie et al., 2013; Wang et al., 2012). Monitoring infauna provides an early indication of mercury entering the food web and complements sediment quality assessments.

Fish Monitoring Approach

Fish monitoring will focus on species identified by FSANZ (or local equivalent) as having higher mercury accumulation potential, including long-lived, predatory species. Annual sampling will be conducted within the impact zone using non-lethal or standard fisheries methods (e.g. line fishing, traps), targeting marketable-size individuals. A minimum of five specimens per species will be collected and analysed for total mercury content in muscle tissue, using validated laboratory techniques.

This method is justified by extensive literature showing that mercury concentrations in fish increase with trophic level, age, and diet, with TMFs for methylmercury in marine fish ranging from 1.5 to 2.0 (Cheng et al., 2011; Bloom, 1992). Monitoring fish provides direct evidence of mercury biomagnification and potential exposure risks to marine predators and human consumers.

3.3 Step 4: Determine Water/Sediment Quality Guidelines Values

DTA will be used to determine the Protective Concentration (PC) PC80, PC95 and PC99 for water quality. ANZG toxicant default guideline values (with site specific refinement for mercury where triggered) for sediment quality also apply in order to better account for potential bioaccumulation of some toxicants in the marine ecosystem.

ANZG mercury water quality DGV for 99% species protection will be adopted as a relevant guidelines value along with it being used as a trigger for some adaptive management actions. This is consistent with ANZG recommendation to adopt a suitable guideline value protective of bioaccumulation effects and managing impacts consistent with acceptable levels. ANZG guidance to tailor guidelines to local environments, given that default sediment DGVs (e.g. 0.15 mg/kg for mercury) were low reliability and largely based on silty, organic-rich sediments unlike the sandy, low-TOC sediments at the Crux platform site. If triggered, the site-specific sediment mercury DGV will serve as a benchmark for managing sediment quality.

The risk of mercury to human health from dietary sources are managed through recommended seafood portion sizes and maximum levels of contaminants and natural toxicants in food set in Schedule 19 of the Food Standards of Australia and New Zealand (FSANZ 2017). The maximum mercury levels differ depending on the type of fish and the number of samples in the lot and are designed for the testing of a subset of fish within a larger batch. The mean level of mercury must be no greater than 0.5 mg/kg (where five or more sample units are available, or 1 mg/kg for fish known to accumulate mercury). Where fewer than 5 samples of a species are

taken no individual should have a concentration greater than 1 mg/kg. There is no guideline describing a level of mercury below which adverse biomagnification impacts are negligible for a food web (Koppel, 2025).

Where applicable, pre-operations baseline monitoring results for water quality, sediment quality, and infauna surrounding the platform location (as detailed in section 10.4.2 of the Installation and Cold Commissioning EP) will also be used to help define the guideline values. This integration of conservative guideline values (including site-tailored values) and early-warning trigger thresholds ensures that both toxicity and bioaccumulation risks are proactively managed in line with best practice (ANZG 2018; 2023; IOGP 2020).

3.4 Step 5: Define Draft Water/Sediment Quality Objectives

The draft water/sediment quality objectives are set in order to ensure the management goals are achieved which in turn protects the community values identified.

The Crux produced water discharge EPSs collectively focus on managing environmental risks with a particular emphasis on addressing uncertainty around mercury. They establish protective thresholds for water and sediment quality, define mixing zones to contain toxicity, and set limits to prevent mercury accumulation and biomagnification in marine fauna. Through adaptive management and early-warning triggers, the AMF ensures that mercury-related risks, especially those involving sediment deposition and food web transfer, are proactively monitored and controlled, maintaining impacts at acceptable levels and aligned with regulatory expectations.

The draft water/sediment quality objectives for the Crux produced water discharge management, taken from EP EPSs, are:

EPS No.	Environmental Performance Standard
7.22	PW discharge will not exceed the relevant threshold concentration set by Direct Toxicity Assessment (DTA) at the edge of the mixing zone boundaries set for PC80, PC95 and PC99. Until mixing zone boundaries are set by DTA results and outcomes of the mixing zone verification study, mixing zone boundaries will be: • PC80 at 100m of the platform. • PC95 at 500m of the platform. • PC99 at 1000m of the platform.
7.23	Mercury concentrations in the produced water discharge will not exceed the ANZG marine water quality 99% DGV for mercury (0.1 µg/L) beyond the edge of the mercury mixing zone boundary set. Until mercury mixing zone boundary are set by outcomes of the mixing zone verification study the mercury mixing zone boundary is set at 20m from the produced water outfall.
7.24	Mercury concentrations in sediments from the produced water discharge will not exceed the; • ANZG marine sediment quality GV-High for mercury (1.0 mg/kg dry weight) anywhere; or • ANZG marine sediment quality DGV for mercury (0.15 mg/kg dry weight) beyond 250m; or • Site-specific GV for mercury, if triggered to be established, will not be exceeded beyond the impact zone.
7.25	No biomagnification of mercury in fish or benthic fauna beyond Australian and New Zealand Food Standard (FSANZ) for fish known to accumulate mercury (1 mg/kg) and all other seafood (0.5 mg/kg) within the impact zone.

3.5 Step 6: Assess if Draft Water/Sediment Quality Objectives Are Met

This step evaluates whether the draft water and sediment quality objectives established in Step 5 are being met based on monitoring indicators. Where exceedances or early warning thresholds are triggered, adaptive management actions are initiated to ensure environmental risks remain within acceptable levels and ensuring compliance with EPOs and relevant EPSs outlined in step 5.

To enable the assessment of whether the draft water/sediment quality objectives are met, the monitoring indicators detailed in Section 3.2.4 are implemented as required and the outcomes of these are assessed to determine if the draft water/sediment quality objectives detailed in Section 3.4 have been met. This will involve collating and assessing multiple lines of evidence as detailed in Section 3.2.4 and may involve carrying out a

weight-of-evidence evaluation where there is insufficient evidence regarding whether water and sediment quality objectives have been met or not.

The following thresholds and responses are consistent with ANZG (2018; 2023) guidance and NOPSEMA expectations. They are designed to provide early warning and escalation pathways for managing potential exceedances of mercury and other contaminants in sediment and water quality. All triggers ensure respective EPO's and EPS's are achieved. However, were any EPO found to have been breached, more significant adaptive management action will be taken, consistent with EPSs detailed in steps 6 and 8.

Trigger-Based Adaptive Actions

The following tables present a structured trigger-based adaptive actions for managing PW impacts and risks, including mercury, associated with the Crux produced water discharge. Triggers are based on water quality, sediment quality, toxicity, and bioaccumulation indicators, applied across defined distances from the platform. Each trigger activates a corresponding adaptive management action, forming a tiered response that escalates controls based on risk severity and environmental uncertainty to ensure EPO's are complied with or return to compliance as soon as reasonably practicable following an exceedance.

Table 6 AMF Triggers

Location	**Triggers[9] - Distance from the Platform/Substructure**						
	Produced water outfall (on platform)	5m from PW outfall	10m from PW outfall	15m from PW outfall	20m from PW outfall	25m from PW outfall	30m from PW outfall
Indicator Values[10]							
Water Quality (WQ)[11]							
80% of Water Quality 99% ANZG DGV for mercury	No action	No action	**Trigger #1**	**Trigger #2**	**Trigger #3**[12]	Exceedance not acceptable	
Water Quality 80% ANZG DGV for mercury	**Trigger #1**				Exceedance not acceptable		
Defined produced water outfall mercury concentrations or predicted mass rates	**Trigger #2 (EPS 7.30 only)**	No action	No action	No action	No action		
Location	**Triggers[13] - Distance from the Platform/Substructure**						
	Produced water outlet (on platform)	Edge of platform/substructure	100m from platform	250m from platform	500m from platform	1000m from platform	2000m from platform
Indicator Values[14]							
Toxicity (DTA)[11] [11]							
80% of PC99	No action	No action	No action	No action	No action	**Trigger #1**[12]	Exceedance not acceptable
80% of PC95	No action	No action	No action	No action	**Trigger #1**[12]	Exceedance not acceptable	
80% of PC80	No action	No action	**Trigger #1**[12]	Exceedance not acceptable			
Sediment Quality (SQ) (annual – Trigger #3)							
80% of Site-specific GV for mercury[15] (99% ANZG WQ DGV based) (**Trigger #3**)	N/A	No action	No action	**Trigger #4**	**Trigger #5**	**Trigger #6**	Exceedance not acceptable
80% of DGV ANZG for mercury	N/A	**Trigger #2**	**Trigger #3/ Trigger #4/ Trigger #5**	**Trigger #6**	Exceedance not acceptable		
80% of GV – High ANZG for mercury	N/A	**Trigger #3/ Trigger #4/ Trigger #5**	Exceedance not acceptable				
Bioaccumulation and Sediment Support Indicators							

[9] Trigger #'s are detailed in the legend for AMF triggers below.

[10] The application of an 80% threshold relative to established guideline values (e.g., ANZG or FSANZ) serves as an early warning trigger consistent with the precautionary principle. This approach enables proactive environmental management by identifying potential risks before full exceedance occurs, allowing time for investigation, mitigation, and adaptive response. It also accounts for natural variability and analytical uncertainty, ensuring that sustained trends toward exceedance of an EPO prevented before an exceedance occurs and ensures impacts and risks are managed to ALARP and acceptable levels.

[11] Triggers with spatial distance predictions are based on predicted PW dispersion, considering RPS 2024 modelling results. Once the model verification study of RPS 2024 is complete, a review of these triggers spatial distances will be carried out based off these results.

[12] Further additional trigger actions being adopted at this point are considered grossly disproportionate to the benefit gained, particularly given the uncertainty around the environmental impacts of exceedances of this indicator value, which are addressed in subsequent triggers. The existing approach reflects a balanced and precautionary response, with future adjustments to be considered as understanding improves.

[13] Trigger #'s are detailed in the legend for AMF triggers below.

[14] The application of an 80% threshold relative to established guideline values (e.g., ANZG or FSANZ) serves as an early warning trigger consistent with the precautionary principle. This approach enables proactive environmental management by identifying potential risks before full exceedance occurs, allowing time for investigation, mitigation, and adaptive response. It also accounts for natural variability and analytical uncertainty, ensuring that sustained trends toward exceedance of an EPO prevented before an exceedance occurs and ensures impacts and risks are managed to ALARP and acceptable levels.

[15] It is predicted this mercury site-specific GV for sediment quality would be protective of 99% of species with high confidence. That is why this trigger value is shown to be less conservative in triggering of actions. If this prediction is wrong, these trigger distance would be revised, to be consistent with the sediment DGV for mercury equivalence.

Precipitation, Flocculation and Sedimentation (PFS) study (**annual - Trigger #2**)	N/A	**Trigger #3**[12]			Exceedance not acceptable
Diffusive gradient thin film (DGT) test (**annual - Trigger #3**)	N/A	No action	No action	**Trigger #4**	Exceedance not acceptable
Infauna – biomagnification - 80% of FSANZ guideline for other seafood[16]. (**Trigger #4**)	N/A	**Trigger #5**		**Trigger #6**	Exceedance not acceptable
Fish – biomagnification – 80% of FSANZ guideline for higher mercury containing fish [17]. (**Trigger #5**)	N/A	**Trigger #6**			Exceedance not acceptable

Legend for AMF Triggers

Trigger Number	Trigger Actions and Details of Trigger Activation[18]
Trigger #1 (EPO 7.1, EPO 7.2, EPO 7.3)	**Triggers:** DTA monitoring trigger #1: • Further to direct measurement of indicator values triggers being activated, a control chart/s will be set-up to monitor toxicity result changes over time and compare then against the trigger indicator values to help as a tool to serve as an early warning indicator. The trigger indicator values will be set-up as reference lines on the control chart. Control limits will also be set based on EPS 7.21. **Actions:** 1. Investigate chemical characterization and mechanistic modelling results and operational data, as relevant, and adopt measures to reduce PW toxicity/mercury levels e.g. adjust chemical dosing and process optimisation. 2. If WQ triggered; Optimise temperature regulation to reduce mercury partitioning into the PW. 3. If DTA or formation water breakthrough triggered; Increase next DTA from min 2 sp/9 sp. to 15 sp. for next round.
Trigger #2 (EPO 7.1, EPO 7.2, EPO 7.3)	**Triggers:** EPS 7.30 trigger #2: • Monitored at the PW outfall using mercury sampling results and using those results to extrapolate predicted annual mass rates of discharge per year as below. • See also EPS 7.30 - Within 12 months of start-up, verify mercury partitioning predictions within the EP (Table 9 61) through chemical characterisation (including using the temporary offshore lab) and further predictive modelling (where appropriate). If produced water outfall mercury concentrations or predicted mass rates of discharge per year exceed predicted mercury concentrations at the PW outfall in the EP (~1.3 to 2.3 µg/L and ~0.1 to 2.6 kg/year), apply adaptive management trigger #2. WQ monitoring trigger #2: • Triggers initiated when two consecutive quarterly sampling events (~3 months) have an average result greater than the trigger value. This is in order to reliably record a sustained elevated level and manage uncertainty and variability associated with lab analysis results. SQ monitoring trigger #2: • average of measurements 80% of the SQ DGV (n ≥ 2) – as a minimum, along the predominant plume direction. Low concentrations may have high variability. Using an average (median or mean) value rather than individual measurements provides a more robust assessment of environmental concentrations and change. 80% of the SQ GV High (n ≥ 1) - Low concentrations may have high variability. However, given this is a GV High value, a single monitoring results exceeding this value at the set distance is considered appropriate to initiate the trigger. **Actions:** 1. Increase frequency of PFS study to annual for remainder of EP being in-force. 2. Where PFS study shows it is likely that mercury is precipitating or flocculating and settling within the impact zone, extend dispersion modelling to include particle dispersion. 3. Investigate chemical characterisation results and operational data, as relevant, and adopt measures to reduce PW toxicity/mercury levels and associated toxicant precipitation. e.g. adjust chemical dosing, process optimisation, inlet temperate optimisation.
Trigger #3 (EPO 7.2, EPO 7.3)	**Triggers:** WQ monitoring trigger #3: • Triggers initiated when two consecutive quarterly sampling events (~3 months) have an average result greater than the trigger value. This is to reliably record a sustained elevated level and manage uncertainty and variability associated with lab analysis results. PFS study trigger #3; • Both the extended dispersion model including particle dispersion and PFS study results suggest sedimentation of mercury precipitates are likely settling on the seabed within the impact zone. • PFS results will be used to assess potential for mercury uptake in marine fauna/benthic fauna. If deemed likely to result in uptake in marine fauna/benthic fauna, this initiates Trigger #3. SQ monitoring trigger #3: • average of measurements 80% of the SQ DGV (n ≥ 2) – as a minimum, along the predominant plume direction. Low concentrations may have high variability. Using an average (median or mean) value rather than individual measurements provides a more robust assessment of environmental concentrations and change. • 80% of the SQ GV High (n ≥ 2) - Low concentrations may have high variability. Low concentrations may have high variability. Using an average (median or mean) value rather than individual measurements provides a more robust assessment of environmental concentrations and change given measurement against this threshold is only at the edge of the substructure.

[16] The trigger value of 0.4 mg/kg wet weight (80% of the FSANZ guideline for "other seafood") is applied to infauna as a conservative early warning threshold. While FSANZ guidelines are intended for human consumption, this value is used here to indicate potential bioaccumulation in benthic organisms that form the base of the marine food web. This approach supports early detection of mercury transfer through trophic levels and aligns with the precautionary principle to ensure risks to ecological integrity are reduced to ALARP and acceptable levels, ensuring relevant EPO 7.3 and EPS 7.24 are complied with.

[17] Higher mercury-containing fish, as defined in FSANZ (2017).

[18] Where relevant, de-escalation of monitoring triggers will be considered in the 5-year EP revision which is submitted to NOPSEMA, which will include a revision of the AMF. Shell may choose to skip trigger values in preference to for adopting higher order trigger actions (e.g. adopt trigger #6 instead of trigger #4 and #5) where Shell determined the evidence support doing so.

	Actions: 1. Where considered ALARP to do so, attempt to further reduce mercury levels at PW outfall through adopting reservoir management measures such as, cycling of wells or temporarily shutting in a well. 2. Increase frequency of sediment monitoring to annual for remainder of EP being in-force. 3. Increase the density of sediment monitoring to improve ability to detect statistically significant change in measured values compared to baseline monitoring. 4. Increase frequency of DGT to annual for remainder of EP being in-force. 5. Establish site-specific mercury guideline value for sediment, guided by the 99% ANZG mercury DGV for water quality. 6. Carry out weight-of evidence evaluation as per section 3.6.1.
Trigger #4 (EPO 7.3)	**Triggers:** SQ monitoring trigger #4: • average of measurements 80% of the SQ DGV (n ≥ 2) – as a minimum, along the predominant plume direction. Low concentrations may have high variability. Using an average (median or mean) value rather than individual measurements provides a more robust assessment of environmental concentrations and change. • 80% of the SQ GV High (n ≥ 1) - Low concentrations may have high variability. However, given this is a GV High value, a single monitoring results exceeding this value at the set distance is considered appropriate to initiate the trigger. • 80% of the site-specific GV - Trigger activates when the average mercury concentration across n ≥ 3 samples along the predominant plume direction exceeds 80% of the site-specific guideline value and shows a statistically significant increase above pre-operations baseline levels (95% confidence interval). This approach accounts for natural variability and ensures robust detection of environmental change. DGT study trigger #4; • Concentration Threshold: Trigger activates when the average DGT-measured average mercury flux[19] across n ≥ 3 samples exceeds: 80% of the ANZG 99% species protection level DGV for water quality (0.1 µg/L) in porewater, or 80% of the site-specific water quality GV. **Actions:** • Infauna mercury biomagnification or mesocosms bioaccumulation monitoring commence. Annual for remainder of EP being in-force. Taking 80% of the FSANZ (2017) guideline for other seafood gives 0.4 mg/kg (mean wet weight). Biota and sediments may have high variability due to natural heterogeneity or processes. Average, based off at least n ≥ 3, will be taken over infauna within the sediment plume/predominant current directions. • Carry out weight-of evidence evaluation as per section 3.6.1.
Trigger #5 (EPO 7.3)	**Triggers:** SQ monitoring trigger #5: • average of measurements 80% of the SQ DGV (n ≥ 2) – as a minimum, along the predominant plume direction. Low concentrations may have high variability. Using an average (median or mean) value rather than individual measurements provides a more robust assessment of environmental concentrations and change. • 80% of the SQ GV High (n ≥ 1) - Low concentrations may have high variability. However, given this is a GV High value, a single monitoring results exceeding this value at the set distance is considered appropriate to initiate the trigger. • 80% of the site-specific GV - Trigger activates when the average mercury concentration across n ≥ 3 samples along the predominant plume direction exceeds 80% of the site-specific guideline value and shows a statistically significant increase above pre-operations baseline levels (95% confidence interval). This approach accounts for natural variability and ensures robust detection of environmental change. **Actions:** 1. Pre-FEED for a mercury removal technology will be initiated and completed to ensure readiness for implementation. This will enable accelerated installation of mercury removal technology should Trigger #6 be activated. 2. Commence mercury biomagnification monitoring in fish species which may have potential to bioaccumulate higher mercury levels. Sampling must include at least 5 individuals of marketable size and commercially fished species, in higher trophic level, being more susceptible to biomagnification of mercury. Biota and sediments may have high variability due to natural heterogeneity or processes hence the minimum number of individuals provided as part of the trigger. Results will be assessed against potential human health and fisheries exposure risks. Annual for remainder of EP being in-force. 3. FEED study for a mercury removal technology will be initiated and completed to ensure readiness for implementation where annual fish biomagnification monitoring identifies mercury concentrations exceeding an average of 0.5 mg/kg wet weight (n ≥ 5) in commercially fished, higher trophic level species. This early action will further accelerate installation of mercury removal technology should Trigger #6 be activated. 4. Carry out weight-of evidence evaluation as per section 3.6.1.
Trigger #6 (EPO 7.1, EPO 7.2, EPO 7.3)	**Triggers:** SQ monitoring trigger #6: • average of measurements 80% of the SQ DGV (n ≥ 2) – as a minimum, along the predominant plume direction. Low concentrations may have high variability. Using an average (median or mean) value rather than individual measurements provides a more robust assessment of environmental concentrations and change. • 80% of the SQ GV High (n ≥ 2) - as a minimum, along the predominant plume direction. Low concentrations may have high variability. Using an average (median or mean) value rather than individual measurements provides a more robust assessment of environmental concentrations. This is applied to the SQ GV high for Trigger 6 only given the cost, time and resources impact associated with meeting this trigger. • 80% of the site-specific GV - Trigger activates when the average mercury concentration across n ≥ 3 samples along the predominant plume direction exceeds 80% of the site-specific guideline value and shows a statistically significant increase above pre-operations baseline levels (95% confidence interval). This approach accounts for natural variability and ensures robust detection of environmental change. Infauna biomagnification monitoring trigger #6: • If annual infauna biomagnification monitoring identifies mercury concentrations exceeding average of 0.4 mg/kg mean wet weight in one year (taken from average of highest 3 samples (n ≥ 3 samples)). Fish biomagnification monitoring trigger #6: • If annual fish biomagnification monitoring identifies mercury concentrations exceeding average of 0.8 mg/kg mean wet weight in one year (n ≥ 5) samples. Fish must be commercially fished species, in higher trophic level, being more susceptible to biomagnification of mercury. **Action:** 1. Install mercury removal technology in platform PW treatment system as soon as reasonably practicable, but within 4 years[20]. Expected performance of the mercury removal technology will be defined through pre-FEED and/or FEED studies.

All other AMF triggers and actions are detailed as EPS's within the EP and are not repeated here.

[19] Flux is a dynamic measure: it reflects movement or transfer over time such as mass of mercury per unit area per unit time (e.g., ng/cm²/day)
[20] Trigger #6 may be adopted earlier at Shell's discretion.

3.5.1 Weight-of-Evidence (WoE) Evaluation

As described in ANZG (2018), "*Weight of evidence describes the process to collect, analyse and evaluate a combination of different qualitative, semi-quantitative or quantitative lines of evidence to make an overall assessment of water/sediment quality and its associated management. It is the central platform for water/sediment quality assessments in the Water Quality Guidelines.*

Applying a weight-of-evidence process incorporates judgements about the quality, quantity, relevance and congruence of the data contained in the different lines of evidence.

The Water Quality Guidelines recommends measuring indicators from multiple lines of evidence across the pressure–stressor–ecosystem receptor (PSER) causal pathway. This will give greater weight (or certainty) to your assessment conclusions — and subsequent management decisions to meet the water/sediment quality objective — than basing your evaluation on a single line of evidence.

Our approach for weight of evidence:

- *harmonises with existing pressure–state–response (PSR) management models that include indicator sets selected across the cause-and-effect pathway*
- *encompasses a broad set of line of evidence indicators, including those with interpretative and diagnostic value (e.g. toxicity, bioaccumulation, biomarkers), as well as non–water quality related stressors*
- *integrates into the Water Quality Management Framework at 3 key steps*
- *adapts to many typical uses of the Water Quality Management Framework."*

Shell will follow this approach in applying WoE evaluations through implementing the AMF. If carried out, this will be done through an expert 3rd party. It will also involve a targeted assessment will be conducted to evaluate the potential for trophic transfer and broader ecological impacts of mercury, where relevant, including implications for higher trophic species and sediment quality.

3.6 Step 7: Consider Additional Indicators or Refine Water/Sediment Quality Objectives

If Step 6 signals that current indicators are insufficient or objectives/guidelines may need adjustment, Step 7 involves exploring additional lines of evidence, applying a weight-of-evidence evaluation or refining the existing targets. Potential additional indicators and evidence include, but are not limited to:

Revisit Conceptual Model (Step 1):

- If unexpected environmental processes or impacts are observed (e.g. a pathway not previously considered leads to a water or sediment quality change), the conceptual model of PW discharge/mercury will be updated. For instance, should field data show mercury is being methylated in sediments at a higher rate than assumed, the conceptual model would be revised to include this process, and subsequent risk assessments would incorporate the enhanced mercury cycling pathway.

Toxicity:

- expanding DTA/ecotoxicological testing to diagnose causes of any observed toxicity. For instance, if whole-effluent tests indicate higher toxicity than predicted, targeted Toxicity Identification Evaluation (TIE) can be conducted to isolate the contributory toxicants (Strom et al, 2009; Burgess et al, 2013; Li *et al*, 2018). Further DTAs with a broader range of species (including more sensitive or local species) may be undertaken to improve confidence in PC80–PC99 values and ensure our toxicity objectives remain appropriately protective. This is consistent with ALARP principles, if a particular component of PW is disproportionately contributing to toxicity and a management option exists to reduce it, that option will be investigated and, if practicable, implemented.
- Microtox® testing of PW to track temporal trends.

- **Chemistry**:
  - more detailed chemical analyses (e.g Gas Chromatography–Mass Spectrometry) to complement routine monitoring. This could involve targeted analyte screening (e.g. for specific production chemicals or trace

contaminants not previously examined) and chemical speciation studies to understand the environmental behaviour of key contaminants.

- **Biodiversity**:
  - ecological surveys of the receiving environment (e.g. ROV surveys, BRUV for fish communities, eDNA metabarcoding, benthic infauna sampling) to detect any ecological changes attributable to PW discharges. For instance, benthic community composition in sediments around the discharge can be monitored; a shift in infaunal species (e.g. loss of sensitive species or proliferation of tolerant ones) could indicate subtle chronic effects, prompting further investigation. Microbial community analysis (amplicon sequencing with flow cytometry) can also serve as an early indicator of ecosystem change in water or sediment, since microbes respond quickly to contaminants. Any significant deviations in community structure might necessitate refining the objectives or adding new management measures targeting the observed effect.
- **Biomarkers/Bioaccumulation**:
  - assessment of contaminant levels in tissues of marine organisms to directly gauge bioaccumulation. As part of the AMF, Shell can analyse tissues of selected biota (e.g. filter feeders, fish or invertebrates) for substances known to bioaccumulate (like PAHs or mercury). If, for example, mercury begins to appear at elevated levels in the tissues of sentinel organisms near the platform (relative to reference sites), this would be a clear line of evidence that bioaccumulation is occurring. Such findings would trigger a refinement of objectives and management actions – potentially lowering the mercury triggers relevant EPOs or increasing monitoring frequency – to ensure protection of higher trophic levels (consistent with ANZG 2023 guidance on ecosystem receptor indicators).

Through Step 7, the AMF remains flexible and responsive: new evidence can lead to new or adjusted indicators, and guideline/objective values can be revised to remain appropriately protective. This step embodies the principle of continual improvement (ANZG 2018), as new information becomes available; Shell will refine its management approach to manage PW impacts and risks to ALARP and acceptable levels.

3.7 Step 8: Consider Alternative Management Strategies

Step 8 outlines the broader strategic response framework that supports and builds upon the adaptive actions initiated in Step 6. While Step 6 focuses on operational triggers and immediate management responses, Step 8 ensures that insights gained from those responses are escalated, evaluated, and embedded into long-term planning and continuous improvement processes.

This includes:

- Escalation of unresolved or recurring issues to senior technical, environmental, and operational leadership for cross-disciplinary review.
- Integration of monitoring outcomes and trigger responses into future revisions of the EP, including updates to EPOs, EPSs, and monitoring design.
- Initiation of formal technical reviews or feasibility studies (e.g. for treatment technology or process redesign) where adaptive actions indicate persistent or emerging risks. This includes:
  - **EPS 7.31**: Carry out periodic reviews of mercury removal technology for PW discharge source as relevant to the Crux facility.
    - These reviews will include:
      - Interim screening every four years, offset about two years from the ‘detailed review’ below, for new or emerging mercury removal technology that has not previously been assessed for use on the Crux facility.
      - Where interim screening identifies new or emerging technology, progress to formal review to establish suitability.
      - A detailed review and revalidation every four years (with the first review occurring within 2 years from the facility start-up to account for verified mercury rates).
    - Detailed reviews will include consideration of:

- Maturation of existing technologies, checking for advancements in treatment capacities and cost efficiency.
- Assessment of new technologies (when applicable).
- Technical feasibility of available technology.
- Engineering risk assessment.
- Latest measured mercury monitoring results.
- Assessment of related aspects (e.g., health, safety, operability & maintenance).
- Economic viability.
- Weighting of cost compared to environmental benefit gained for adopting technology.

▪ Reviews will include a decision point on whether to proceed with a front-end engineering design (FEED) mercury removal project.

○ **EPS 7.32:** If the decision is taken to progress with FEED, within 6 months of completing FEED, a final investment decision will be made, which will take into account the principles of ALARP. Installation will occur as soon as practicable within the appropriate planned major turnaround (shutdown maintenance program) for Crux.

- Stakeholder engagement and transparency, including communication of significant findings or management changes to regulators and relevant persons, where appropriate.
- Knowledge transfer and alignment with other Shell assets or industry initiatives to ensure best practices and lessons learned are shared and applied.

This step ensures that the adaptive management framework remains dynamic, forward-looking, and capable of evolving in response to new information, regulatory expectations, and environmental performance outcomes.

3.8 Step 9: Assess if Water/Sediment Quality Objectives are Achievable

By late in the 5-year EP period (after substantial monitoring data have been gathered and interim adaptive actions (Steps 6–8) have been implemented), Shell will formally evaluate whether the water and sediment quality objectives set in Step 5 are realistically achievable moving forward and being met consistently. The information from Steps 6–8, including all monitoring results, investigations, and any management interventions to date will feed into this assessment. If the objectives are found to be achievable with the measures in place, they will be confirmed (and potentially made more stringent over time in the spirit of continuous improvement). If any objective is found to be not fully achievable with current technology or practices, Shell will determine what additional measures or revised strategies are required. This may include further refining objectives to align with what is ecologically sustainable while still ensuring environmental values are protected, or conversely, committing to new technology deployments to meet the original objective. This step will also involve consulting relevant persons (where appropriate) and reviewing the latest guidelines (e.g. any ANZG updates or new research) to ensure objectives remain aligned with contemporary science and community expectations. The outcome of Step 9 is a decision on whether any further adaptations to the AMF are needed. This feeds into future revisions of the AMF (and EP), embedding the learnings of the past period. In essence, Step 9 serves as a feasibility and continual improvement checkpoint, confirming that Shell's management approach can indeed meet the protective goals set and if not, charting a path to bridge any gaps so that environmental risks from produced water continue to be managed to ALARP and acceptable levels.

3.9 Step 10: Implement Agreed Management Strategy

Step 10 ensures that the agreed management strategies, including all monitoring, trigger responses, and escalation pathways developed through Steps 1–9, are effectively implemented and embedded into day-to-day operations. This step focuses on translating the adaptive management framework into operational practice, consistent with the ANZG WQMF emphasis on continuous improvement and the EP's Section 10 commitments to performance management, monitoring, and reporting.

Key implementation elements include:

- Operationalisation of Monitoring and Triggers: All monitoring activities (e.g. DTA, chemical characterisation, sediment and biota sampling) and trigger thresholds are integrated into the facility's management system ensuring timely detection and response to environmental risks.
- Execution of Adaptive Management Actions: Triggered actions (as defined in Step 6) are implemented through established systems such as the Compliant and We Can Prove It (CAWPI) system.
- Data Management and Reporting: Environmental data are captured, quality-assured, and stored in accordance with Shell's internal systems and regulatory requirements. Results are reviewed regularly to assess compliance with EPOs and EPSs and inform internal and external reporting obligations.
- Performance Review and Feedback Loops: Outcomes from monitoring and management actions are reviewed periodically, as appropriate, to assess effectiveness, identify trends, and inform updates to the AMF and EP. This includes formal reviews aligned with the EP revision cycle and informal reviews triggered by monitoring results or operational changes.

This step ensures that the AMF is not only a planning tool but a living framework embedded in Crux operations, enabling Shell to manage environmental risks from produced water discharge in a responsive, transparent, and accountable manner.

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