ROLLO MULTICLIENT
MARINE SEISMIC SURVEYS
ENVIRONMENT PLAN SUMMARY

CHAPTER 1
Stakeholder Engagement

PGS Australia Pty Ltd
October 2018

Contents

LIST OF TABLES

1. DOCUMENTATION

Stakeholder submissions, meeting summaries, assessments of merit and ongoing consultation requirements are presented in this chapter. Stakeholder input was considered in developing additional Performance Outcomes, Standards and Measurement Criteria detailed in Chapters 2 and 3. Where information is personal this has been blacked out for reason of privacy.

Chapter 2 – comprises a review of the Bioregion within which the proposed OAs are located, the North-west Marine Region (NWMR; as defined by the Commonwealth). The outcome of the Bioregion risk evaluation resulted in various temporal and/or spatial exclusion zones being implemented. This chapter assesses the known potential impacts or risks to stakeholders' activities or interests from the activity. No direct stakeholder feedback / submissions received regarding the Rollo EP are incorporated into this Chapter.

Chapter 3 – deals with many elements that are relatively constant by nature, such as titleholder information, legislative requirements, assessment process, the nature and management of the operating vessels, environmental risk evaluation (including methodology), and implementation strategy.

PGS is confident that the structure defined above will, over time, allow stakeholders to become more familiar with Chapters 2 and 3, and as such not require constant review in their entirety, but rather reviewed as required when considering details contained within the project specific Chapter 1. Revisions or amendments to Chapters 2 and 3 from stakeholder engagement will be highlighted so that the entire contents need not be re-read. The revised version of the Rollo EP will then be submitted to NOPSEMA for acceptance under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS [E] Regs; as amended January 2015).

Both the interim versions of the EP and the versions submitted to NOPSEMA will be posted on a specific website designed for that purpose. Details of how to access the three chapters of the EP will be contained within the initial stakeholder letters. For stakeholder confidentiality purposes, no direct stakeholder correspondence will be disclosed on the EP website. However, summaries of key points raised will be posted in the interest of transparency, so each individual respondent can verify that respective submissions were accurately captured.

The EP is a large and complex document and may contain errors. Where such errors are noted, and the intent is clear to a reasonable person given the context and general discussion contained within the EP, they shall be amended under Management of Change (MoC) procedures in such a manner that the intended outcome is attained.

2. STAKEHOLDER ENGAGEMENT

Engagement with stakeholder groups, primarily within the commercial fishing industry, concerning the proposed 3D and 2D MS and CSEM surveys within the Rollo OA commenced in July 2016. In March 2018 PGS changed the scope of the EP to two defined operating areas (NCB and Beagle) and to 3D surveys only. PGS recommenced consultation based to communicate these changes and re-engage with stakeholders. Considering these changes some stakeholders were no longer "relevant persons".

The merits of all stakeholder objections and claims have been assessed and incorporated into the EP as required by Regulation 16(b). All stakeholders will be able to see a full summary of these discussions through the posting of the submitted EP on the EP specific website as notified within the initial stakeholder letters.

Stakeholder engagement comprises phases as described below:

- Phase 1: Preparatory stakeholder consultation and engagement:
  - All identified relevant persons (stakeholders) have been sent an invitation to comment on the Rollo EP five (5) year EP, along with a fact sheet for the proposed activity which included information regarding the proposed location, timing, survey specifications and contact details.
  - Engagement with key stakeholders prior to submission of EP to NOPSEMA.
    - Consists of face-to-face meetings, telephone conversations and written correspondence as appropriate.
  - PGS complied with all reasonable requests from stakeholders for further information, and upon request provided stakeholders with information regarding the environmental risk assessment undertaken for the activity relevant to the stakeholders' activities and interests.
  - Stakeholders have been provided with the means to access the EP specific website containing the interim versions of Chapters 1, 2 and 3 of the EP.
    - As of January 2017, 11 out of the 138 stakeholders contacted so far for the PGS Rollo EP, have requested access to the Rollo EP website.
  - Where applicable, Cooperation Protocols and Ongoing Consultation Plans defining agreed operating and communication protocols have been put in place.
  - Updates regarding project changes and new scientific literature.
    - CSEM update sent out on 19th September 2016.
  - As a gesture of transparency, PGS has posted the NOPSEMA OMR letter received from the first-round assessment on the Rollo EP project website (dated 21 November 2016).
  - In April 2018 PGS undertook a review of stakeholders considering the change to the Rollo OA to identify those that were still "relevant persons".
  - Updated information and engagement was undertaken for the new Rollo OAs with relevant persons and those stakeholders who are no longer relevant persons but had responded to previous correspondence from PGS.
- Phase 2: Pre-survey Consultation:
  - For individual seismic surveys under this EP, stakeholders whose interests fall within the operational area of the survey will be sent targeted information regarding the proposed survey, including proposed location, timing and duration.
  - Any relevant agreements with, or commitments to, stakeholders resulting from Phase 1 consultation will automatically become active and the relevant stakeholders will be notified accordingly.
  - PGS will provide stakeholders with targeted information regarding the environmental risk assessment undertaken for the survey relevant to a stakeholder's activities and interests should such an assessment vary from that initially contained within the NOPSEMA accepted EP.
- Phase 3: Ongoing Consultation:
  - Includes complying with new and reasonable requests from stakeholders for additional information, survey updates, along with assessments of merit of any new issues raised.
- Phase 4: Post-survey Notifications:
  - Completion notifications will be sent to all stakeholders affected by individual projects under this EP upon completion of such projects.

2.1 PHASE 1 - PREPARATORY STAKEHOLDER ENGAGEMENT – BROADER ROLLO

2.1.1 Stakeholder Engagement Letters

To prepare for stakeholder consultation, relevant persons were identified based on the following information:

- Commonwealth and WA State government agencies under relevant legislation.
- Non-government organisations that have interest/activities in operational area.
- GIS shapefiles of commercial fishery license areas.
- Current status reports of WA fisheries and aquatic resources (Fletcher & Santoro, 2015).
- Current status reports of Commonwealth fisheries and aquatic resources (ABARES, 2015).
- Current list of license holders extracts (provided by DoF, 2016).
- Scientific literature.
- Information provided directly from previous PGS stakeholder consultation.

The following stakeholders, including fisheries bodies and organisations and State and Commonwealth Government departments, were informed of the survey, via letters and emails sent out on the 5th July 2016 (along with phone calls as appropriate) as part of Phase 1: Preparatory Stakeholder Engagement for the Rollo EP.

- Entities or individuals currently holding licences for the following WA State-managed commercial fisheries have been contacted and informed of the proposed operations:
    - Gascoyne Demersal Scalefish Managed Fishery (GDSF)
    - Mackerel Managed Fishery (MMF)
    - Northern Demersal Scalefish Managed Fishery (NDSF)
    - Pilbara Demersal Scalefish Fishery (PDSF)
        - Pilbara Fish Trawl Interim Managed Fishery (PFTIMF)
            - Seafresh Holdings hold licences in the PFTIMF.
        - Pilbara Trap Managed Fishery (PTMF)
        - Pilbara Line Fishery (PLF)
    - North Coast Prawn Managed Fishery (NCPMF)
        - Broome Prawn Management Fishery (BPMF)
        - Nickol Bay Prawn Managed Fishery (NBPMF)
            - Seafresh Holdings hold licences in the NBPMF.
        - Kimberley Prawn Managed Fishery (KPMF)
            - Austral Fisheries hold licences in the KPMF.
            - Raptis Fishing hold licences in the KPMF.
            - Seafresh Holdings hold licences in the KPMF.
        - Onslow Prawn Managed Fishery (OPMF)
            - Seafresh Holdings hold licences in the OPMF.
    - Pearl Oyster Managed Fishery (POMF)
    - Shark Fisheries
        - WA North Coast Shark Fishery (WANCSF)
        - Northern Shark Fishery (NSF)
    - West Coast Deep Sea Crab (Interim) Managed Fishery (WCDSCF)
    - West Coast Western Rock Lobster Managed Fishery (WRLF)[1]

Licence holders of the following Commonwealth fisheries were contacted via their representative bodies (see below).

- North West Slope Trawl Fishery (NWSTF)

[1] *Stakeholder consultation letters sent on 01/05/2017. Follow up calls undertaken on 13/6/2017.*

  - Northern Prawn Fishery (NPF)
  - Southern Bluefin Tuna Fishery (SBTF)
  - Western Deepwater Trawl Fishery (WDTF)
  - Western Skipjack Tuna Fishery (WSTF)
  - Western Tuna and Billfish Fishery (WTBF)

- Fishing Associations:
  - Western Australian Fishing Industry Council (WAFIC)
  - Commonwealth Fisheries Association (CFA)
  - Australian Fisheries Management Authority (AFMA)
  - Pearl Producers Association (PPA)
  - NPF Industry Pty Ltd
  - WA Seafoods
  - Northern Prawn Fishery (Qld) Trawl Association Inc.
  - Northern Territory Seafood Council (NTSC)
  - Australian Southern Bluefin Tuna Industry Association (ASBTIA)

- Recreational Fishing Associations
  - Australian Recreational Fishing Foundation (ARFF)
  - Broome Fishing Club (BFC)
  - Kimberley Professional Fishermen's Association (KPFA)
  - Mary Island Fishing Club (Derby)
  - Recfishwest

- Fishing and Diving Charter Companies[2]
  - Exmouth Game Fishing Club
    - Exmouth Gamex competition
  - Blue Sun2
  - Image Dive
  - Top Gun Charters
  - BlueJuice Fishing Charters
  - Blue Lightning Fishing Charters
  - Port Bouvard Charters
  - Apache Fishing Charters
  - Blue Horizon Fishing Charters

- Non-government Organisations
  - Cape Conservation Group (CCG)
  - Centre for Whale Research (CWR)
  - International Fund for Animal Welfare (IFAW) Oceania (IFAW)
  - Ningaloo Coast World Heritage Advisory Committee (NCWHAC)

- Government Departments
  - Australian Maritime Safety Authority - Nautical Advice (AMSA)
  - Australian Border Force (ABF)
  - Australian Hydrographic Service (AHS)
  - Commonwealth Department of the Environment - Marine Reserves Branch (DoE-CMRB)
  - Department of Defence (DoD)
  - Defence Property Services Group[3]

[2] *Stakeholder consultation letters sent on 24/11/2016.*
[3] *Stakeholder consultation letter sent on 04/01/2017.*

    - Directorate of Property Acquisition, Mining and Native Title
  - NT Department of Transport (NT DoT)[3]
  - Strategic Border Command (SBC)
  - WA Department of Fisheries (DoF)
  - WA Department of Mines and Petroleum (DMP)
  - WA Department of Parks and Wildlife (DPaW)
  - WA Department of Transport (DoT)

It is not possible to obtain a list of licence holders in the Pearl Oyster Managed Fishery (POMF; including pearl farms in the Montebello Islands) from DoF as this fishery is administered under the *Pearling Act 1990* rather than under the WA *Fish Resources Management Act 1994*. DoF advised that the best way to contact individual licence holders in the POMF is via the peak industry body for this fishery - the Pearl Producers Association (PPA). PPA supported this advice.

As there were 597 individual licence holders in the West Coast Western Rock Lobster Fishery (WCWRLF), communication and consultation with individual licence holders was via the peak industry body for this fishery: the Western Rock Lobster Council (WLRC) and individual co-ops and associations:

- United Mid West Professional Fishermen's Association (UMWPFA)
- Western Rock Lobster Council (WRLC)
- Kalbarri Professional Fishermen's Association
- Geraldton Professional Fishermen's Association (GPFA)
- Geraldton Fishermen's Co-operative Ltd.

All Commonwealth managed fisheries are administered through AFMA. The CFA has previously advised that they have an obligation to inform their members of potential projects, and that consultation at the fishery level is best handled by regional industry associations where they exist.

As outlined on AFMA's website, the following fishing industry associations, along with AFMA, were contacted in regards to the proposed survey:

Commonwealth Fishery	Fishing Association	Representative Bodies
North West Slope Trawl Fishery (NWSTF)	• CFA • WAFIC	n/a
Northern Prawn Fishery (NPF)	• CFA	• NPF Industry Pty Ltd • WA Seafoods • Northern Prawn Fishery (Qld) Trawl Association Inc. • Northern Territory Seafood Council (NTSC)
Southern Bluefin Tuna Fishery (SBTF)	• CFA	• Australian Southern Bluefin Tuna Industry Association (ASBTIA)
Western Deepwater Trawl Fishery (WDTF)	• CFA • WAFIC	n/a
Western Skipjack Tuna Fishery (WSTF)	• CFA	• Australian Southern Bluefin Tuna Industry Association (ASBTIA)
Western Tuna and Billfish Fishery (WTBF)	• CFA	n/a

Copies of stakeholder engagement letters, fact sheets and consultation update letters sent to stakeholders were provided to NOPSEMA as part of the EP submission.

The stakeholder letter provides information concerning the generic location, timing and nature of the proposed activities, a link to further information regarding seismic activities and its impacts and provides contact details should stakeholders wish to seek further information.

As planning for individual surveys within the Rollo OA is finalised stakeholders will be contacted 8 weeks prior to commencement of each survey, and therefore stakeholders will have another opportunity to comment, request additional information and potentially raise any new concerns regarding the proposed individual survey within the Rollo OA.

2.1.2 Stakeholder Engagement Meetings

All stakeholders were notified via the stakeholder engagement letter that PGS was available for face-to-face meetings to discuss the Rollo EP. PGS has initiated face-to-face stakeholder engagement meetings, prior to submission of the EP to NOPSEMA, with key stakeholders - including WA and Commonwealth fisheries licence holders, fisheries bodies and organisations, and State and Commonwealth government departments identified in Chapter 2.

A summary of these meetings is in Table 2-2.

Key stakeholders identified below are those that accepted PGS offer of a face-to-face or phone meeting prior to submission of the Rollo EP to NOPSEMA.

- Licence holders of the following WA State fisheries[4]:
    - Gascoyne Demersal Scalefish Managed Fishery (GDSF)
    - Mackerel Managed Fishery (MMF)
    - Northern Demersal Scalefish Managed Fishery (NDSF)
    - Pilbara Demersal Scalefish Fishery (PDSF)
        - Pilbara Fish Trawl Interim Managed Fishery (PFTIMF)
        - Pilbara Trap Managed Fishery (PTMF)
        - Pilbara Line Fishery (PLF)
    - North Coast Prawn Managed Fishery (NCPMF)
        - Broome Prawn Management Fishery (BPMF)
        - Nickol Bay Prawn Managed Fishery (NBPMF)
        - Kimberley Prawn Managed Fishery (KPF)
        - Onslow Prawn Managed Fishery (OPMF)
    - Pearl Oyster Managed Fishery (POMF)
    - West Coast Deep Sea Crab (Interim) Managed Fishery (WCDSCF)

- Licence holders of the following Commonwealth fisheries via their representative bodies:
    - Northern Prawn Fishery (NPF)

- Fishing Associations:
    - Western Australian Fishing Industry Council (WAFIC)
    - Commonwealth Fisheries Association (CFA)
    - Australian Fisheries Management Authority (AFMA)
    - Pearl Producers Association (PPA)

- Non-governmental Organisations:
    - Cape Conservation Group (CCG)
    - Ningaloo Coast World Heritage Advisory Committee (NCWHAC)

- Government Departments:

[4] Stakeholder engagement meetings have been conducted either with individual licence holders or via their representative fishing industry bodies.

- WA Department of Fisheries (DoF)

Key stakeholders identified below are those that either did not accepted or did not respond to PGS offer of a face-to-face or phone meeting prior to submission of the Rollo EP to NOPSEMA.

- Licence holders of the following Commonwealth fisheries via their representative bodies:
  - Western Deepwater Trawl Fishery (WDTF)
  - Western Tuna and Billfish Fishery (WTBF)

- Fishing Associations:
  - Australian Fisheries Management Authority (AFMA)

- Recreational Fishing Associations
  - Recfishwest

- Non-governmental Organisations:
  - Centre for Whale Research (CWR)

PGS has responded in writing to all stakeholders attending face-to-face meetings with a summary of the items discussed, concerns raised, outcomes and agreed protocols of interaction. Stakeholders received an opportunity to confirm the information was correct prior to the EP being submitted to NOPSEMA for acceptance.

Outcomes, agreed protocols of interaction and copies of all communications from the stakeholder engagement face-to-face meetings were provided to NOPSEMA as part of the EP submission. Only summaries of such correspondence is provided in this EP summary or posted on the PGS EP website so as to maintain confidentiality of stakeholder submissions.

2.1.3 Stakeholder Update Letters

Consultation with all relevant stakeholders identified via the consultation process described above in Section 2.1 have continued during the EP assessment period.

The following consultation updates have been sent out whilst the EP has been under assessment:

- September 2016 – CSEM Update - 1
  - The purpose of this update was to provide an update regarding the additional activities proposed for the Rollo operational area (OA), as well as a revised EP fact sheet with information on the proposed activities.

- March 2017 – Environment Plan Activity Update - 2
  - The purpose of this update was to provide an update to stakeholders regarding recent changes and additional mitigation controls proposed in the re-submitted Rollo EP.
  - PGS informed stakeholders they have reviewed and assessed the recent FRDC publication[5] relating to the impact of marine seismic surveys on crustacean, and bivalve fisheries as it relates to the proposed Rollo EP. PGS' assessment of the scientific paper has been included in the EP resubmitted to NOPSEMA (February 2017), see Rollo EP – Chapter 2, Section 3.2.2.7 - Disturbance to Benthic Invertebrates.
- August 2017 - Environment Plan Activity Update - 3

[5] *FRDC publication 2012/008: Assessing the Impact of Marine Seismic Surveys on South-east Australian Scallop and Lobster Fisheries (2016).*

- The purpose of this update was to provide stakeholders with an opportunity to provide comments prior to the EP being re-submitted, as well as advise them of additional information regarding recent changes to the proposed EP, such as:
  - Fisheries spatial analysis
  - Increased operational restrictions
  - Review of new science – Plankton Paper and Marine turtle recovery plan.
  - Increased spatial buffers.

2.1.4 Stakeholder Submissions and Assessment of Merit

As of 15th September 2017, responses were received from stakeholders contacted during the Phase 1 pre-survey consultation. Details of these submissions and PGS assessment of merits are provided in Table 2-1 and Table 2-2. Copies of all correspondence (stakeholder submissions and PGS responses) were provided to NOPSEMA as part of the EP assessment. An assessment of the merits of objections or claims about regarding the Rollo MC MS EP was undertaken, and where practicable those with merit were incorporated into the EP.

Table 2-1 - Phase 1: Preparatory consultation – stakeholder submissions and PGS responses on Broader Rollo

No.	Stakeholder	Date requested project website login	Date Response Received	Method	Feedback	PGS Assessment on Feedback and Response
1	Australian Border Force (ABF)	n/a	14-Sep-2016	email	ABF thanked PGS for the opportunity to comment on the project, and on this occasion, they declined to comment.	• No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
2	Australian Fisheries Management Authority (AFMA)	06-Jul-2016	06-Jul-2016	email	AFMA requested a login and password to access the Rollo MC MSS EP.	• PGS provided website login. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
3	Australian Hydrographic Service (AHS)	n/a	15-Sep-2016	email	AHS acknowledged receipt of the Rollo EP update. AHS requested PGS provide confirmation of details at least three weeks prior to commencement of survey.	• No action is required from PGS. • Stakeholders will be contacted four weeks prior to commencement of each survey. • Therefore, PGS will adhere to the AHS request of receiving notification at least three weeks prior to the commencement of a survey (**EPS 3**).
			15-Sep-2016	email	Read receipt received.	• No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			21-Aug-2017	Email	AHS confirmed receipt and acknowledged receipt o	• Please accept this email as acknowledgement that your email has been received by the AHS.
4	Australian Maritime Safety Authority (AMSA)	07-Jul-2016	07-Jul-2016	email	AMSA requested a website log-in.	• PGS provided website login. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			12-Jul-2016	email	AMSA thanked PGS for requesting feedback from AMSA and providing the website log on. AMSA provided PGS with an AIS vessel plot showing the MC MSS OA. AMSA informed PGS of the following: • The OA overlaps a heavy traffic area. -The OA includes several charted shipping fairways. -The survey vessel will need to be active and maintain exceptional communications with all commercial shipping, should they be encountered, in the survey area noting there will be a considerable speed difference between commercial shipping and the survey vessel whilst the latter is conducting operations. -The seismic vessel must display appropriate day shapes, lights and streamers, reflective tail buoys, to indicate the vessel is towing and is therefore restricted in her ability to manoeuvre. -Visual and radar watches must be maintained on the bridge at all times. • Please have the survey vessel(s) notify AMSA's Joint Rescue Coordination Centre (JRCC) through rccaus@amsa.gov.auu (Phone: 1800 641 792 or +61 2 6230 6811) for AUSCOAST warning broadcasts 24-48 hours before operations commence. -AMSA's JRCC will require the vessels details (including vessel name, callsign and Maritime Mobile Service Identity (MMSI), satellite communications details (including INMARSAT-C and satellite telephone), area of operation, requested clearance from other vessels and will need notification of when operations commence and are complete. • Please ensure that the Australian Hydrographic Service is notified through datacentre@hydro.gov.au at least 4 weeks prior to the commencement of survey to allow for the timely promulgation of related Notices To Mariners (NTM). • AMSA edits to the Rollo MC MSS EP - Chapter 2 Maritime Safety Information and updates to AMSA's Marine Notices. -Amending the AMSA Maritime Safety Information link on page 133 to: http://www.amsa.gov.au/search-and-rescue/distress-and-safety-comms/msi/msi-email/index.as -Updating the Marine Notices referenced in 3.2.1.8 on page 146 to 17/2014 Sound navigation practices and 14/2015 Reducing the risk of collisions at sea-Updating the Marine Notices	• 12-Jul-2016 PGS thanked AMSA for reviewing the EP and recommending the changes. • PGS updated the Rollo MC MSS EP Chapter 2 (Rev 2), created a list of amendments and edits and re-posted the EP on the Rollo project website on 2 August 2016. • PGS will comply with the requests from AMSA (EPS 3). • Stakeholders will be contacted 4 weeks prior to commencement of each survey. • Therefore, PGS will adhere to AMSA's request that the AHS receive survey notifications at least four weeks prior to the commencement of a survey (EPS 3). • PGS updated the Rollo EP with the edits suggested by AMSA (Chapter 2-Section 2.5.7.).

					referenced in 3.3.3.8 on page 295 to 17/2014 Sound navigation practices and 14/2015 Reducing the risk of collisions at sea.	
			15-Sep-2016	email	Read receipt received.	• No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			21-Aug-2017	email	Read receipt received.	• No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			21-Aug-2017	email	AMSA informed PGS they have noted that the changes to the planned survey have not altered the survey boundaries, previous advice provided by AMSA on 12 July 2016, 19 September 2016 and 16 March 2017 remains extant.	• PGS responded acknowledging that the previous advice received from AMSA in March 2017 and September 2016 for the Rollo EP still stands.
5	Australian Maritime Safety Authority (AMSA) - Pilbara Ports	n/a	14-Sep-2016	email	Read receipt received.	• No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			18-Aug-2017	Email	Read receipt received.	• No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
6	Australian Southern Bluefin Tuna Industry Association (ASBTIA)	n/a	07-Jul-2016	email	ASBTIA requested PGS to resend the pdf as they were not able to view the letter.	• 8-Jul-2016 PGS re-sent ASBTIA a copy of the Rollo stakeholder letter as requested.
			18-Jul-2016	email	ASBTIA advised PGS that the proposed OA is not an area of key concern for the purse-seine fishery operations for the ranching of Southern Bluefin Tuna, and therefore they have no objections to the activity. ASBTIA informed PGS that the OA overlaps the WTBF operations area, and that AFMA are likely to have a contact address, or ASBITIA can chase up if PGS need help.	• 19-Jul-2016 PGS advised ASBTIA that they typically notify WTBF via the CFA, but if they have direct contact details it would be very useful. • To date no response has been received from ASBTIA regarding the WTBF contacts. • PGS acknowledges that ASBTIA has no objections as the Rollo OA is not an area of concern for the purse seine fishery. • PGS agrees with ASBTIA. • No action is required from PGS.
			15-Sep-2016	email	Read receipt received.	• No action is required from PGS.
			15-Sep-2016	email	Read receipt received.	• No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
7	Cape Conservation Group (CCG)	07-Jul-2016	06-Jul-2016	email	• CCG requested a login to the website. • CCG informed PGS that due to the number of large-scale (area/ time) proposed seismic, CCG are currently preparing a document to facilitate the consultation process. As it is not ready they would like greater detail about the proposal in the areas relevant to the CCG. • CCG requested a website login to review the EP in order to ask more specific questions. • CCG are interested in mitigation of environmental impacts (particularly marine mammals and cumulative impacts). • CCG informed PGS that if PGS visit Exmouth, they would be interested in meeting up to discuss the project.	• 7 Jul 2016 PGS provided website login. • PGS agreed with the CCG that the preparation of consultation document is a good idea and that they would be happy to discuss this during a face-to-face meeting. • PGS agreed with CCG that the Rollo MC MS is a large EP, however it is not a large survey and PGS will provide some perspective to CCG during the meeting by comparing typical annual amount of work, which is further refined in the EP. • PGS other large multi-year EP -Outer Exmouth MC3D MSS EP, has had no work done under it so far and it's nearly 2 years old. Not ideal from a commercial point of view of course, but it's a good example of how much an EP size can differ from actual worked performed. • PGS informed CCG that they are very happy to provide access to the EP and provided password and log in.
			21-Jul-2016	email	CCG informed PGS that they are still working their way through the EP and hope to make the 4 week comment period.	• 22 Jul 2016 PGS thanked CCG for the effort they are making to review the Rollo EP and have no problem with them taking longer to complete the EP review.

			30-Jul-2016	email	Response letter received from CCG • CCG thanked PGS for their patience and informed PGS that although it was a very large document it was certainly helpful being able to see the full plan. CCG raised the concerns regarding the following topics: 1. Conservation agreements 2. Acoustic disturbance 3. Fauna 4. Knowledge gaps 5. Alternative strategies 6. Mitigation measures 7. Cumulative Impacts 8. General questions 9. Changes in commitments post approval 10. Consultation 1. Conservation Agreements CCG identified legislation applicable to the protection of Ningaloo regions: *Environment Protection and Biodiversity Conservation Act 1999* *Wildlife Conservation Act 1950* Acoustic Disturbance • Given that four ships will be running arrays simultaneously in the same area with a potential minimum separation distance of 30 km there could still be significant amplification when signal peaks coincide, especially as they could be from two separate sources within 30 km amplifying the signal twice, for both the ships on the inside of the seismic fleet. • CCG feels further consideration must be given to focussing on this region not only as habitat for marine animals but also as a migratory route for whale sharks, marine turtles, manta rays and as calving/resting ground for humpback whales. Fauna • The Pygmy Blue Whale is a migratory species, listed as endangered under the EPBC Act. Past studies of Kangaroo Island Pool and Canyons have noted that blue whales stopped feeding in proximity to the seismic survey vessel did not resume feeding until 30 minutes after the array was shut down (IFAW, 2013). • The EP describes this potential foraging area as unlikely supported by claims there is scientific evidence "confirming low productivity levels occur in this area". The full reference to this hasn't been provided and CCG assumes it is: Double MC, Andrews-Goff V, Jenner KCS, Jenner M-N, Laverick SM, et al. (2014) Migratory Movements of Pygmy Blue Whales (Balaenoptera musculus brevicauda) between Australia and Indonesia as Revealed by Satellite Telemetry. PLoS ONE 9(4): e93578. doi:10.1371/journal.pone.0093578 • CCG literature review of deep chlorophyll maxima and pygmy blue whale presence: CCG notes that Double et al indicated low levels of chlorophyll in their sample results however these sample results were near surface chlorophyll a concentration using MODIS aqua satellite, 9km using an 8 day resolution and only provides a snapshot of this productivity parameter. Studies of chlorophyll off the Ningaloo (Hanson, Pattiaratchi & Waite, 2005, Rossi et al. 2013) found that levels were low at the surface and increased with depth.	15-Sep-2106 PGS responded to the CCG stakeholder letter: • PGS informed CCG that they appreciate the effort invested and concerns expressed for the CCG and they hope the information provided provides CCG with sufficient information regarding the proposed activities and the potential impacts to the marine environment, particularly in regards to the Ningaloo Coast and surrounding area of interest to the CCG. • PGS acknowledged that the Rollo MC MSS EP is a large and complex document, and they appreciate the enormous amount of work CCG volunteers have put in to providing feedback for the proposed activities. • The response from PGS incorporates references to various EP sections to help assist the CCG with familiarization of the Rollo EP. PGS hope that the tabled responses will assist the CCG in identifying links between specific spatial and temporal exclusions which will actually benefit multiple species. • PGS informed CCG that they hope the information provides CCG with increased confidence that PGS will undertake the proposed activity in a manner that will minimise impacts to the marine environment to acceptable levels that are As Low As Reasonably Practicable. • The PGS Rollo EP acknowledges and adheres to these Acts. Acoustic Disturbance • PGS informed the CGG: At most there will be 2 vessels working at distances less than 30 km of each other. The EP currently states the following: At any one time there will be no more than 4 seismic survey vessels operating under the Rollo EP and no more than two seismic survey vessels working under the Rollo EP within 30 – 100 km. • An environmental risk assessment (ERA) has been completed for impacts and risks to migratory marine species such as the humpback whale, whale shark, marine turtles. The ERA includes additional mitigation measures for the Exmouth Gulf humpback whale resting area BIA from June to October, as follows: Narrow Migratory Corridor / Resting Area As a precautionary approach, during the humpback whale migration period, no seismic acquisition will occur: - within 60 km of the mainland from Point Cloates to the North West Cape; and - within 60 km radius of the Montebello Islands (Jenner, 2010). Fauna • PGS requested the CCG to provide the IFAW complete reference. IFAW, 2015 reference paper does not contain this information. Page 3, Summary and Page 14, Table 2. Summary of marine mammal's encounters during the survey does not identify any pygmy blue whales being observed during this survey. • PGS had provided the complete pygmy blue whale reference (Double et al., 2014). • PGS assessed the deep chlorophyll maxima references cited by CCG. Hanson et al., (2005) study was conducted in November 2000, and lower levels of surface chlorophyll a concentrations were found. Low levels are to be expected at this time and are consistent with the timing of the survey being conducted outside of known period for whale shark foraging aggregations, and towards the end of the pygmy blue whale migration period (i.e. majority of migrating animals would have already left the area). Rossi et al. (2013) study was conducted in autumn, this study correlates with the migration of whale sharks to the area to feed, and transiting pygmy blue whales.

Similarly Rousseaux, Lowe, Feng, Waite and Thompson (2012) found that chlorophyll was suppressed in autumn to deeper levels and suggested the late winter bloom was associated with the Leeuwin current and the significant grazing pressure during autumn.

Work by Sleeman et al (2010a) found a poor correlation between Whale Sharks and chlorophyll surface concentrations and yet it is well established Whale Sharks migrate to Ningaloo to feed (Sleeman et al. 2010b).

So while CCG does not dispute the “low productively levels” recorded at the surface, we do not agree that the evidence from this particular study supports the notion the area is not an important foraging area for the Pygmy Blue Whale as the deeper chlorophyll concentrations and upwelling events in the region are now well documented (Xu, 2015).

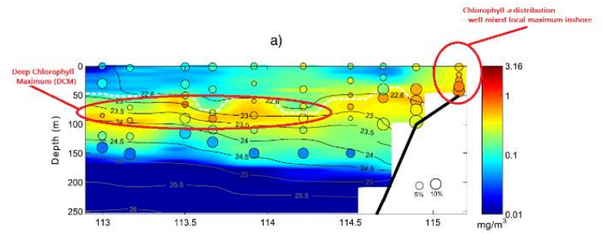


Figure 4. Offshore dynamics. Longitude versus depth section of CTD sensors and water sample measurements along transect 1 at 21°S. (a) Chlorophyll *a* ($\log_{10}$) from the fluorometer (calibrated versus water samples, $R^2 = 0.6$), with black/gray contours representing the density field. The filled circle represent the water samples measurements, color is chlorophyll *a* concentration, while the size of the circle is proportional to the percentage of large phytoplankton cells (larger than 5 µm).

The presence of a Deep Chlorophyll Maximum (DCM) located at deeper water depths (50-100 m) offshore from Ningaloo Reef is not evidence of pygmy blue whales foraging in the area. Pygmy blue whales are known for surface lunge feeding on krill which feed on phytoplankton utilising the sun for photosynthesis.

Pygmy blue whales are known to feed off the southern Australian coast in summer. The potential foraging area at Exmouth is not an area where large numbers of aggregating pygmy blue whales forage at the surface. It’s likely that the Ningaloo Current upwelling provides opportunistic feeding for whales transiting the area whilst on migration, however it is not considered a critical habitat where large numbers of animals aggregate to feed.

PGS does not agree with interpretation of the Rousseaux et al., (2012) study. The paper does not state chlorophyll a concentrations were suppressed in autumn.

Rousseaux et al., (2012) states: In this study, we found the MLDs in the waters off Ningaloo Reef considerably deepen in autumn, which coincided with an increase in nutrients and surface chlorophyll a concentrations.

Rousseaux et al. (2012) found that surface chlorophyll a concentration peaks at 0.33 mg m 3 in June, and then starts to fall, this coincides with the latest whale shark Conservation Advice; for the Ningaloo Coast. The whale shark foraging aggregation period is identified as being from March to July, during this time Chlorophyll a concentrations have peaked and MLD begins to deepen. Whale sharks migrate away from Ningaloo from July onwards, during the winter months, when the MLD is at its deepest and Chlorophyll a concentrations are falling (Rousseaux et al., 2012; Xu et al., 2015).

The peak in chlorophyll a concentrations may lead to increased zooplankton and is the most likely explanation for the aggregation period of whale sharks between March and July (Rousseaux et al., 2012).

PGS does not agree with interpretation of the Sleeman et al., (2010a) paper by CCG.

The study undertaken by Sleeman et al., (2010a) compares sea level, wind shear and sea surface temperatures with average and weekly abundances of whale shark data from the Department of Environment and Conservation. The study does not compare chlorophyll a concentrations with migration data, the study only suggests that chlorophyll a concentrations can be overlaid on migration pathways to determine the extent of whale shark aggregations.

This is further supported by research undertaken by Sleeman et al., (2007); who found that in 2001 and 2002 observations of pygmy blue whale migrating over the NWS during north and south bound migration periods, correlated with decreasing surface chlorophyll a concentrations on the northern migration and increasing surface concentrations on the southern migration. Whereas, the occurrence of whale sharks, who migrate specifically to Exmouth to forage, overlaps the peak surface chlorophyll a concentrations. The observations of pygmy blue whale migrating through the area missed the peak chlorophyll a concentration, which provides further evidence that they are not specifically migrating to Exmouth to feed, they may opportunistically feed whilst on migration as they transit the area.

- The Australian Conservation Management Plan for Blue Whales (2015) identifies seismic noise interference as a “very high risk”, the highest risk ranking used, and recommends

- The potential foraging area at Exmouth is not an identified aggregation area. Large aggregations of foraging blue whales have not been observed at Ningaloo Reef, upwellings

"immediate additional mitigation action". While the potential foraging site is not specifically referred to in the older EPBC Act Policy 2.1 (DEWHA, 2008), the same act states that aggregation areas need to be avoided (EPBC Act Policy Statement 2.1, Sec.4). CCG therefore requests avoidance of the potential foraging area be observed and this included in the mitigation measures.

Based on work by Bain & Williams CCG would recommend the survey exclusion zone between 1st June and 31st October from the Ningaloo Coast be extended to a minimum of 70km – noting that the distance of impacts of seismic surveys on Humpbacks, and other cetaceans, is not clear and this distance should be being measured from the species distribution edge not the shoreline.

While some cetaceans, for example the humpback whale, have mitigation measures, the information provided in the EP was insufficient in relation to mitigation measures for all cetaceans. CCG requests clarification regarding (some of these items were spread through the document and hard to piece together as one):

1. What protocol is in place when a cetacean citing causes an operation shut down?
2. Please outline the operational procedures that would occur should an increased frequency of sightings and shutdowns occur.
3. How a new site is chosen for relocation should that option be initiated?
4. Please expand on the evidence alluded to which shows use of PAM is ineffective?

at Ningaloo may provide opportunistic feeding opportunities for whales transiting on migration, however it is not a location where large numbers of whales aggregate and feed.

Additional information has been added to the Rollo MC MSS EP:
"Aggregation areas were confirmed during an International Whaling Commission (IWC) survey in late 1995 (Kato et al. 1996). The Bonney Upwelling and Perth Canyon are the best known Blue Whale aggregation areas in Australian waters. Bass Strait and the waters of the eastern Great Australian Bight are also known feeding areas, although perhaps only in certain years (Mustoe 2003 pers. comm.). Other important areas of aggregation include Geographe Bay and Quondong Point, which are used as migratory waypoints, the upwellings around Browse Island, which is likely feeding area during migration to Indonesia, and areas around Cape Naturaliste and Rottnest Island, which are also feeding grounds (DEWHA 2008b)".
An international shipping fairway overlaps the potential foraging BIA, and from AMSA AIS data (2016) a high number of vessels transit the area, however there has only been one sighting of a pygmy blue whale potentially foraging in the area.

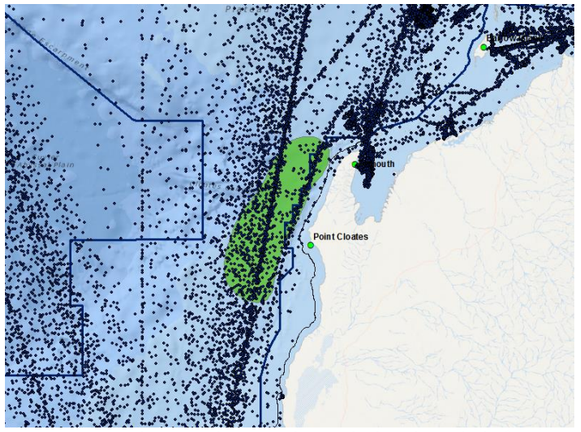


Figure 1 – AIS Shipping data overlay with the Blue whale foraging area BIA

The Rollo EP Chapter 2 (Rev 0) provided to CCG contains justification for the mitigation measures proposed for the blue whale foraging area in Section 3.2.2.14, Table 3.14.
As surveys are not proposed within an identified aggregation area, there is no justification for avoidance of the blue whale possible foraging area, based on one observation.

- This distance originated from Jenner, 2010 aerial survey data and estimations of the humpback whale migration path around the narrow migratory corridor from Pt Cloates to the Montebello Islands and offshore Dampier, is approximately 50 km from the mainland coast. Similar to Jenner 2010, the coastline has been used as a point of reference. PGS have incorporated an additional 10 km buffer to this distance and therefore consider the 60 km buffer a conservative buffer for migrating whales around the narrow migratory pathway.

1. EPBC Part A Standard Management Procedures will be implemented for all surveys within the Rollo MC MSS operational area (OA).
   If a whale triggers an operational shut down, the acoustic source will be turned off and will recommence via soft start procedures until the animal has been observed to leave the mitigation zone, or the animal has not been observed after 30 minutes of dedicated observations by the MFO.
2. The following summary of the adaptive management measures will adhered to for all surveys within the Rollo MC MSS OA:

If there are three or more sightings within the preceding 24 hours within the power-down/shut-down zone, the density of whales in the area is deemed to be sufficiently high to cause either of the following management measures to be implemented:

Precaution zones increased (Observation Zone ~3 km; Low power zone 1.5 km; Shut-down Zone 500 m).

CCG fully supports the mitigation factor of requiring all vessels to reduce to 10 knots should a cetacean be seen in the observation zone supporting work shown by Conn & Sibler (2013) in reduction of boat strikes with reduced speed. Can you please explain:

1. How the implementation was going to be initiated?
2. Will there be MFOs on the support vessels?
3. Will crew receive mandatory training?
4. Will there be dedicated person/s on watch?

If an increased density of animals is encountered, increasing the Low power zone to 1.5 km will enable marine mammal observers to effectively monitor the precaution zones and implementation of mitigation procedures.

At a distance of 1.5 km from the acoustic source the predicted SEL for the 4,130 in^3 array is ~148 dB re 1µPa^2·s and well below levels said to cause TTS and PTS injury to whales.

Implementation of a mitigation acoustic source (e.g. single acoustic source) during acquisition at night-time or during low visibility conditions.

Night-time operations ceased OR relocation – survey vessel will relocate to another survey line >10 km from location of last whale sighting and will not return within 24 hours.

3. Dynamic risk assessment.
   A new site within the individual survey area will be determined via a dynamic risk assessment and recommendations from the MFO, based on MFO observations. It is in PGS best interests, from an environmental and cost point of view, to move the acquisition of a survey to a location within the work program to an area where there will be reduced amount of whale instigated shut downs; the outcome being focussed on reducing impact on whales, and reduce the amount of down time during seismic acquisition.
4. See Table 3.14 for complete assessment of PAM.

This procedure is internationally recognised for effective marine mammal mitigation for selected species of cetaceans.

PGS is aware of several inherent limitations by the use of PAM for mitigation purposes and therefore will not be implemented for individual surveys within the Rollo OA

1. The seismic source vessel will be travelling at 4 knots whilst operating.
2. MFO will not deployed on the seismic vessel.
3. Yes, as per EPS 29:
   Survey vessel personnel (marine and seismic) provided with pre-survey induction on EPBC-2.1 requirements and protected fauna.
4. Yes, as per EPS 19 and 30:
   EPS 19: An experienced and dedicated Marine Fauna Observer (MFO) on the survey vessel for the entire duration of the survey will ensure accurate and reliable compliance.
   EPS 30: Only appropriately experienced MFOs (as determined by a review of their CVs in the project proposal submitted by the provider) will be contracted to undertake the proposed OA

Given the long term serious concerns for marine turtles and hatchlings, CCG requests clarification regarding:

1. The timing of seismic surveys conducted in these areas?
2. What mitigation measures will be in place to ensure there is no impact on turtle hatchlings?
3. Consideration be given regarding exclusion of seismic surveys from the coastline a minimum of 20km of the Ningaloo Coast & Muiron Islands between 1st December and 30th April?
4. Clarification about how the 20km separation distance from landfall was ascertained?

1. PGS is unable to provide timing of individual surveys that may occur throughout the EP validity, surveys will be limited to the Rollo OA.
2. PGS has extended the marine turtle temporal exclusion period to include an additional 4 weeks for emerging hatchlings, this being from 1 October to the 31 March.
3. The marine turtle exclusion period already includes a 20 km buffer whereby no seismic surveys will be conducted within 20 km from nesting areas
4. The 20 km buffer has been incorporated from the Department of the Environment identification of biologically important areas for marine turtles. http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf

CCG holds concerns about plans to make visual observations at ship level, which is inaccurate (Nelms et al. 2016), as a mitigation measure:

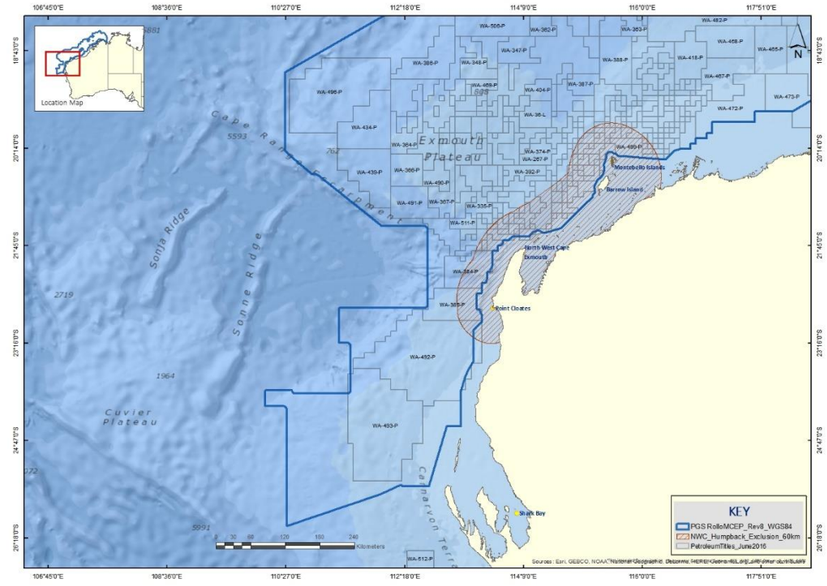
1. What evidence is there that this will be effective and how will its effectiveness be measured?
2. Have you considered the use of Multi-Beam Echo Sounders?
3. CCG would like to reiterate that there are serious concerns about the impact of seismic surveying on marine turtles and hatchlings during the breeding period and in an area considered to be critical habitat for their survival.

1. Adherence to the Environmental Commitments in the EP will be used as a measurement of KPI effectiveness. Environmental Performance reports will be available on the Rollo project website
   Measurement Criteria have been developed to show that the EPS are being met. The measurement criteria are measurable and will be made available via the MFO reports on the Rollo project website.
2. This technique has not been considered in the Rollo EP. Implementation of this technique would require a dry dock of the vessel to install a new transducer. The current multibeam system sounders used on seismic survey vessels are produce a narrow beam and are not fit for this purpose.
3. PGS understands the concerns of the CCG. Spatial and temporal restrictions are already in place for marine turtle nesting and internesting BIA identified by the Department of the Environment and Energy.

					Shark frequency is between 3-250 Hz (O'Brien, 2002) a range that is likely to overlap with that of the proposed seismic survey. CCG requests explanation regarding whale sharks: 1. What the suggested migration period to Ningaloo is considered to be? 2. Whether seismic surveys will be allowed in the Ningaloo region over canyons and flow features during March-July? 3. If surveys occur during this time-frame what measures are in place to ensure they are not disrupted from feeding? <u>Knowledge Gaps</u> 1. In order to contribute toward research on seismic surveying and its environmental impacts, CCG would like request that any data collected be made publically available. 2. The Ningaloo World Heritage Area is a highly sensitive area and of great ecological significance. CCG requests that Rollo provide a quantitative risk assessment of the area and addresses the question of whether the alternative, marine vibroseis, has been considered. 3. Are there Key Performance Indicators identified to establish the effectiveness of the mitigation measures in place? 4. Aside from the whale response protocol, are there systems in place to respond to these key performance indicators in real time? 5. How will information be utilised to contribute to future seismic survey environmental management?	PGS does not agree with the interpretation of this reference paper: O'Brien 2002 states that echo sounder frequencies vary depending on their use. Higher frequencies still are used for detecting scattering from plankton and fish and are therefore important in studying their distribution. In the report Table 3 summarises the range of frequencies needed to detect different components of the oceanic biomass (Medwin and Clay, 1977). In Table 3, 3-250 kHz is the echo sounder detection frequencies to detect whales and sharks with a diameter 2-6 m. This is not the shark hearing frequency range 1. The migration period to Ningaloo is not specified in the DoE conservation atlas. Based on the available information regarding the movement of whale sharks, and the lack of empirical migration data, it is difficult to determine the whale sharks peak migration period to the high density foraging area along the reef edge at Ningaloo Reef. 2. Seismic surveys will be conducted with the implementation of EPBC Part A mitigation procedures. 3. The Rollo MC MSS does not overlap the high density feeding area BIA at Ningaloo Reef. Mitigation measures already in force for humpback whales means that no seismic acquisition will occur from June to October: within 60 km of the mainland from Point Cloates to Northwest; and within 60 km radius of the Montebello Islands (Jenner, 2010). <u>Knowledge Gaps</u> 1. The Rollo MC MSS EP contains an EP commitment to make Marine Fauna Observer data available throughout the Rollo EP validity. EPS 42: Notification of activity details to interested and relevant stakeholders prior to the survey commencing. Including informing stakeholders that MFO observation reports will be made available to stakeholders through the Rollo project website. MFO reports will be posted on a specific website designed for that purpose. Details of how to access reports will be contained within the initial stakeholder letters. 2. Ningaloo World Heritage Area has been addressed in the Environmental Risk Assessment provided to CCG. PGS will not consider using an alternate technology such as vibroseis until the technology is further proven. The environmental benefits to introducing this technology are unproven and the costs associated with changing to such technology far outweigh any perceived environmental benefit. PGS is currently funding a marine vibroseis research and development program. However, the implementation of this technology is some years away before being commercially available, and there is no certainty that it will reach commercial or technical acceptance. 3. Adherence to the Environmental Commitments in the EP will be used as a measurement of KPI effectiveness. PGS wish to acknowledge that due to the recommendations from the CCG Rollo MC MSS EP Annual Environmental Performance reports will also be made available on the Rollo project website. 4. Measurement Criteria have been developed to show that the EPS are being met. The measurement criteria are measurable and will be made available via the MFO reports on the Rollo project website. 5. Environmental performance and the implementation strategy of all proposed surveys within the Rollo OA will be reviewed in a number of ways. These reviews are undertaken to ensure that: all significant environmental aspects of the activity are covered in the EP; that environmental management measures (including PGS's environmental management framework) to achieve EPO and EPS are being implemented, reviewed and where necessary amended; identification of potential non-conformances and opportunities for continuous improvement; that all EPO and EPS have been met before completing the activity: and that all environmental commitments contained in the Environmental Commitments Register (ECR) have been fulfilled.

	CCG also wishes to highlight that there are other mitigation and monitoring options that could help further reduce risk and improve monitoring. These include aerial surveying before, during and after the seismic activity; adaptive planning to include monitoring of upwelling intensity and krill swarm presence and adaptation of survey accordingly; thermal imagery and night-vision technologies to address detection of marine animals at night-time and in poor visibility. These latter measures would likely require additional MMOs to enable them to be carried out successfully. **Cumulative Impacts** CCG requests that Rollo provide further information about how this particular aspect of cumulative impact will be addressed. What confirmed mitigation measures are in place to prevent cumulative impacts. <u>General Questions</u> 1. Will you provide and advise your vessels, including support vessels, to adhere to the AMSA shipping restrictions for the Ningaloo Coast? 2. The 39m exclusion zone – does this apply to the whole survey area? And was the source depth of 5-7m taken into account? 3. CCG requests a review of the boundary of the seismic survey within the Ningaloo World Heritage area specifically detailing the survey area. 4. CCG requests a review of the stand-off distances on cetacean siting and the distances from landfall that are noted in the EP – 20km from landfall for marine turtles and 60km for whales. The distance that the noise from an airgun can blanket is well established (Weilgart, 2013). The frequencies used for seismic surveying overlap so many different species acoustic ranges, and behavioural changes have been documented at 70km from the seismic vessel (Parsons, 2009; Bain & Williams, 1998). CCG requires clear management of the area by imposing a set distance from landfall because the arbitrary distances shown in the EP, with different distances for different species, will be ineffective in management of all marine animals. Ningaloo's ecological values are highlighted throughout this submission, and it is suggested that preservation of these be a priority by imposing a minimum of 70km or greater from the boundary of the World Heritage Area rather than landfall.	PGS do not believe this is necessary. The Ningaloo region is one of the most researched areas in the world from both a scientific perspective, as well as a result of research from petroleum operators. Petroleum operators have funded aerial surveys and boat surveys for a number of years over the North West Cape and offshore Dampier. As such, there is a wealth of knowledge on the marine fauna within the region. Although it is acknowledged that new information is always becoming available as research continues, based on what is currently available, PGS believe they have identified and assessed potential risks and impacts appropriately and that the proposed mitigation measures are appropriate and acceptable **Cumulative Impacts** Cumulative Impacts have been addressed in the EP provided to CCG. Chapter 2 Section 3.2.2.19 EPS 33: PGS will not undertake a seismic survey less than one month after a survey has been undertaken over the same area. <u>General Questions</u> 1. All vessels must comply with international and AMSA legislative requirements, including any shipping restrictions that may apply around Ningaloo Reef. Furthermore AMSA is a stakeholder for the EP and have been notified, and GIS data supplied, for the operational area. 2. EPS 29: No discharge of the acoustic source outside of the proposed OA. EPS 40: The use of array volume within the area of the southern shoals, Sahul shoals, northern shoals, shoals of the Londonderry High, the carbonate bank and terrace system of the Sahul Shelf, the pinnacles of the Bonaparte Basin, and within the Bonaparte Basin (collectively the Designated Shoals) will be depth dependant as per the Acquisition procedures: Standard 4,130 in^3 array when water depths are greater than 55 m chart depth. Maximum of 3,060 in^3 array between 55 m and 39 m chart depth. No data acquisition in depths below 39 m chart depth. No acquisition outside of the operational area. 3. Following on from feedback from the CCG and the Ningaloo Coast World Heritage Advisory Council, PGS is currently reviewing the buffer at the boundaries of the CMR IUCN II & IV and World Heritage Properties (WHP). The mitigation measures for the Narrow Migratory corridor from Point Cloates to Montebello humpback whale resting area BIA from June to October overlaps this sensitive area defined by the CCG, as follows: a) Narrow Migratory Corridor / Resting Area As a precautionary approach, during the humpback whale migration period, no seismic acquisition will occur: within 60 km of the mainland from Point Cloates to Northwest; and within 60 km radius of the Montebello Islands (Jenner, 2010). 4. As above.
	CCG believes it is not appropriate to have a proposal renegotiated by a third party consultant, as this can result in decreases in environmental commitments and mitigation measures post approval. NOPSEMA must remain the primary body for review of any changes to the requirements for environmental commitments and mitigation measures.	• The primary objective of the mitigations contained within this EP is to reduce the likelihood of cetaceans coming within a range of the operating acoustic array where there is potential for physical injury (e.g. TTS or PTS). If, at any point during a survey, it becomes evident that the implemented mitigations are clearly not sufficient to achieve this, then adaptive management and Management of Change (MoC) should be used and the mitigations amended accordingly (see Chapter 3 Section 4.10). Likewise if the mitigations are clearly overly conservative (e.g. in a situation where there are few/no animals in the area). The guiding principles should be the intent of the EPBC Policy Statement 2.1 and accompanying Background Paper. This ensures any errors that may be contained within the EP do not inadvertently lead to an unwanted outcome. In order to preserve transparency, such changes are to be independently reviewed and agreed by a 3rd party environmental consultant. • Existing and proposed CMP are subject to the Australian IUCN reserve management principles as presented in Schedule 8 of the EPBC Regulations.

						• Until management plans come into effect for the proclaimed CMR in the NWMR (which was scheduled to occur in July 2014 but did not take place) transitional arrangements apply and there are no changes on the water for users of the new reserves - i.e. seismic surveys are permitted to take place within any zone of the "in transition" CMR (DoE, 2015e). However, PGS recognises that during the life of the EP (being five years) that the Management Plans for the CMR may come into effect (and may vary in relation to the IUCN management areas as currently proposed). Consequently, PGS shall comply with any legislative requirements associated with the proclaimed CMR. As part of the pre-survey planning undertaken prior to the commencement of any individual survey, PGS shall check the status of the CMR and ensure activities are not inconsistent with the principles and plans in force. • PGS shall ensure that activities within the CMR (existing or proclaimed) will not result in unacceptable impacts to the environment or matters protected under Part 3 within those reserves; will have regard to the Marine Bioregional Plans for the NWMR (DSEWPAC, 2012); and will not act inconsistently with a plan of management for a CMR.
			11-Aug-2016	email	n/a	• PGS sent CCG copy of Popper *et al.* 2014.
			16-Aug-2016	email	n/a	• 16 Aug 2016 Following on from the meeting, PGS sent CCG a cooperation protocol, ongoing consultation plan, and a summary of the meeting.
			05-Sep-2016	email	CCG queried as to when a response from PGS would be ready for the CCG. CGG provided additional information for PGS to incorporate into PGS response to CCG feedback letter. -Identification of killer whale predation of humpback whales at Ningaloo, Exmouth coinciding with the presence of humpback whale neonates during the months of July and August (Pitman et al 2015). -Suggestive that the Humpback calves were born on the north-bound voyage. -Ongoing research provides support for the area to be a calving ground for Humpback whales during July-August. -Recent aerial surveys have shown a substantial number of neonate calves along the North West Cape in the months of July and August (Irvine. L, unpublished data). -CCG will be informing NOPSEMA.	5 Sept 2016 PGS thanked CCG for the additional information and informed CCG that PGS will include this information in their response to the CCG letter. • PGS informed CCG that a response will be ready by the end of the week. • PGS requested CCG provide PGS with the full citation for the reference paper and information regarding the unpublished data comments: • Such as the year the surveys were conducted, total number of humpback whales observed, as well as the numbers of calves. • PGS responded to this submission in the response letter sent to CCG on the 15 Sep 2016: The mitigation measures for the Narrow Migratory corridor from Point Cloates to Montebello humpback whale resting area BIA from June to October overlaps this sensitive area defined by the CCG, as follows: a) Narrow Migratory Corridor / Resting Area As a precautionary approach, during the humpback whale migration period, no seismic acquisition will occur: within 60 km of the mainland from Point Cloates to Northwest; and within 60 km radius of the Montebello Islands (Jenner, 2010).
			05-Sep-2016	email	5 Sep 2016 CCG provided the killer whale reference paper to PGS and informed PGS that as soon as the unpublished data is published they will forward the additional information. Additionally CGG queried PGS as to how the Gascoyne Reserve management zoning proposed changes will be incorporated into the proposal? The Gascoyne Marine Reserve zoning has changed – impacting on the areas over the Sub-sea canyons, could you also include how this is going to be incorporated into your proposal? http://www.environment.gov.au/system/files/pages/23061bf8-df19-4b74-b867-5a57ccbc5c8b/files/cmrreviewbioregionaladvisorypanelreportfinalchapter42.pdf	6 Sept 2016 PGS thanked CCG for the reference paper and advised CCG that the Rollo MC MSS EP acknowledges that individual surveys will not be conducted within CMR's with an IUCN status of II and IV (Table 2.25). • At present, there are no CMR with an IUCN category of I, II, IV overlapping the Rollo operational area, and the EP acknowledges that the activity is not consistent with IUCN categories other than the Multiple-use zone IUCN VI (Rollo MC MSS EOP Chapter 2 - Table 2.25). • In the event that the CMR boundaries change when the CMR management plans are put in force, PGS will amend the Rollo operational boundaries so there continues to be no overlap with CMR with a IUCN categories of IV, II, I. • PGS provided CCG with Miller and Cripps 2013 reference paper.
			08-Sep-2016	email	• 8 Sept CCG provided feedback to the proposed cooperation protocol and ongoing consultation plan.	9 Sept 2016 PGS informed CCG that they are delayed at responding to the CCG letter, but will be completed within the week. PGS acknowledged that CCG found an error in the meeting notes. • PGS made the necessary edits and sent the final version back to CCG for their review.
			21-Sept-2016	email	• No response from CCG	21 Sep 2016 PGS informed CCG that on further review PGS would also like to acknowledge that the point CCG raised regarding new technologies is a good one in the context of a 5 year plan. • Therefore, should new technologies (such as advanced sounders allow for better whale mitigation), and such mitigations still demonstrably conform with the principles of the EPBC Act Policy Statement 2.1 and are ALARP and cost effective, PGS will endeavour to adopt such technologies under the Rollo EP.

			16-Jan 2017	email	• No response from CCG	• 16-Jan 2017 PGS sent CGG an update informing them of the following proposed changes to the Rollo EP: • OMR item 5.2.3 states that the EP does not include an assessment of the merit or statement of response from the Cape Conservation Group (CCG) email below. PGS would like to inform the CCG that the issue raised in the email below regarding the increase of neonates and killer whales at Exmouth was responded to on the 15th September 2016 (attached). • PGS would like to take this opportunity to inform you of the additional mitigation measures PGS are considering for the second submission of the Rollo EP to NOPSEMA for acceptance. • 1. Site specific acoustic modelling, for six (6) different locations within the Rollo operational area is currently being conducted by JASCO a third-party acoustic specialist consultancy and will be included in the acoustic risk assessment and the subsequent re-submission of the EP to NOPSEMA. • 2. The narrow migratory corridor exclusion area overlapping the area of concern identified below, has been extended to include the area between the Northwest Cape (NWC) and the Montebello Islands (see map attached). PGS believe that the mitigation measures proposed for no seismic acquisition within the 60 km exclusion area around NWC during the humpback whale migration period addresses CCG concern of activities potentially impacting cows with neonate calves (as per your email below). • Acoustic modelling results will confirm if the proposed 60 km buffer around the NWC is sufficient to ensure that received levels to potential cows with neonate calves are acceptable. • Pending the modelling results the buffer may be increased, it will not be reduced. • 3. An additional 6 km buffer has been applied around all Commonwealth Marine Reserves with an IUCN rating of II and IV that were previously abutting the Rollo OA. • Acoustic modelling results will confirm the appropriateness of the 6 km buffer. Pending the acoustic modelling results the buffer may be increased, it will not be reduced • 4. The minimum distance between concurrent seismic vessels has been increased from 30 km to 40 km, this is consistent with current industry standards. • 5. All pre-survey notifications will be sent out a minimum of four (4) weeks prior to the commencement of an individual survey being undertaken, as opposed to the previous 2 week commitment. Additionally, stakeholders that have an agreed Operations Protocol in place with PGS, will be contacted as specified in their respective agreements in order to initiate meaningful discussions and feedback. 

			25-Aug-2017	email	• n/a	• PGS sent CCG an update letter, and as a result of the changes to the Rollo EP, Attachment 4 contains updated information relevant to the CCG letter dated 28 July 2016, which requested clarification, explanation and/or additional information regarding the proposed Rollo EP. References to various EP sections are listed to assist the CCG with familiarisation of the Rollo EP. Attachment 4 will support the CCG in identifying links between specific sections of the environmental risk assessment and mitigation measures implemented.
					• The risk of acoustic disturbance to marine animals and migratory species in the area is a primary concern. Noise modelling has demonstrated that seismic sound will travel considerable distances at or above levels known to cause behavioural change in other cetacean species, and may extend beyond the boundaries of the survey.	1. PGS understands and agrees with CCG's concerns for acoustic disturbance to marine fauna, and as such, the Rollo EP contains a robust environmental impact assessment based on the best available scientific information. In June 2016, PGS commissioned SVT Engineering Consultants (SVT) to complete underwater noise modelling at the Camden Sound humpback whale calving BIA and using the proposed acoustic source and survey parameters. The acoustic modelling estimated the received sound levels at the boundary of the calving area and determined a spatial buffer around the calving area which will result in no behavioural disturbance to humpback whale cows and calves. Then in February 2017, PGS commissioned JASCO Applied Sciences (JASCO) to estimate underwater sound levels associated with the Rollo EP's proposed sound sources at several site-specific habitats throughout the operational area. These habitats were selected carefully to represent the most sensitive environments for marine fauna and to inform the assessment of possible acoustic effects on marine fauna. JASCO's acoustic modelling results were incorporated into the revised Rollo EP's environmental risk and impact assessment and provided the scientific support for the mitigation measures (i.e. spatial buffers and shut-down zones), which were updated to further reduce potential, acoustic impacts on marine fauna in critical habitats and during sensitive time periods. In March 2017, these acoustic modelling results and associated revisions were included in the most recent version of the Rollo EP that was submitted to NOPSEMA for assessment, and JASCO's full acoustic modelling report was included as an appendix, both of which were made available to stakeholders (including CCG) through the Rollo EP website.
					• The frequency is potentially biologically harmful to marine mammals, and can blanket an area of up to 300,000km2, raising background noise levels 100 fold (20 dB), continuously for weeks or months (Weilgart, 2013).	2. Based on JASCO's acoustic modelling, the main low-frequency range of the proposed sound sources would be between 10 Hertz (Hz) and 2 kHz. The acoustic modelling results also estimated the received sound intensity levels from the proposed sound sources at several locations throughout the proposed operational area and the distances at which these sound levels would exceed acoustic threshold criteria, thus supporting proposed mitigation measures (i.e. spatial buffers and shut-down zones). Further details of the acoustic modelling results and associated mitigation measures are in the Rollo EP. • Finally, please note that seismic sound sources are not transmitted continuously for weeks or months, but rather periodically at set intervals. The proposed sound source for the Rollo EP will be projected every 10 seconds, and when considering the slow speed of the seismic vessel (i.e. 8–9 km/hr), a sound pulse will be transmitted approximately every 16.67 m. The Rollo EP contains additional information about the parameters of the acoustic source array.
					• Seismic surveys are felt on an extraordinarily wide geographic scale. The impact of a single survey can cause endangered fin and humpback whales to stop vocalizing, an essential behaviour for breeding and foraging, in an area at least 100,000 nm in size (Natural Resources Defence Council, 2010).	3. The Rollo EP environmental risk assessment evaluated the potential behavioural changes that are likely to occur in baleen whales and based on the best available scientific data. Also, JASCO's acoustic modelling presented accurate, robust and site-specific estimates of sound levels received in the operational area and thus likely to impact baleen whales. Therefore, the revised mitigation measures included additional spatial buffers based on acoustic modelling results and will further reduce acoustic impacts during the migration periods for baleen whales. For example, the seismic source will <u>not</u> be discharged within the pygmy blue whale foraging BIAs: at Northwest Cape plus an 18 km exclusion buffer or within the Scott Reef foraging BIA plus an 8 km buffer. • Furthermore, based on our research, the reference provided by CCG (Natural Resources Defence Council, 2010) does not contain any information about seismic survey impacts on fin or humpback whales within important areas that were 100,000 nm in size. We were unable to find these results and would appreciate further clarification from CCG.
					• Some of the physical impacts from seismic surveying can also include hearing loss, disruption of echolocation, masking of noises and habitat abandonment, (IFAW, 2013; Tyack, 2008). It is also thought to be associated with reduced reproductive performance, the loud, low frequency sound disrupting the chorusing behaviour essential to breeding. While	4. PGS agrees that increased underwater noise may cause physical impacts, such as those listed in the CCG response letter. However, there is little scientific evidence that demonstrated conclusively a clear impact to cetaceans from seismic survey sound sources, for which the Rollo EP environmental risk assessment provided additional evidence. Nonetheless, PGS

responses can differ according to context, sex, age class or species, in general, marine mammals are known to avoid seismic noise by vacating the area (Tyack, 2008; Weilgart, 2013).		developed rigorous and conservative mitigation measures that will reduce potential acoustic impacts to cetaceans, including spatial separations and temporal restrictions based on accurate estimates of received sound levels from the proposed seismic array. Also, a seismic survey will implement additional monitoring measures such as pre-survey planning, passive acoustic monitoring (as appropriate) and pre-start procedures (e.g. observations, shut-downs and soft-starts). Thus, PGS relied on the best available scientific evidence and underwater acoustic modelling to reduce potential physical impacts from acoustic disturbance to ALARP.
• There is some evidence that seismic airguns are a probable cause of whale stranding and deaths as well (Nelms et al., 2016; Weilgart, 2013).	5.	The references in CCG's statements conclude that stranding's and deaths are probably caused by increased underwater sound and not specifically seismic acoustic sources. Based on PGS environmental risk assessment and the references in CCG's letter, the scientific evidence for a direct relationship between seismic survey sound sources and whale stranding's and death are lacking. However, PGS agrees that appropriate mitigation measures must be implemented as a precautionary approach. As such, the Rollo EP's proposed acoustic source will not have received sound levels of sufficient magnitude to cause mortality/potential mortal injury, as confirmed and supported by acoustic modelling results. Furthermore, control measures will be implemented routinely for marine seismic surveys in Australian waters, all of which are based on and supported by scientific data and acoustic modelling and in compliance with EPBC Act Policy Statement 2.1 (i.e. use of MFOs; observation, low-power and shutdown zones, soft starts, etc.).
• Studies carried out in the recent past also acknowledge that seismic activity dramatically depresses the catch rates of various commercial species by 40-80% over thousands of square kilometres around a single array (Natural Resources Defence Council, 2010; O'Brien, 2002). In addition to the noise induced issues, fish are known to suffer tissue and organ damage, including barotrauma (Nelms *et* al, 2016; Raustein, 2008).	6.	PGS shares CCG's concerns about the potential impacts to fish species and commercial fisheries within the operational area. During the stakeholder consultation process, PGS made extensive effort to engage with commercial fishermen for their feedback and advice, which were considered carefully in the Rollo EP's environmental risk assessment. Summaries of these discussions were included in the EP. Also, the Rollo EP contained a thorough description of fish species and commercial fisheries that are likely to occur within the operational area, which overlaps license areas for several commercial fisheries. The EP's environmental risk assessment evaluated thoroughly the potential acoustic disturbance to fish species and commercial fisheries. Based on the best available scientific data, the stock assessment for all target fish species indicated adequate breeding stock and fishery catch levels. Also, there is no scientific evidence of mortality, injury or population level impacts to fish from sound exposure to seismic sources. Further, scientific evidence confirmed that hearing sensitivity recovered in fish that were exposed to seismic sources. If more definitive information becomes available (e.g. through stakeholder consultation or new scientific publications) regarding key locations for spawning and/or fishing locations within the operational area, PGS shall determine the feasibility of avoiding these periods/locations. Thus, based on the deep-water environments, acoustic modelling results and implemented control measures, temporary acoustic impacts to target fish species for commercial and recreational fisheries will be reduced to ALARP and acceptable levels.
Another consideration is that while marine animals continue to be killed by ship propellers and entanglement in nets, the tow cables now also present a physical threat to fauna in the area (IUCN, 2016a; Nelms *et al.*, 2016). • Without any long-term study it is not possible to suggest that such an impact would be localised or temporary and it is impossible to be sure that there will not be longer-term impacts to animals in this region and its ecology.	7.	The Rollo EP environmental risk assessment evaluated the likelihood and consequences of both vessel collisions and entanglement with the survey lines and arrays. The survey and support vessels may present potential physical hazards (e.g. vessel strike) to marine fauna including cetaceans, turtles, whale sharks and dugongs. However, marine seismic survey vessels will travel at slow speeds (~4 knots) along defined paths, and vessel operations within the proposed operational area will be consistent with EPBC Act Regulations 2000 - Part 8 Division 8.1 (Regulation 8.04) - Interacting with cetaceans. Thus, based on scientific evidence, the probability of a lethal whale-ship interaction with the seismic vessel travelling at 4 knots is rare and therefore acceptable and ALARP. • Additionally, the tail buoys that are attached to the end of seismic streamers can represent an entanglement risk for turtles, which can then lead to mortality, but geophysical acquisition companies and seismic contractors have designed and implemented "turtle guards", which are modifications to the tail buoys that minimise the potential for turtle entrapment and reduce turtle entrapment. An example of these tail buoys is the PartnerPlast 900L, which skim along the surface with just a single chain extending beneath the surface. PGS will ensure that the survey vessel used within the Rollo EP's proposed operational area shall either be fitted with the abovementioned tail buoys or turtle guards to prevent entrapment. Furthermore, the conservative spatial buffers for the hawksbill, loggerhead and green turtles will be implemented, and the use of mitigation measures

		(including soft-starts, observation zones and use of MFO, the BIA for the hawksbill, loggerhead and green turtles) will also reduce potential impacts to marine turtles during sensitive periods. Finally, 60-km exclusion zone (plus an additional 7.5 km buffer) shall be implemented around recognised flatback turtle nesting during peak sensitive periods. As such, it is anticipated that the likelihood of vessel strike or entanglement with marine turtles is minimal.
• The effect of proximity of seismic vessels to migratory animals, for example the humpback whale, must also be interpreted in the context of their need to calve, to rest and educate their young within their zone of acoustic discomfort if their migration is in the proximity of an active seismic vessel (Morrice *et al.* 2004, cited in Origin Energy, 2012).	8.	PGS understands and agrees with CCG that the proximity to seismic vessels may result with potential impacts to marine fauna, especially the humpback whale. Please be assured that extensive research and effort were made to ensure that impacts to migratory animals are reduced to ALARP and acceptable levels. Regarding the humpback whale, site-specific, underwater acoustic modelling predicted the likely received sound levels at important habitats (including Camden Sound and Exmouth Gulf), and the results of which served as the basis for mitigation measures (such as spatial buffers and exclusion zones) to ensure that acoustic impact thresholds will not be exceeded (see response #1 above). As a conservative and precautionary approach, between 1 June and 31 October , PGS will implement a 100-km spatial and temporal exclusion zone from Shark Bay and Exmouth Gulf resting BIA, whereby the acoustic source will not be discharged and no seismic acquisition will occur. This will ensure that during the migration season and within potential resting BIA, acoustic impacts and risks to migrating humpback whales within the Rollo operational area are below the behavioural impact threshold criterion, and therefore considered acceptable.
• CCG has serious concerns about the level of acoustic assault on such critically important habitat, because it has been shown that acoustic signals in deeper water carry further with those approaching slopes enhanced, and some signals being clearly audible 70 km away (Bain & Williams, 1998).	9.	PGS shares CCG's concerns with the distances over which the seismic sound levels may be transmitted. As such, PGS commissioned site-specific, underwater acoustic modelling based on the proposed seismic acoustic source to estimate the received sound levels throughout the operational area (see responses #1 and #8 above). Based on these results, conservative mitigation measures (such as spatial and temporal exclusions) will be implemented to reduce potential acoustic disturbance to marine fauna in their critically important habitats.

• Disturbance to vocal social activity during migration or resting is likely to make them vulnerable.	10.	The Rollo EP environmental risk assessment contains an updated and rigorous description of the potential impacts and risks to baleen whales from exposure to underwater sound, particularly seismic acoustic impacts. PGS shares CCG's concerns for disturbance to the whale behaviours during migration, resting, breeding and foraging. As such, the revised Rollo EP contained additional and conservative EPS and mitigation measures that further reduce potential impacts to baleen whales. For example:
		• Pygmy blue whales – no discharge of the seismic source within 8 km of identified pygmy blue whale foraging BIA boundary located at Scott Reef or 18 km of the Northwest Cape foraging BIA
		• Humpback whales (between 1 June and 31 October)
		  ○ no discharge of the seismic source within the noise buffer zone or within the identified humpback whale Camden Sound calving area BIA
		  ○ no seismic acquisition will occur within 100 km of the mainland coast at Shark Bay and Exmouth Gulf resting BIAs.
		• Adaptive management - if the likelihood of encountering whales, whale sharks or marine turtles is moderate to high, then the following will be implemented:
		  ○ Relocation - survey vessel will relocate to another survey line >10 km from location of last whale sighting and will not return within 24 hours; or
		  ○ Cessation - if there are no options for relocation, no survey operations will occur in current location for 24 hours. At this point, if less than three sightings within the power-down/shut-down zones occurred during the preceding 24 hours, night-time operations can re-commence in this location, as per EPBC-2.1 Part A.

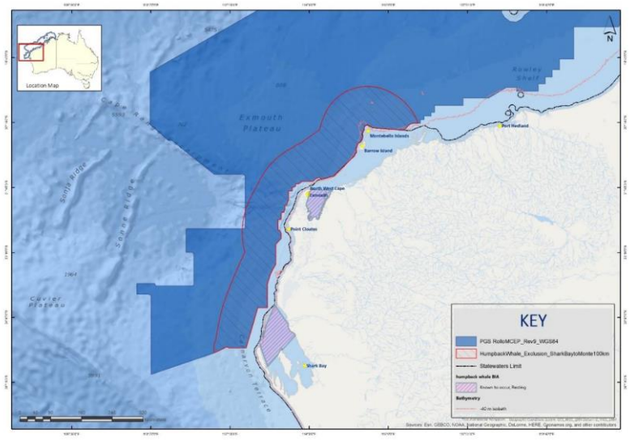
• CCG was wondering what Key Performance Indicators will be used to measure success for the population?	11.	The Rollo EP contains several Environmental Performance Outcomes (EPO) and Standards (EPS) that manage the environmental impacts and risks of the activity and have measurement criteria to determine if they are being met, similar to key performance indicators. Regarding acoustic disturbance to humpback whales, the Rollo EPO is to prevent adverse noise impacts on marine fauna from discharge of the acoustic source, under which a seismic survey will adhere to several EPS, ranging from the basic requirements of the EPBC Act Policy Statement 2.1, to exclusion periods and areas for humpback whale calving, migration and resting. Also, adaptive management measures (e.g. survey relocation or cessation) will be implemented if the likelihood of encountering a whale is moderate to high.

	Each EPS will be assessed based on specific measurement criteria, such as records of all sightings, non-compliance and/or vessel movements and operations. For further details, please refer to Table 4.1 in Section 4.2 of Chapter 2.
• The threat of seismic surveys to marine turtles has been underestimated and the long-term consequences are unknown. Marine turtles are able to detect low frequency acoustic stimuli, indicating that their hearing ranges overlap with the peak amplitude, low frequency sound emitted by seismic airguns (Nelms et al. 2016; Samuel et al., 2005) and it is assumed seismic surveys disturb marine turtles (DMP, 1997; McCauley, et al. 2000).	12. The Rollo EP contains a thorough, accurate and updated description of the occurrence, distribution and behaviours of all marine turtle species that are likely to occur within the operational area, including a detailed review of their hearing sensitivity levels. PGS agrees with the conclusions made by CCG regarding marine turtle hearing and that the best hearing range overlaps with the frequency range of maximum energy in the proposed acoustic source.
• Nelms et al. (2016) describe the possible ramifications to turtles from seismic surveying to include: exclusion from critical habitats; damage to hearing; interruption of behaviours such as those required for breeding, foraging or thermoregulation. The behavioural response to seismic surveys places an increased energy demand on the individual and could impact at the population level (Nelms et al., 2016).	13. PGS agrees with the marine turtle behavioural information provided by CCG, and the Rollo EP's environmental risk and impacts assessment described all possible environmental risks and impacts based on the best available scientific data.
• There is also the likely possibility of physiological damage from entanglement in seismic survey equipment. A recent incident where 8 Olive Ridley turtles (Lepidochelys olivacea) became entangled in Ocean Bottom Cable off Gabon has been reported in the media.	14. PGS agrees that entanglement in seismic survey gear is a potential environmental impact for marine turtles. Please see response #8 above.
Can the following information be provided please: • Has there been an analysis of turtle migration routes to and from the Ningaloo rookeries?	15. The Rollo EP contained a compressive review of the occurrence, distribution and behaviour of all marine turtle species that are likely to occur within the operational area. This includes turtle migratory behaviour and important habitats. Please refer to Section 2.3.6.8 of Chapter 2 in the Rollo EP. The Ningaloo rookeries were described and included in the environmental risk and impacts assessment, particularly for the green, hawksbill and loggerhead turtles. Detailed maps of the rookeries and BIAs were included in Appendix 2B.
• The EP defines the turtle nesting season as 1st October to 28th January. Peak nesting season in the Ningaloo Area being between 1st of December and the 28th of February with the season extending in a lesser degree either side (Whiting, 2008). Hatchings in the area are known to occur after a 6-8 week incubation period (Booth, 2009) indicating peak hatching season to be from January to April (EPA, 2010).	16. PGS disagrees that the Rollo EP defines the turtle nesting season as 1st October to 28th January. In all versions of the EP, the critical periods for breeding, nesting and internesting were individually described for each species. Furthermore, the next submission of the Rollo EP will contain updated information from the recently released *Recovery Plan for Marine Turtles in Australia 2017–2027*.To ensure that the proposed mitigation measures were inclusive of the various periods, the Rollo EP included EPS to reduce potential acoustic impacts to marine turtles from Shark Bay to Troughton Island within the period of 1 October and 31 March.
CCG believe the risk to hatchlings needs to consider: • Lack of extra reserves required to initial avoidance behaviour • Inability to avoid seismic source travelling 4 times their maximum swim speed • Inability to avoid seismics due to an overriding biological imprint for initial swimming frenzy • Very low survival rates • Inability to monitor impacts on hatchlings – impacts might not be apparent until they are sexually mature decades later. • CCG notes that relatively little data is available on the impacts to turtle and hatchling behaviour when acoustic disturbance occurs and has heightened concern for the repeated surveys in the same areas and over the longer term being conducted by Rollo during hatchling season. Any long term damage that occurs at hatchling phase may not be apparent until sexual maturity is reached and nesting numbers may begin to decline.	17. PGS appreciates and agrees with CCG's concerns for marine turtles and the potential behavioural responses that are likely to occur following exposure to seismic acoustic sources. The Rollo EP considered all possible environmental impacts and risks regarding acoustic disturbance to marine turtles, and based on published scientific evidence (e.g. Pendoley 1997), it is unlikely that the noise associated with seismic discharges would override the biologically imprinted drive in turtle hatchlings to complete the initial 24-hour 'swim frenzy' that takes them out to sea as quickly as possible. Given the very high mortality rate in hatchlings, it is unlikely that the impacts from seismic source would be measurable. Despite the unlikely occurrence of acoustic impacts to marine turtles (including hatchlings), PGS developed pre-cautionary and conservative mitigation measures that will further reduce the potential acoustic impacts and disturbance to marine turtles, such as but not limited to a marine turtle exclusion from Shark Bay to Troughton Island: • From 1 October to 31 March, there will be no discharge of the seismic source within: ○ Within 60 km of identified flatback turtle nesting BIA plus a 7.5 km buffer; and ○ Within the green turtle, hawksbill turtle and loggerhead turtle internesting BIA (as identified on the NCVA) plus a 7.5 km buffer.
• CCG is concerned that the mitigation measures in place for whale sharks rely heavily on visual observation from the ship. Furthermore their activity at dusk/night may decrease any visual accuracy. Is there any evidence to support this mitigation measure will be an accurate way to observe the whale shark presence in the 'observation' zone?	18. PGS shares CCG's concerns regarding potential environmental impacts and risks to whale sharks and appreciates the information provided by CCG. The Rollo operational area does not overlap the whale shark high intensity foraging BIA along Ningaloo Reef and is located 8 km away from Point Cloates and 14 km away from the North West Cape. The mitigation measures to reduce impacts to whales sharks have the highest performance level for visual observations and were based on the methods required for cetaceans under the EPBC Act. However, after further consideration of CCG's previous comments and other stakeholder concerns, PGS revised the Rollo EP with acoustic modelling results and additional

	conservative controls. In line with a pre-cautionary, conservative approach, the acoustic source will not be discharged within 100 km of the mainland coast from Shark Bay to the Montebello Islands from June to October. With this additional spatial exclusion zone, potential impacts and risks to migrating whale sharks will be reduced, and received sound levels will not have a behavioural impact on whale sharks. Therefore, based on the distance away from Ningaloo Reef, the acoustic modelling results and the mitigation measures (including visual observations and spatial exclusions), no acoustic disturbance to the whale shark aggregations at Exmouth is expected, and acoustic disturbance impacts will be reduced to ALARP and acceptable levels.
• Studies on the effect of seismic surveys on oyster spawning, spawning populations and spawning migration have shown that the powerful external forces on the spawning grounds can disturb or cease spawning altogether (Dalen, 2008).	19. The Rollo EP environmental impact and risk assessment included a thorough and updated summary of the scientific evidence for potential acoustic disturbance to eggs and larvae. As a pre-cautionary, conservative approach to further reduce impacts to oyster spawning, PGS made extensive effort to consult with stakeholders and implement acceptable control measures. As such, PGS engaged directly with the Pearl Oyster Managed Fishery (POMF) and Pearl Producers Association (PPA) to develop specific control measures that will reduce potential acoustic impacts to the fishery and its target species. From September–December, PGS will <u>not</u> discharge the acoustic source in water depths <100 m during the identified peak spawning period for the pearl oyster and in water adjacent to Eighty Mile Beach plus an additional 40 km spatial exclusion zone on either side of the POMF Zone 2 boundary. PGS will adhere to the 100-m minimal operational depths within the defined POMF green zone and pending research outcomes that are acceptable to the PPA. The acoustic array will not discharge in water depths less than 50 m outside of pearl oyster spawning. Prior to any individual survey within the Rollo OA PGS will consult with the PPA to determine if there are any new pearl lease areas of concern and incorporate a 10 km spatial buffer from any new pearl lease areas.
• There are knowledge gaps in the effect that seismic surveying might have on coral spawning, however, and this cannot be downplayed because of the close link that coral spawning has to the life history and behaviours of many marine species in the region. CCG believes that even with the knowledge gaps in relation to coral spawning, the coral remains an intricate link to the survival of all marine animals and any threat to its survival would cause an ecosystem collapse.	20. PGS agrees that coral have an intricate link to the marine environment, and the Rollo EP environmental impact and risk assessment was based on the best scientific data available, of which there is no evidence that documented seismic acoustic impacts to coral or coral spawning. However, the Rollo EP was revised to include an assessment of a recent scientific publication that demonstrated negative impacts to zooplankton following exposure to a seismic source. From this analysis, mortality or mortal injury may occur to plankton, including fish eggs and larvae, although potential impacts are localised (within the OA) and short-term based on estimated recovery times (e.g. three days). These potential impacts are not significant when compared to rates of natural mortality in planktonic populations (10 – 50% per day).
• Before seismic survey proceeds, CCG recommends that Rollo contracts independent scientists to conduct visual and acoustic surveys of the proposed area and its surrounds, and to make this information publicly available. These surveys must include sufficient effort over multiple years to be able to make an adequate assessment of likely marine animals and migratory species presence and distribution across the region. .	21. PGS acknowledges CCG's recommendation to conduct visual and acoustic surveys of the proposed area and its surrounds. However, based on the numerous scientific surveys of marine fauna in the north-west Western Australia, including scientific publications and government reports, additional surveys are not required at this time. Also, the significant financial and temporal investments required for a scientific survey are both impractical and unfeasible for each seismic survey. For the Rollo EP, PGS invested a substantial amount of time, cost and effort to undertaking advanced, site-specific and survey-specific underwater acoustic modelling (see response above), the results of which contributed significantly to the robust and rigorous environmental risk assessment. Furthermore, following engagement and in-person meetings with commercial fishers, PGS recognizes and agrees that knowledge gaps exist regarding environmental impacts from seismic surveys and advised about the difficulty for an individual seismic compact to undertake such research. PGS determined that a practical solution would be for PGS to request voluntary contributions from all purchasers of MultiClient data acquired under the Rollo EP, with such funds to be directed towards seismic/fishing interaction research. This approach was well-received in all stakeholder discussions and will be a positive first step towards a possible research fund.
• Avoiding key times of cetacean presence is the best way of avoiding impacts from acoustic disturbance. This information is essential for stakeholders to be able to make an informed assessment of the possible consequences of the activity.	22. PGS agrees with CCG that avoidance of sensitive periods for cetaceans will reduce impacts from acoustic disturbance. As such, the Rollo EP contains mitigation measures with spatial and temporal exclusion zones during which the seismic acoustic source will not be discharged. For example, during the relevant whale migration periods, there will be no discharge of the acoustic source within 18 km of the Northwest Cape foraging BIA for pygmy blue whales, and no seismic acquisition will occur within 100 km of the mainland from Shark Bay to the Montebello Islands (i.e. narrow migratory corridor for humpback whales).

• The severity of the acoustic and physical impact on marine animals cannot be downplayed, with much research providing evidence to this end (Weilgart, 2013). Mitigation measures appear to be focused on the impact to the individual and not the population – the use of Key Performance Indicators to measure mitigation success appears to be absent.	23. PGS agrees with CCG's concern regarding the acoustic and physical impacts to marine fauna and invested a substantial amount of research and development to present an accurate and robust environmental impact statement with rigorous and conservative mitigation measures, EPOs and EPS. Extensive underwater acoustic modelling by independent experts were undertaken with survey and site-specific parameters to support the Rollo EP and will ensure that the assessment will be based on reliable data and impacts reduced to ALARP and acceptable levels. Also, please see the response #11 above regarding key performance indicators in the Rollo EP.
CCG has serious concerns regarding: • Marine animal avoidance and behavioural changes. • Migrating populations. Impacts to habitat access, social and breeding behaviours. • Acoustic impacts from simultaneous surveys reaching an important habitat • from multiple directions • Acoustic and physical impacts from simultaneous surveys crossing a migration pathway • Concurrent seismic surveys in the same area • Multiple surveys occurring along a migration pathway in one season • Multiple surveys occurring in the same area, in the same season, across years	24. PGS appreciates and agrees with CCG's concerns regarding cumulative impacts. Based on the best available scientific data, the Rollo EP contains an environmental impact assessment that carefully and thoroughly considered: • Avoidance and behavioural changes for all marine fauna species that are likely to occur within the operational area • Migration populations (including critical habitats and behaviours) • Potential impacts from simultaneous and multiple surveys on important habitats and migration pathways • Concurrent seismic surveys in the same area. A detailed environmental risk and impact assessment was undertaken for simultaneous operations, cumulative impacts and potential worst case scenarios. As such, the Rollo EP will implement a 40-km separation distance as a conservative approach between any survey vessels undertaking full acquisition activities simultaneously (including PGS and non-PGS vessels) within the proposed operational area. Based on acoustic modelling predictions, received sound levels associated with the simultaneous acquisition activities will have attenuated well below known behavioural avoidance response levels for marine fauna at the closest distance to concurrent surveys. Prior to commencement of the individual surveys, PGS will check the NOPSEMA website to determine if any further seismic surveys not mentioned above may potentially occur in the area and consult with other geophysical companies operating in Australian waters, and/or titleholders of petroleum titles adjacent to the proposed operational area to ascertain if there are any other seismic surveys proposed for areas adjacent to the proposed operational area and over the same time period. Also, to reduce impacts from multiple seismic surveys, PGS will not undertake a seismic survey less than one month after a survey has been undertaken over the same area. • With the development and implementation of the proposed mitigation measures, cumulative impacts would be reduced to negligible levels. Furthermore, once a survey is complete, any resonant noise within the proposed operational area or surrounding marine environment would diminish. Following this, the potential effects from increased sound exposure to marine mammals and fauna would cease and animals would return to preferred habitat.
• Ningaloo World Heritage Area is a significant place, constantly under review with regard to new and important ecologically important areas. As such the likelihood for establishment of new reserves or proposed zoning changes to the area must be incorporated into any decisions made in relation to the seismic surveying that Rollo proposes to undertake.	25. The Rollo EP evaluated and described the Commonwealth Marine Reserves (CMR), especially in regards to the Australian IUCN reserve management principles as presented in Schedule 8 of the EPBC Regulations. Until final management plans come into effect for the CMR in the NWMR (draft management plans released recently), the transitional arrangements apply, and there are no changes on the water for users of the new reserves (i.e. seismic surveys are permitted to take place within any zone of the "in transition" CMR), which is an approach recommended by NOPSEMA. However, PGS recognises that during the life of the EP (being five years) that the final Management Plans for the CMR may come into effect (and may vary in relation to the IUCN management areas as currently proposed). Consequently, PGS shall comply with any legislative requirements associated with the proclaimed CMR. As part of the pre-survey planning undertaken prior to the commencement of any individual survey, PGS shall check the status of the CMR and ensure activities are not inconsistent with the principles and plans in force. At all times, PGS shall ensure that activities within the CMR (existing or proclaimed) will not result in unacceptable impacts to the environment or matters protected within those

						reserves, especially in regard to the Marine Bioregional Plans for the NWMR (DSEWPAC, 2012). Thus PGS will not act inconsistently with a plan of management for a CMR. • Following on from feedback from the CCG and the Ningaloo Coast World Heritage Advisory Council, PGS is currently reviewing the buffer at the boundaries of the World Heritage Properties (WHP) and has requested the NCWHAC to inform PGS as to the basis of the 20 km buffer request.
					• CCG requests at least four weeks for all documentation in order to make an informed assessment of the possible consequences of the activity on our interests in seeing marine life in the area protected from potential impacts related to the proposed survey.	26. As planning for individual surveys within the Rollo OA is finalised, all stakeholders will be contacted four weeks prior to commencement of each survey, and therefore stakeholders will have another opportunity to comment, request additional information and potentially raise any new concerns regarding the proposed individual survey within the Rollo OA.
			20-Sep-2017	Email	CGG thanked PGS for their previous response and were pleased with PGS commitments to abide by Commonwealth Marine Reserve restrictions and future changes, to review/incorporate new research into revised Eps and to notify stakeholders four weeks prior to survey commencement. Concerns raised included the following: • our reference to mitigation measures are taken from scholarly research articles that are based on 'best scientific evidence' available. The conclusions are based on evidence from these, some inferring a lack of evidence about impacts, not that impacts don't occur. Good governance then requires the proponent to use the Precautionary Principle rather than the assumption that the findings favour the proponent's activities. It is our responsibility to substantiate claims and employ the Precautionary Principle in order to preserve integrity. For example, it is implausible to suggest that because the impacts on zooplankton of a seismic survey are localised, that it does not have an impact on whale sharks. Recent studies have shown that zooplankton are significantly affected by seismic surveys, and that as basis of the food web any threat to its health will cause significant deficiencies higher up (McCauley 2017). In this context it is not possible to reduce the discussion to their significance on a 'regional scale' with any objectivity, unless of course, the comment on zooplankton being small in relation to the larger regional scale has been made simply to favour the proponent.	PGS responded with two emails sent on 27 September and 5 October 2017 and provided the following responses: • We certainly do understand and appreciate both the effort made and difficulties for a volunteer organisation in assessing numerous proposals. • In regard to comments about PGS adapting research towards proponents' claims, I believe this is unfair. In the Rollo EP, PGS has made numerous amendments and introduced significant additional mitigations based on many studies that do not favour what we would have intended to do had these assessments not been made. This is what we are required to do, and we do it to the best of our ability with good intentions.
					• Whale shark mitigation measures are documented to begin in June after the peak Whale shark migration period at Ningaloo.	From our previous response to the CCG (dated 17 August 2017), the information in Attachment 4 included a summary from the full Rollo EP, as relevant to the particular question from CCG. Please be aware that the full Rollo EP (for which CCG has complete access through the Rollo EP website) contains further information and substantially more details regarding control measures and environmental performance standards. Our response highlighted just one of the many control measures (i.e. more than 100) that will reduce environmental impacts, and this one control measure will be implemented from June to October based on the migration of other marine fauna in the area. While we advise to first refer to the full Rollo EP for all of the control measures, below is a list of the control measures to reduce acoustic impacts to whale sharks: • EPBC-2.1 – Part A – Standard Management Procedures - vessel operations will adhere to the EPBC-A for all surveys conducted under the Rollo EP. Mitigation procedures will be implemented for whales, whale sharks, marine turtles, dugongs, and the Australian snubfin dolphin: ○ A.3.1 Pre Start-up-Visual Observation; ○ A.3.2 Soft Start Procedure (also known as ramp-up); ○ A.3.3 Start-up Delay Procedure; ○ A.3.4 Operations Procedure; ○ A.3.5 Stop Work Procedure; ○ A.3.6 Night-time and Low Visibility Procedures; ○ A.4 Compliance and Sighting Reports; and ○ the following precaution zones will be implemented for all individual surveys within the proposed OA: ▪ Observation zone: 3+ km horizontal radius from the acoustic source. ▪ Low power zone: 2 km horizontal radius from the acoustic source. ▪ Shut-down zone: 500 m horizontal radius from the acoustic source.

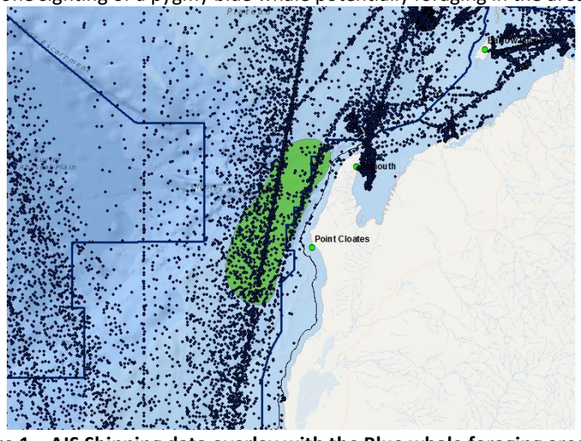
						• EPBC-2.1 – Part B – Additional Management Procedures - vessel operations will adhere to the following EPBC-B for all surveys conducted under the Rollo EP. Mitigation procedures will be implemented for whales, whale sharks, marine turtles, dugongs, and the Australian snubfin dolphin: o Two (2) dedicated MFO on the survey vessel for all surveys, at all times. o As per Chapter 3 Section 4.1.1, pre-survey research (e.g. desktop review of best available, updated scientific data, evaluation of any suitable additional controls) to determine likelihood of encountering whales, to inform on-going improvement and assess if increased precaution zones or other adaptive management measures are required to be implemented to ensure impacts are ALARP and acceptable. • Adaptive Management Procedures will be implemented for whales, whale sharks, marine turtles, dugongs, and the Australian snubfin dolphin, such that if the likelihood of encountering these species is moderate to high (i.e. sightings indicator and occurrence rate indicator are triggered; Table 3.40), then the following will be implemented: o Relocation - survey vessel will relocate to another survey line >10 km from location of last whale sighting and will not return within 24 hours; or o After relocation, if >3 whales observed within low-power zone during pre-start observation period, vessel will relocate to another line and recommence pre-start observation period. o Cessation - if there are no options for relocation, no survey operations will occur in current location for 24 hours. At this point, if less than three sightings within the power-down/shut-down zones occurred during the preceding 24 hours, night-time operations can re-commence in this location, as per EPBC-2.1 Part A.
					Further attention is required to the 100km buffer zone for Humpback whales in relation to the Exmouth Gulf resting area, but the narrowed migratory corridor on the west side of North West Cape, an area likely to be an important calving ground has not been addressed. Due to the imminent publication of current findings on this, CCG urge you to contact the local Department of Biodiversity, Conservation and Attractions in order to address this concern.	PGS acknowledged the critical habitat of the North West Cape for humpback whales throughout every response and the Rollo EP, and an overwhelming effort was made to ensure that environmental impacts to the North West Cape would be reduced through conservative control measures. Please know that no seismic data acquisition will occur within 100 km of the mainland from Shark Bay to the Montebello Islands, thus including the North West Cape (see figure below). Again, PGS advises to please refer to the full Rollo EP for all information regarding control measures and environmental performance standards and objectives.  Humpback whale migratory corridor spatial and temporal restriction exclusion area for the Rollo EP
					The impacts on fish has been restricted to species targeted by commercial or recreational fisher persons, and is of concern to us because the biodiversity of the area extends beyond these species, particularly where a habitat restricted species may not be able to move away from a seismic source.	As stated in our previous response (dated 17 August 2017), the Rollo EP contained a thorough description of fish species and commercial fisheries that are likely to occur within the operational area and was not restricted to just species targeted by commercial or recreational fisheries. As stated above, PGS advises CCG to please refer to the full Rollo EP for all the complete Description of the Environment and the Environmental Risk Assessment in Chapter 2, particularly Section 3.3.2.8, which evaluated acoustic impacts and risks to all fish species that are likely to occur within the Rollo OA, including site-attached species.

					Finally, CCG note that PGS clarified by email that the buffer zone for marine turtle nesting sites along Muiron Islands, North West Cape and Ningaloo would be 20km (PLUS an additional 7.5kms) in accordance with the Australian Marine Turtle Recovery Plan. However, we were unable to find this in the response.	Our previous response stated clearly that a 7.5 km buffer (i.e. no discharge of acoustic source) will be implemented around all known marine turtle BIAs, which includes the 20-km internesting BIA (or 60-km for flatback turtles) at the Muiron Islands, North West Cape and Ningaloo. The text below was taken directly from the table in Attachment 4: • A 60-km exclusion zone (plus an additional 7.5 km buffer) shall be implemented around recognised flatback turtle nesting during peak sensitive periods. • From 1 October to 31 March, there will be no discharge of the seismic source within: o Within 60 km of identified flatback turtle nesting BIA plus a 7.5 km buffer; and o Within the green turtle, hawksbill turtle and loggerhead turtle internesting BIA (as identified on the NCVA) plus a 7.5 km buffer. Again, PGS advises CCG to refer to the full Rollo EP for details of the implemented control measures, as well as maps and figures of all marine turtle BIAs that overlap the OA.
					Please note that CCG did not request a buffer zone of 20km. CCGs request was as follows: "Based on work by Bain & Williams CCG would recommend the survey exclusion zone between 1st June and 31st October from the Ningaloo Coast be extended to a minimum of 70km – noting that the distance of impacts of seismic surveys on Humpbacks, and other cetaceans, is not clear and this distance should be being measured from the species distribution edge not the shoreline."	Thank you for this clarification. We hope that CCG understands and agrees with the Rollo EP's comprehensive acoustic impacts and risks assessment, which determined impact distances based on accurate, reliable and robust modelling predictions (completed by JASCO Applied Sciences) of the sound fields from a seismic source located on the closest possible edge of the operational boundary to representative, sensitive habitats in the OA, including the Ningaloo Coast. Thus, PGS and the independent acoustic experts from JASCO Applied Sciences agreed that this was a more realistic, effective and conservative approach to determining acoustic impact distances and spatial exclusion distances to reduce acoustic impacts. The complete JASCO report as well as how the results informed the environmental impact and risk assessment and control measures are included in the full Rollo EP for your review.
					Finally, in an email sent by CGG to Scope Resources (dated 20 September 2017), the following question was raised: We have had a look at your update and while the survey is a long way from our local area, we would like some more information about how you are going to address cumulative impacts from multiple surveys in the area? With your own and other company vessels?	Please be assured that the Rollo EP contains a thorough and robust evaluation of cumulative impacts from the survey activities. The complete cumulative impact and risk assessment, as well as associated control measures, can be reviewed directly from the Rollo EP (Chapter 2, Section 3.3.2.19), for which CCG has access through our Rollo EP website. Below is a summary of the control measures to reduce cumulative impacts (from PGS and other vessels): • Vessels will not undertake full seismic acquisition activities within 40 km of another vessel that is also acquiring data. • PGS shall search the NOPSEMA website and consult with geophysical companies and/or titleholders to determine the presence of other seismic operations overlapping the proposed OA. PGS will not undertake a seismic survey less than one month after a survey has been undertaken over the same area.
8	Commonwealth Fisheries Association (CFA)	n/a	06-Sep-2016	email	• No response from CFA	• PGS re-sent the stakeholder consultation letter and informed CFA that consultation on the new approach by PGS has been well received and they look forward to any feedback from the CFA.
			27-Jul-2016	phone	• CFA advised PGS via phone that they do not expect to comment much on the Rollo MC MSS EP and will try to revert within a week.	• No action is required from PGS regarding this response from the CFA.
			05-Oct-2016	email	• CFA informed PGS that their position is that the decision making process for project proposals must require proponents to demonstrate that their consultation and negotiation strategies engage appropriately about both environmental and access issues with intersecting and adjacent fishing interests. • The duty to consult lies with the commercial proponent, and appropriate methods and techniques must be used during consultation. CFA does not consider information provision alone as constituting appropriate and meaningful consultation. • CFA resources are limited, and although there is an obligation to CFA membership to inform them of potential projects, it is not the responsibility of CFA to prepare or collate feedback for the oil and gas proponents. • It is CFA's position that, if such consultation work is needed, then appropriate remuneration must be negotiated between the oil and gas proponent and CFA for access to membership databases and/or preparation/collation of information requested by that proponent. It is also of CFA's position that consultation at the fishery level is best handled by regional industry associations where they exist. • The CFA has identified that regional/State industry associations or companies that must be contacted below;	5 Oct 2016 PGS responded to email from CFA noting the recommendations from CFA and confirmed with CFA that PGS has gone to considerable lengths to carry out appropriate and meaningful consultation. • PGS looks forward to the CFA receiving positive feedback from your members on these efforts over the coming period. • PGS contacted all fisheries licence holders / representative bodies identified by the CFA during the Phase 1 Consultation plan. • WAFIC were contacted via the first contact mail out on the 5th July 2016 via email. • Northern Prawn Fishing Industry were contacted via the first contact mail out on the 5th July 2016 via email and records of the email correspondence. • Austral Fisheries were contacted via the first contact mail out on the 5th July 2016 via the fisheries licence holder extract and currently hold licences in the following fisheries: Kimberley Prawn Managed Fishery • Raptis Fishing were contacted via the first contact mail out on the 5th July 2016 via the fisheries licence holder extract and currently hold licences in the following fisheries: Kimberley Prawn Managed Fishery

					• WAFIC; • Northern Prawn Fishing Industry; • Austral Fisheries; • Raptis Fishing; • Seafresh holdings; • Western Tuna and Billfish Fishery; and • Western Deepwater Trawl Fishery.	• Seafresh holdings were contacted via the first contact mail out on the 5th July 2016 via the fisheries licence holder extract and currently hold licences in the following fisheries: Pilbara Fish Trawl Kimberley Prawn Managed Fishery Nickol Bay Prawn Onslow Prawn Shark Bay Prawn Managed Fishery Shark Bay Scallops Managed Fishery • Western Tuna and Billfish Fishery; and, Western Deepwater Trawl Fishery were contacted via their representative bodies; WAFIC and CFA.
9	Director of National Parks (DNP)	06-Jul-2016	06-Jul-2016	email	• DNP advised PGS that they would endeavour to submit feedback regarding the proposed Rollo MC MSS EP by the end of July 2016. • DNP thanked PGS for including a map showing the overlay of the proposed CMR zones and the Rollo MC MSS OA. • DNP requested login to review the EP	• PGS provided website login. • No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			27-Jul-2016	email	• DNP noted that the proposed Rollo MC MSS OA overlaps Multiuse Zones IUCN VI zones for which transitional management arrangements currently apply. • DNP advised PGS that Australian and international practice regarding the management of IUCN protected areas is that mining operations (including petroleum exploration and recovery) are not consistent with IUCN categories other than Category VI (Multiple Use). • DNP acknowledged that the Rollo MC MSS OA does not overlap IUCN category VI zones. • DNP informed PGS in May 2016 the Government committed to make management plans operational within 12 months and when this occurs, the DNP would expect that all titleholders consider the need to revise and amend EPs accordingly. • DNP sought clarification regarding whether seismic streamers may, under the current EP incur into IUCN II and/or IV zones. • For any further questions, please contact the Commonwealth Marine Protected Area Branch at marinereserves@environment.gov.au.	28-Jul-2016 PGS advised DNP for the Rollo MC MSS EP, streamers will not be towed outside the operational area, or within IUCN II and/or IV zones. • The scope of the EP covers seismic data acquisition activities, and normal vessel movements and operations (survey and support vessels), within the Rollo MC MSS operational area (Chapter 1-Scope). • PGS requested information for the location of Government announcements regarding the CMR's.
			02-Aug-2016	email	• DNP thanked PGS for confirming that seismic streamers will not be towed into IUCN II and/or IV zones under the Rollo MC MSS EP. • DNP provided a link to the previous Minister for the Environment's reference to management plans being operational within 12 months from the date of the media release (3 May 2016): https://environment.gov.au/minister/hunt/2016/mr20160503.html	• No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			15-Sep-2016	email	• Read receipt received.	• No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			19-Sep-2016	email	• DNP informed PGS that they have noted the Rollo EP update and to send any further queries and notifications are to be sent to marinereserves@environment.gov.au	• No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
10	Gascoyne Demersal Scalefish Fishery – Licence Holder	n/a	15-Sep-2016	email	• Read receipt received.	• No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
11	Geraldton Port	n/a	06-Jul-2016	email	• Geraldton Port informed PGS they do not expect any impact arising with the Port from the activity, and acknowledged that the OA is located north and outside of their jurisdiction.	• PGS agrees with the Geraldton Port, the OA is located outside of the Geraldton Port jurisdiction and therefore no impacts are expected from activities conducted under the Rollo EP. • No action is required from PGS.
12	IFAW Oceania	19-Jul-2016	19-Jul-2016	email	• IFAW acknowledged that the approach by PGS allowing stakeholders to review the complete EP is an interesting approach and they welcome the potential for greater transparency.	• 19 Jul 2016 PGS sent stakeholder website log-in. • PGS responded to IFAW and informed them that PGS believes that the EP provided does provide sufficient information, but respect your position with regard to capacity. • PGS also expressed the opportunity to meet for general discussion in the future if the opportunity arises.

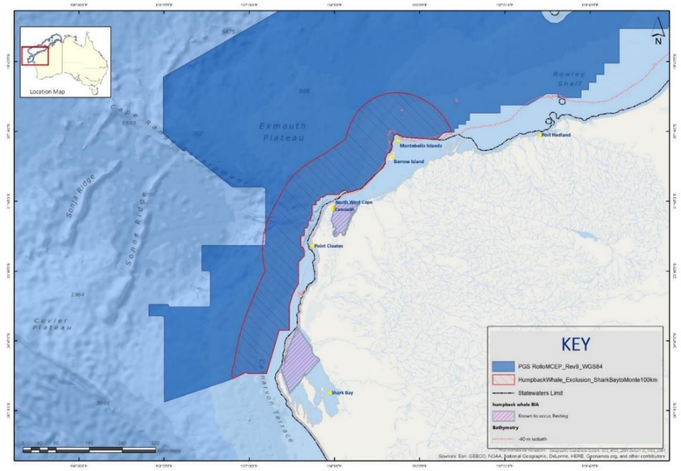
					• IFAW informed PGS that they believe that EPs presented on entire basin wide scales like this, which very unlikely reflect the final proposed activities, IFAW sees little value in responding at this time, nor has the capacity to on a basin-wide scale. • IFAW informed PGS that actual areas and periods to be surveyed are of their interest in seeing marine mammals protected from noise pollution and until these can be more properly defined and without more detail on proposed mitigation methods, they feel they do not have sufficient information to be able to give any kind of informed feedback.	• No action is required from PGS.
			13-Sep-2016		• Matt Collis informed PGS that he has left Australia and has returned to the UK, where he is working for the IFAW international whale team, which doesn't allow the capacity to do respond to Australian projects. • IFAW apologised that they were not able to respond to the Rollo consultation. • IFAW provided the new contact for IFAW Australia and advised PGS that it is unlikely that IFAW will be able to respond given the transition taking place in the office.	13 Sept 2016 PGS contacted IFAW to check if IFAW had reviewed the Rollo EP as PGS hope to submit the EP for assessment soon. 14 Sept 2016 PGS thanked IFAW for the update and if they have any questions to contact PGS. • PGS also expressed the opportunity to meet in the future. • No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			18-Aug-2017	Email	• Read receipt received.	No action is required from PGS.
13	Mackerel Managed Fishery		14-Sep-2016	mail	• Mail returned	• PGS checked mailing address against DoF fisheries extract address received March 2016, address is correct. • No action is required from PGS regarding this response. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
14	Mary Island Fishing Club (Derby)	n/a	15-Sep-2016	email	• Read receipt received.	• No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
15	MG Kailis Group	n/a	03-Aug-2016	email	• Base Marine provided PGS with contact details for MG Kailis Exmouth.	• PGS thanked Base Marine for providing the contact details. • No action is required from PGS regarding this response. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			04-Aug-2016	email and phone	• MG Kailis followed up on contact details. • Confirmed availability for Friday 12th August meeting.	• PGS thanked MG Kailis for the email and confirmed meeting. • No action is required from PGS regarding this response. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			16-Aug-2016	email	23 Aug 2016 MG Kailis is happy with the cooperation protocol, ongoing consultation plan and meeting summary. • MG Kailis acknowledged that they appreciate PGS efforts to accommodate fishing and other industries around their activities. • MG Kailis informed PGS they look forward to meeting with PGS operations team in the future to work out how we can contribute to their projects on a commercial basis to PGS benefit.	16 Aug 2016 Following on from the meeting PGS sent MG Kailis an operations protocol and ongoing consultation plan, plus and a summary of the meeting. • No action is required from PGS regarding this response. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			14-Sep-2016	email	• Read receipt received.	• No action is required from PGS regarding this response. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			21-Aug-2017	email	• Read receipt received.	• No action is required from PGS regarding this response. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
16	Ningaloo Coast World Heritage Advisory Committee (NCWHAC)	18-Sep-2016	03-Aug-2016	email	• NCWHAC contacted PGS to find out if a late submission from the NCWHAC would be accepted. • NCWHAC confirmed they would like to meet up for a discussion.	• PGS informed NCWHAC that a late submission would be accepted and informed NCWHPAC that PGS will be visiting Exmouth next week if they would like to meet in person to discuss the project. • No action is required from PGS regarding this response. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			09-Aug-2016	email	• Ningaloo Coast World Heritage Advisory Committee (NCWHAC) responded to PGS with the following comments:	14 Sep 2016 PGS responded to the NCWHAC:

				• NCWHAC recommendations 1. The proposed activities do not enter the World Heritage property at any point, and given streamer length is up to 12km that a buffer of at least 20 km is proposed for any seismic activity at any time of year. 2. The activity is timed to avoid key species events occurring inside and adjacent to the property (e.g. migrations, breeding, reproduction and feeding events). The assessment includes the potential impacts on coral spawning activity from which Ningaloo recruits. 3. The committee is kept up to date on the location and timing of the surveying activities within 100 km of the property. 4. Key Performance Indicators (KPIs) are set for each of these World Heritage values to ensure they are not adversely affected by the proposed activity and the committee is provided an annual update on the performance of the KPIs.	• PGS thanked the NCWHAC for their response to the Rollo MC MSS Environment Plan (EP). PGS acknowledged the effort invested and the concerns raised for the Ningaloo Coast World Heritage Property. • PGS responded to the NCWHAC recommendations as follows. 1. PGS will adhere to the request whereby individual surveys and towed equipment will not enter within the boundaries of the World Heritage Property (WHP). PGS is reviewing the NCWHAC request to incorporate a buffer at the boundary of the WHP. Once this has been thoroughly reviewed PGS will send NCWHAC an update to this recommendation. 2. PGS has committed to undertaking pre-survey planning to review current information to try to avoid recognised BIA during sensitive periods. <u>EPS 36:</u> PGS will undertake pre-survey planning to review current information to try to avoid recognised BIA during sensitive periods. The Rollo EP currently contains spatial and temporal restrictions to seismic acquisition for marine turtles which also coincides with the primary (March) and secondary (October) coral spawning events at Ningaloo Reef. <u>EPS 26:</u> 1 October to 31 March No discharge of seismic source within 20 km from the recognised flatback turtle nesting area, or within the green turtle, hawksbill turtle and loggerhead turtle internesting BIA, (as identified on the NCVA) during the marine turtle peak nesting period, plus an additional four weeks for emerging hatchlings. 3. PGS will adhere to this request from the NCWHAC to be kept informed of the location and timing of the surveying activities within 100 km of the property. Updates for the Rollo MC MSS EP will be posted on the Rollo project website. 4. PGS believes that impacts and risks to the KPI of the World Heritage values will not be impacted upon with the current EP commitments in force. Annual reporting on adherence to the Rollo MC MSS environmental performance objectives will be posted on the Rollo project website. • PGS hopes that this information provides NCWHAC with increased confidence that PGS will undertake the proposed activity in a manner that will minimise impacts to the marine environment to acceptable levels that are As Low As Reasonably Practicable.
			16-Aug-2016	email	• No feedback received from NCWHAC.	16 Aug 2016 PGS sent the NCWHAC a draft cooperation protocol and congoing consultation plan for their review and approval. • No action is required from PGS regarding this response. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			18-Sep-2016	email	• NCWHAC requested website access	• PGS provided website login. • No action is required from PGS regarding this response. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			03-Oct-2016	email	• NCWHAC requested a one week extension for submitting a response to the Rollo stakeholder update letter.	• PGS responded to NCWHAC and informed them that they have no problem with a week extension to the CSEM update feedback.
			14-Oct-2016	email	• Response letter received from NCWHAC. • NCWHAC thanked PGS for the opportunity to comment on the Rollo EP and acknowledged the extension request and additional delay in responding. • NCWHAC responded to PGS with the following recommendations: 1. Buffer for streamers – we recommended that a buffer of at least 20 km rather than 12km be used to ensure that 12 km long streamers did not enter the WHA, particularly at the northern end of the WH Property. This does not seem to have been addressed.	19 Oct 2016 PGS responded to the NCWHAC: • PGS thanked the NCWHAC for their response to the Rollo MC MSS Environment Plan (EP). PGS acknowledged the effort invested and the concerns raised for the Ningaloo Coast World Heritage Property. • PGS responded to the NCWHAC recommendations as follows. 1. Individual surveys and towed equipment will not enter within the boundaries of the World Heritage Property (WHP). PGS is reviewing the NCWHAC request to incorporate a buffer at the boundary of the WHP.

						PGS would like to request further information and what is the recommendation of a 20 km buffer from the WHP based on, i.e. acoustic impact, presence of vessel etc. • No response received from NCWHAC.
					2. Timing of seismic activities to avoid key species events (e.g. migration, spawning etc.). • a. We note that this has been done for humpback whale BIA (restricted migration corridor – 1st June- 31st Oct - 60km exclusion zone), marine turtles BIA (1st Oct- 28th Feb – 20 kms exclusion zone), but not for blue whale foraging BIA and whale shark BIA.	2. The source for the Whale shark Biologically Important Area (BIA) is via the Australian Government Department of the Environment and Energy *"Find Environmental Data"* website: http://www.environment.gov.au/fed/catalog/search/resource/details.page?uuid=%7B2ed86f5a-4598-4ae9-924f-ac821c701003%7D PGS has committed to undertaking pre-survey planning to review current information to try to avoid recognised BIA during sensitive periods. <u>EPS 36:</u> PGS will undertake pre-survey planning to review current information to try to avoid recognised BIA during sensitive periods. <u>Pygmy blue whale</u> The potential foraging area at Exmouth is not an identified aggregation area. Large aggregations of foraging blue whales have not been observed at Ningaloo Reef, upwellings at Ningaloo may provide opportunistic feeding opportunities for whales transiting on migration, however it is not a location where large numbers of whales aggregate and feed. • Additional information has been added to the Rollo MC MSS EP in response to the Cape Conservation Group (CCG) Response: "Aggregation areas were confirmed during an International Whaling Commission (IWC) survey in late 1995 (Kato et al. 1996). The Bonney Upwelling and Perth Canyon are the best known Blue Whale aggregation areas in Australian waters. Bass Strait and the waters of the eastern Great Australian Bight are also known feeding areas, although perhaps only in certain years (Mustoe 2003 pers. comm.). Other important areas of aggregation include Geographe Bay and Quondong Point, which are used as migratory waypoints, the upwellings around Browse Island, which is likely feeding area during migration to Indonesia, and areas around Cape Naturaliste and Rottnest Island, which are also feeding grounds (DEWHA 2008b)". An international shipping fairway overlaps the potential foraging BIA, and from AMSA AIS data (2016) a high number of vessels transit the area, however there has only been one sighting of a pygmy blue whale potentially foraging in the area.  **Figure 1 – AIS Shipping data overlay with the Blue whale foraging area BIA** As surveys are not proposed within an identified aggregation area, there is no justification for avoidance of the blue whale possible foraging area, based on one observation. <u>Whale Shark</u>

	PGS acknowledges the global IUCN status for whale sharks is listed as Endangered, however the status under the Commonwealth Protected Matters Search Tool is still listed as Vulnerable. The source for the World Heritage Property Boundary is via the Australian Government Department of the Environment and Energy "Find Environmental Data" website: http://www.environment.gov.au/fed/catalog/search/resource/details.page?uuid=%7B6C54FE6C-2773-47C6-8CBC-4722F29081EF%7D The migration period to Ningaloo is not specified in the DoE conservation atlas. Based on the available information regarding the movement of whale sharks, and the lack of empirical migration data, it is difficult to determine the whale sharks peak migration period to the high density foraging area along the reef edge at Ningaloo Reef. • Seismic surveys will be conducted with the implementation of EPBC Part A mitigation procedures. • The Rollo MC MSS does not overlap the high density feeding area BIA at Ningaloo Reef. • Mitigation measures already inforce for humpback whales means that no seismic acquisition will occur from June to October: 1. within 60 km of the mainland from Point Cloates to Northwest; and 2. within 60 km radius of the Montebello Islands (Jenner, 2010).
• The annual aggregation of whale sharks is one of the key features of the Property. Whale sharks are listed as endangered and we seek your clarification about the source of the BIA boundaries that exclude the northern end of the Property.	• PGS sought clarification from NCWHAC regarding the source of the BIA boundary – see email dated 17-Oct-2016.
• b. Our earlier submission requested that consideration be given to the impacts of seismic activity on coral spawning in Ningaloo WHA. We note that coral spawning is addressed as a biological activity, but not the potential impacts from seismic activity.	• Please see Section 3.2.2.6 Disturbance to Planktonic Organisms for potential impacts to planktonic organisms, which includes coral spawn, i.e. fish eggs, larvae and other minute planktonic organisms.
3. Chapter 1 Section 1.3 – Mitigation Procedures for EPBC Listed Species. Mention is made of a review of mitigation measures "In order to preserve transparency, such changes are to be independently reviewed and agreed by a 3rd party environmental consultant." It is recommended that in the interests of transparency such review is a public document.	3. PGS will adhere to this request from the NCWHAC: • All third-party reviews by an environmental consultant will be made available to stakeholders by publishing on the Rollo EP website.
4. Chapter 1 Section 3.1.1 Stakeholder Engagement Meetings. Under Government Departments is listed "World Heritage Program Ningaloo Coast Council". The Ningaloo Coast World Heritage Advisory Committee does not know this body. If the reference is meant to be the Committee, please amend.	4. This reference was intended to be the NCWHAC, PGS has amended as requested.
5. Chapter 1 Section 3.1.2 Stakeholder Engagement Letters – Government Departments. Under WA Department of Parks and Wildlife (DPaW) is listed "World Heritage Program Ningaloo Coast". We assume that this was intended to refer to the Ningaloo Coast World Heritage Advisory Committee which is a stand-alone advisory Committee established by State and Commonwealth Environment Ministers, not part of DPaW. Funds are provided by the Commonwealth Government for its secretariat and meeting activities, which are serviced by DPaW. Please show the NCWHAC as a separate body, rather than as a Government Department.	5. Thank you for clarifying, PGS has amended as requested.
6. Chapter 2 Section 3.2.2.19 Simultaneous Operations and Cumulative Impacts. The Committee remains concerned about cumulative impacts where there are simultaneous operations, even with the proposed 30km separation. The Committee recommends that simultaneous operations not be undertaken as the standard and that the proposed time separation between consecutive surveys (1 month) be maintained or increased	6. At most there will be 2 vessels working at distances less than 30 km of each other. The EP currently states the following: • At any one time there will be no more than 4 seismic survey vessels operating under the Rollo EP and no more than two seismic survey vessels working under the Rollo EP within 30 – 100 km.
7. Chapter 2 Section 2.3.1 Productivity and Plankton Communities, Section 2.4.5.1 Commonwealth Marine Reserves and Fig 2.28. Note that in the recent Commonwealth Marine Reserves Review http://www.parksaustralia.gov.au/marine/review/reports.html the Habitat Protection Zone (IUCN IV) in the Gascoyne Commonwealth Marine Reserve has been recommended for substantial expansion eastwards in order to provide better protection for the Cloates and Cape Range Canyons.	7. Existing and proposed CMR are subject to the Australian IUCN reserve management principles as presented in Schedule 8 of the EPBC Regulations. • Until management plans come into effect for the proclaimed CMR in the NWMR (which was scheduled to occur in July 2014 but did not take place) transitional arrangements apply and there are no changes on the water for users of the new reserves - i.e. seismic surveys are permitted to take place within any zone of the "in transition" CMR (DoE, 2015e). However, PGS recognises that during the life of the EP (being five years) that the Management Plans

						for the CMR may come into effect (and may vary in relation to the IUCN management areas as currently proposed). Consequently, PGS shall comply with any legislative requirements associated with the proclaimed CMR. As part of the pre-survey planning undertaken prior to the commencement of any individual survey, PGS shall check the status of the CMR and ensure activities are not inconsistent with the principles and plans in force. • PGS shall ensure that activities within the CMR (existing or proclaimed) will not result in unacceptable impacts to the environment or matters protected under Part 3 within those reserves; will have regard to the Marine Bioregional Plans for the NWMR (DSEWPAC, 2012); and will not act inconsistently with a plan of management for a CMR. • Following on from feedback from the CCG and the Ningaloo Coast World Heritage Advisory Council, PGS is currently reviewing the buffer at the boundaries of the CMR IUCN II & IV and World Heritage Properties (WHP).
				8. Chapter 2 Section 2.3.3 Benthic Communities. Note that in recent years significant deepwater sponge beds with many new species have been found within the Ningaloo World Heritage Area – (see Schonberg, C. & Fromont, J. (2011). Sponge Gardens of Ningaloo Reef (Carnarvon Shelf, Western Australia) are biodiversity hotspots. Hydrobiologia: (687) p. 143-161.).	9. PGS thank you for providing additional information which will be reviewed and incorporated into the Rollo EP accordingly.
			17-Oct-2016	email and phone	• NCWHAC informed PGS they are seeking clarification from their members regarding the comment: from their members regarding the comment: *"source of the BIA boundaries that exclude the northern end of the Property"*.	17 Oct 2016 PGS called NCWHA and requested clarification regarding the comment *"source of the BIA boundaries that exclude the northern end of the Property"*. • PGS awaiting NCWHAC response. • No action is required from PGS regarding this response. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			17-Oct-2016	phone	• No response received from NWHAC.	• PGS called and left message regarding the source of the BIA boundaries query. • No action is required from PGS regarding this response. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			19-Oct-2016	email	• NCWHAC advised PGS that the boundary query is regarding the whale shark BIA. • The Whale Shark BIA in the Appendices 2 Figure 3.9 it shows a 'high density prey' foraging area which extends up to the tip of the North West Cape (NWC) and then north of the Muiron Islands there is a foraging area identified – leaving a gap between the two area from the north of the NWC to north of the Muiron Islands. • The area between here is of great interest as Whale Sharks were discovered 5nm west of the Muiron Islands in May 2012 in a group of 40-50 individuals feeding on krill at dusk, 2 follow-up surveys a week later confirmed this behaviour in large numbers was continuing. • The local DPaW office might have information about if additional surveys have been conducted since this time. *Because of this information we were curious about how the BIA locations for Whale Sharks were identified.*	• PGS thanked NCWHAC for their quick response to PGS questions. • PGS informed the NCWHAC that the BIA used for the Rollo EP risk assessment are sourced from the Commonwealth Government Department of Energy and Environment 'find environmental data' website and the latest update of this information was in February 2016: • http://www.environment.gov.au/fed/catalog/search/resource/details.page?uuid=%7B2ed86f5a-4598-4ae9-924f-ac821c701003%7D
			19-Oct-2016	email	• NCWHAC thanked PGS for the prompt response and informed PGS that they will be in contact if they have any further queries.	• No action is required from PGS regarding this response. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			14-Aug-2017	Email	• NCWHAC confirmed receipt of the request and informed PGS they will follow up on this and get back to PGS asap.	• PGS contacted NCWHAC to remind them of the outstanding request for the Rollo EP sent on 19 Oct 2016. • What is the recommendation of a 20 km buffer from World Heritage Properties' based on? e.g. acoustic impact, vessel presence etc.
			17-Aug-2017	Email	• NCWHAC DPaW confirmed meeting at Exmouth on 21 August 2017. See **Table 2-2**	• PGS contacted NCWHAC DPaW at Exmouth to organise a face to face meeting.
			25-Sep-2017	Email	Thank you for the opportunity for the Ningaloo Coast World Heritage Advisory Committee (NCWHAC) to comment on the revised PGS Rollo Marine Survey Environment Plan (EP). We note the revised EP contains increased management controls for sperm whales, whale sharks, marine turtles, dugongs and Australian snubfin dolphins. Thank you also for the two papers on seismic effects on plankton. • In our previous submission we recommended that a 20km buffer zone between seismic activities and the outer western boundary of the Ningaloo Coast World Heritage area	On 10 October 2017, PGS provided the following responses in a letter sent via email to Simon Woodley: Thank you for the Ningaloo Coast World Heritage Advisory Committee (NCWHAC) letter (dated 25 September 2017) regarding PGS' proposed Rollo Multi-client Marine Seismic Surveys Environment Plan (Rollo EP). PGS acknowledges that the Rollo EP is a large and complex document and appreciates the NCWHAC's feedback and response. PGS understands the NCWHAC's concern and recommendations for a 20-km buffer zone between seismic activities and the outer western boundary of the Ningaloo Coast World

					(NCWHA) be maintained. We recommended this distance because the streamers used for seismic testing are 14km long and the additional 6km gives a buffer, if the seismic activities are deployed close to the outer western boundary. The declared boundary for the NCWHA is a jurisdictional boundary based to some degree but not entirely on ecological criteria. The demonstrated effects of seismic activities on marine species and assemblages that form part of the Outstanding Universal Value of the World Heritage property are not fully known particularly any cumulative effects. Therefore we have applied the precautionary principle in making this recommendation, not any particular policy or research finding.	Heritage Area (NCWHA). The Rollo EP contains a thorough and robust description of the NCWHA and its outstanding universal values, as well as a precautionary approach to reducing environmental impacts and risks to the marine environment. As such, there are several control measures that will be implemented to protect the NCWHA, including a 100-km exclusion zone along the mainland coast from Shark Bay to the Montebello Islands (thereby including the NCWHA) from June to October each year. This control measure was based on accurate and reliable underwater noise modelling predictions by independent, acoustic modelling experts (JASCO Applied Sciences). Their modelling results demonstrated that with this exclusion zone implemented (in which the acoustic source will not be discharged), the sound levels entering the NCWHA will be reduced to ALARP and acceptable levels. While this distance was established primarily to reduce impacts to migrating humpback whales, it will likewise provide environmental protection for the entire marine environment (see figure below). Furthermore, the modelling predicted that at other times during the year, when the survey activities will be >6 km away from the NCWHA, the received sound levels will be lower than thresholds known to harm marine fauna. An excerpt of the acoustic noise impact and risk assessment to World Heritage Properties is attached, and further details can be found in the full, Rollo EP (Chapter 2 Section 3.3.2), for which you have access through the Rollo EP website.  •
					We note that the recently released Commonwealth Recovery Plan for marine turtles contains a recommended 20km critical habitat buffer distance for inter-nesting turtles. • We have no further comments on the revised EP in addition to those made to earlier draft EPs. Thank you for the continued engagement with the NCWHAC on seismic issues.	Furthermore, please be assured that the environmental impact and risk assessment in the Rollo EP is based on the advice and values in the most recent conservation and recovery plans, including the recent Recovery Plan for Marine Turtles in Australia (2017). As such, the following control measure is based on the identified critical habitat buffers for internesting turtles (in-line with the NCWHAC's recommendations): • **Marine Turtles (1 October to 31 March) Shark Bay to Troughton Island (including NCWHA) - No discharge of the acoustic source within 7.5 km of the identified NCVA marine turtle nesting, internesting, or internesting buffer BIA boundary (i.e. 27.5 km exclusion zone).**
17	NDSF - Northern Wildcatch Seafood Australia (NWSA)		1-Jul-2016	email	• No response from NWSA	• PGS sent NWSA a stakeholder consultation plan and meeting summary to review and approve. • No action is required from PGS regarding this response. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			16-Aug-2016	email	• No response from NWSA.	• PGS sent NWSA another stakeholder consultation plan and meeting summary to review and approve. • No action is required from PGS regarding this response. • No assessment of merits undertaken as no feedback or comments received from stakeholder.

			24-Aug-2016	email	• NWSA advised PGS that they had read the proposal and it looks fine. • NWSA informed PGS that they could see that they have clearly put some time into the proposal. • NWSA sought information regarding the progress of the bathymetry data (discussed during the meeting). • NWSA stated he is ok with the proposal.	• PGS sent an email reminder to NDSF to review the consultation plan and to advise PGS if they are happy with the plan. • PGS sent NWSA a copy of bathymetry data files, which Fremantle Marine Electrics are able to read. • No action is required from PGS regarding this response. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			25-Aug-2016	email	• Thanked PGS for the software and provided information on software used.	• PGS sent NWSA another data file to test and informed NWSA and attached a sample of what the image should look like.
			28-Sep-2016	email	• NWSA advised PGS of the software that they use.	• PGS supplied NWSA with a sample bathymetry dataset to trial. • No action is required from PGS regarding this response. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
18	NPF Industry Pty Ltd	n/a	25-Jul-2016	email	• No feedback received from NPFI.	• 25 Jul 2016 as per request of the NTSC, PGS re-sent via email the NPFI the Rollo stakeholder consultation letter.
			15-Aug-2016	email	• 16 Aug 2016 NPFI advised PGS that they are attending a meeting in Brisbane and requested to reschedule the phone meeting for the same time tomorrow.	• 15 Aug 2016 Prior to phone discussions with NPFI, PGS sent the NPFI the fisheries presentation/ • 16 Aug 2016 PGS confirmed phone meeting for 17 Aug 2016.
			06-Sep-2016	phone	• NPFI advised PGS they will respond to PGS within a week.	• 6 Sep 2016 PGS called NPFI following up on call of 17 Aug 2016,
			05-Oct-2016	email and phone	• NPFI advised PGS that they are in transit and will review over the weekend.	• 5 Oct 2016 PGS informed NPFI they tried to call and have send a draft protocol which is very similar to what PGS has set up for other groups. • PGS requested NPFI to provide maps of key shallow water areas of concern that NPFI mentioned during the initial phone conversation.
			14-Oct-2016	email	• NPFI apologised for not responding. • NPFI informed PGS that they hope to have a response delivered Wed pm.	• 14 Oct 2016 PGS informed NPFI that the Rollo EP will be submitted next week. • PGS acknowledged that NPFI are concerned about operations in shallow waters and PGS are waiting for NPFI to get back to PGS regarding this. • PGS confirmed that they will not be operating any shallower than 39 m in the NPFI licence area. • PGS sent the NPFI a consultation plan and meeting summary. • PGS responded to NPFI reply and acknowledged that they look forward to receiving a response from the NPFI. • No action is required from PGS regarding this response. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			9-Feb-2017	email	• No feedback received from NPFI.	• 9 Feb 2017 PGS contacted NPFI to inform them that PGS are in discussions with Santos regarding sharing the NPFI current fishing effort data, and they may revert back to NPFI to discuss any possible commercial-in-confidence issues. • PGS also re-sent NPFI the latest correspondence between PGS and NPFI and the original PGS Rollo notification with a map.
			17-Feb-2017	email	• Santos confirmed with PGS they have permission from the NPFI to allow Santos to share the NPFI fishing data to PGS, which was originally supplied to Santos.	• 17 Feb 2017 PGS checked if Santos had received permission from NPFI to share the NPFI fishing data.
			23-Feb-2017	email	• 27 Feb 2017 No feedback received from NPFI.	• 23 Feb 2017 PGS thanked NPFI for allowing PGS to use the data from Santos. • PGS updated and amended and resent the NPFI draft protocol taking into account the additional data and informed NPFI to contact PGS if they have any queries.
			14-Aug-2017	email	• NPFI advised PGS that they are on the road this week however they will review and get back to PGS over next week or so.	• PGS sent NPFI an update regarding the proposed control measures in the Rollo EP relevant to the prawn fishery. • Following on from the provision of data from Santos, PGS has developed and implemented mitigation controls individual surveys conducted under the Rollo EP, in the vicinity of the Northern Prawn Fishery. However, please accept my sincere apology as it has come to my attention that the Northern Prawn Fishery Industry (NPFI) was not provided with an opportunity to comment or feedback on the proposed controls.

						• Please see item 1 below which defines the Rollo EP proposed controls previously submitted to NOSPEMA in February 2017. • Item 2 is the revised controls proposed for surveys conducted in the vicinity of the NPF, and these will be included in the next submission of the Rollo EP to NOSPEMA for acceptance. o <u>1. Rollo EP submission in response to OMR 1 - NPFI mitigation controls:</u> o During the identified Northern Prawn Fishery (NPF) prawn fishing seasons 1 and 2 identified below, PGS will not discharge the acoustic array within 4 km of prawn trawling activities (including low to high intensity fishing zones), as identified by the Commonwealth Government Fishery Status Report 2013–14 or from stakeholder consultation with the Northern Prawn Fishing Industry: o • Season 1 (mainly banana prawns caught): 1 April – 30 June o • Season 2 (mainly tiger prawns caught): 1 August – end of November. o <u>2. Rollo EP OMR 2 - proposed amendment to mitigation controls:</u> o During the identified Northern Prawn Fishery (NPF) prawn fishing seasons 1 and 2 identified below, PGS will not discharge the acoustic array within 4 km of the Northern Prawn Fishery Active Area (NPFAA) which includes low to high intensity fishing zones, as identified by the most recent Commonwealth Government Fishery Status Report (2015) or from stakeholder consultation with the Northern Prawn Fishing Industry: o • Season 1 (mainly banana prawns caught): 1 April – 30 June o • Season 2 (mainly tiger prawns caught): 1 August – end of November. • PGS believes with the implementation of the control measure identified above (item 2), potential impacts and risks to the NPF have been reduced to ALARP and will be acceptable to NPFI. As such I look forward to NPFI providing comment and confirming that the above measures are considered acceptable.
19	Northern Territory Seafood Council (NTSC)	19-Jul-2016	05-Jul-2016	email	• No feedback or response received from NTSC.	• PGS sent NTSC stakeholder consultation letter and acknowledged the recent catch up meeting in Darwin with PGS and NTSC.
			19-Jul-2016	email and phone	• NTSC thanked PGS for the follow up call regarding the Rollo MC MSS EP stakeholder letter. • The NTSC advised PGS that the OA does not cover NT Seafood Council members fishing areas. The Northern Prawn Fishery will likely have key fishing grounds within the proposed area. • NTSC advised PGS to contact the Northern Prawn Fishery Industry (NPFI) CEO. • NTSC requested login to access the consultation information for my interest only with regards to viewing your companies' initiative to make information available prior to the EP being submitted, an initiative I suspect will be a welcome relief from the seafood industry. • NTSC confirmed receiving log in information.	• 19-Jul-2016 PGS informed NTSC that they will send the NPFI the Rollo MC MSS stakeholder consultation letter. • PGS provided website login. • No action is required from PGS regarding this response. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
20	Pilbara Line Fishery – Fat Marine Pty Ltd	n/a	25-Jul-2016	email	• No feedback received.	• 25 Jul 2016 PGS sent Licence Holder an Operations Protocol and Meeting Summary to review.
			06-Sep-2016	email	• No feedback received.	• 6 Sep 2016 PGS sent Licence Holder an email reminder to provide feedback for the Cooperation Protocol and Meeting Summary.
			21-Sep-2016	email	• Licence Holder apologised for the late response to the minutes presented for review. • Licence Holder informed PGS that they are confident that the minutes pretty well reflect the meeting held in the WAFIC office in Fremantle on Friday 27th May 2016.	• PGS thanked Licence Holder for the response and PGS understand the concern. • PGS look forward to working with Licence Holder on our first project under the Rollo EP. In this market, it is hard to say when that will be of course. • No action is required from PGS regarding this response. • See email sent 28-Aug-2017 in Table 2-2.
			22-Sep-2016	email	• Copied into email to electronics company.	• 22 Sep 2016 PGS sent a sample bathymetry dataset, to check if they can read this into a system compatible with what Licence Holder is using.
			23-Sept-2016	email	• Copied into email to electronics company.	• 23 Sep 2016 confirmed they cannot import the data but attached a photo of the data can import to its 3D database. • No action is required from PGS regarding this response. • No assessment of merits undertaken as no feedback or comments received from stakeholder.

21	Pilbara Line Fishery – RNR Fisheries	n/a	25-Jul-2016	email	• No response received from Licence Holder.	• 25 Jul 2016 PGS sent Licence Holder the draft minutes of the meeting, and a draft cooperation plan for their review and approval.
			16-Aug-2016	email	• No response received from Licence Holder.	• PGS requested Licence Holder to review the attached protocol are all ok. • No action is required from PGS.
			8-Sep-2016	Email	• Licence Holder confirmed that Operations Protocol and Meeting Summary covered all items discussed at the meeting.	• PGS confirmed with Licence Holder that the protocol will kick into gear when PGS get a project going, which may take a while in this market.
22	Pilbara Trap Managed Fishery - Old Brown Dog Fishing Co	n/a	05-Jul-2016	email	• 5 July 2016 Old Brown Dog (OBD) informed PGS that they are finishing off a vessel refit and will have time to look at this in the next couple of weeks.	• 5 July 2015 PGS sent Licence Holder a stakeholder consultation letter and acknowledged the recent catch up meeting. • PGS informed Licence Holder that the meeting minutes and a draft operational protocol will be finalised shortly and forwarded on for their review and approval.
			11-Jul-2016	email	• OBD thanked PGS for taking the time to actually try to find a way forward through the impasse that comes up when our respective operations clash upon the water. • OBD informed PGS that they will endeavour to work with PGS to the extent that has minimum impact necessary on day to day operations and that they expect that with sensible and timely communications this should be able to be achieved. • OBD will wait for PGS to pick up work in their fishing area in the Pilbara and/or Kimberley fishing zones. • OBD informed PGS that they believe that sensible communications is the key to resolving issues between the two industries, and suggested that it may be helpful to prepare a briefing for PGS vessels on how PTMF boats operate and go about their daily operations. • Which may go some way to avoiding some of the presumptions that the fishing industry regularly encounters from seismic vessels. • OBD will wait for a PGS project to go ahead before putting a briefing package together.	• PGS thanked OBD for the feedback and confirmed that the protocol will be submitted to NOPSEMA for assessment. • PGS informed OBD that the protocols will not be uploaded on to the Rollo project website as they consider the agreements along with any direct correspondence confidential. • PGS agreed with OBD and they appreciate the idea of a briefing from the fishing industry and agreed that the more we understand about each other's operations the easier it will be to accommodate each other. • PGS informed OBD that they look forward to putting this planning into action at some point in the future when they have a firm project. • PGS updated OBD that they are currently testing out some bathymetry file types for OBD.
			15-Sep-2016	email	• Read receipt received.	• No action is required from PGS.
23	POMF - PPA	28-Jul-2016	05-Jul-2016	email	• No response from PPA.	• 5 July 2015 PGS sent PPA a stakeholder consultation letter and acknowledged the recent catch up meeting.
			28-Jul-2016	email	• PPA requested login and password.	• PGS sent stakeholder website login and acknowledged the meeting on the following day.
			06-Sep-2016	email	• 7 Sep 2016 PPA informed PGS not available to meet. • PPA queried PGS use of the word re-jig.	• 6 Sept 2016 PGS sent PPA a draft protocol and minutes for their review and approval. PGS requested a meeting with PPA for Friday afternoon if available.
			08-Sep-2016	email	• No response from PPA.	• 8 Sept 2016 PGS confirmed the summary is not a re-jig, but formalised into a draft document. • PGS requested PPA highlight the two areas of potential concern for the POMF, located south of 80 Mile Beach.
			13-Sep-2016	email	• No response from PPA.	• PGS requested meeting with PPA.
			13-Oct-2016	email	• No response from PPA.	• PGS forwarded an amended meeting minutes and protocol to the PPA, with a map showing the Eighty Mile Beach (south- Port Hedland) boundary changes made in response to PPA's request. • PGS forwarded the PPA a map showing the boundary changes made to Rollo OA as per PPA recommendations. • 14 Oct 2016 PGS updated protocol and map and re-sent to PPA

			19-Oct-2016	email	• 20 Oct 2016 the PPA thanked PGS via email: *Thank you for updating the Rollo MS survey boundaries to accommodate the considerable pearling interests that are located along the Dampier Peninsular, which include pearl oyster fisheries and a number of pearling leases, the fishery around the Turtle islands and the amendment of the MSS boundary in the Northern Kimberley, which is adjacent to a number of pearl farms.* *With respect to the Dampier Peninsular and the significant risks Seismic energy could provide to pearl production in a pearl culture context in the absence of science that says otherwise, we appreciate PGS undertaking to remain outside the 60m isobath, and also staying outside the 80m isobath at 80 Mile Beach which is home to Pinctada maxima brood stock that supports the sustainability of Australian South Sea Pearl Oyster Industry.* *Not only have we appreciated the recognition and incorporation of pearling interests in the Rollo plan, we have appreciated the iterative and ongoing consultation process that has enabled us the Pearl Producers Association to access the proposed Environmental Plan on the Rollo project website. We appreciate that this consultation process is ongoing, and that you are open to feedback even after acceptance of the EP (if it is to be accepted). To this end we ask that PGS provide us with survey plans, as they are proposed.*	• 20 October 2016 PGS thanked the PPA for the positive response, informed the PPA that PGS has appreciated the positive nature of the dialogue all along. It has been a rewarding experience from my side, and I have learnt a lot during the process. • PGS confirmed that they will update the PPA with survey plans as they are proposed.
24	Recfishwest	n/a	14-Sep-2016	email	• Read receipt received.	• No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			21-Aug-2017	email	• Read receipt received.	• No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
25	Tuna West Indian Ocean Tuna Association	n/a	15-Sep-2016	email	• Read receipt received.	• No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
26	WA Department of Fisheries (DoF)	n/a	05-Jul-2016	website	• Department of Fisheries provided a receipt for the request of advice / comment on the Rollo MC MSS EP.	• PGS submitted the Rollo MC MSS Stakeholder consultation letter (first contact) via the DoF website - online submissions.
			09-Aug-2016	email	• 9 Aug 2016 Response letter received from DoF with the following feedback: • The department will only provide detailed advice on petroleum activities commencing within six months. • Where the spatial and temporal scope for an individual survey is not known, the Department is unable to provide advice at an appropriate scale.	• 15 Sept 2016 PGS responded to DoF as follows: • PGS provided stakeholders with the opportunity to review the proposed interim Rollo MC MSS Environment Plan in efforts to reduced stakeholder fatigue and increase transparency. • PGS acknowledges DoF position that advice will not be provided for the Rollo MC MSS EP, until spatial and temporal scope of individual surveys is explicit.
					• The department is concerned that for an already approved EP there is no formal, arbitrated mechanism for stakeholder and relevant person' feedback to influence the scope or timing of these individual surveys prior to them being undertaken. • The department objects to the current proposal and requests that this position is communicated to the regulator (NOPSEMA). • The Regulator should also be advised that the department and its stakeholders will provide targeted advice and comment as we have for previous seismic survey proposals, as the scope of this proposal is further refines. Department requests that all impacts as described above and any objections or claims raised by stakeholders, are included in the EP submission.	• PGS is surprised that the Department objection to the proposed Rollo EP is in part 'based on there not being a 'formal, arbitrated mechanism for stakeholder and 'relevant person' feedback to influence timing of surveys'. • During the meeting on 11 July 2016, PGS discussed what they are doing differently for this EP and the effort being undertaken to meet with as many fisheries as possible who may be fishing within the Rollo operational area. • The meetings have been well received by the fishing community, including WAFIC.Meetings with individual fishers, including WAFIC covered the following discussion topics: • • Increasing transparency by providing stakeholders with the opportunity to review the proposed interim Rollo MC MSS Environment Plan Working with licence holders to develop Fisheries Interaction Management Plans defining agreed operating protocols, with commitments such as: Agreed notice periods acceptable to individual fishers ahead of the commencement of any project under the Rollo EP that may impact their fishing operations. Fishers will be invited to suggest the preferred direction of seismic coverage such that it might minimize impacts on planned fishing activities, provided such plan does not impose an unreasonable cost burden on PGS Boat to boat communications protocols will be developed for safe offshore cooperation.

						Extending an invitation to a representative of the fisher/fishery will be invited to visit the operating vessel when working within the fishers fishing zones. This is done in the spirit of transparency, and with a view to enhancing mutual understanding between the industries. Research – PGS will request voluntary contributions from all purchasers of Multiclient data acquired under the Rollo EP, with such funds to be directed towards seismic/fishing interaction researcho Chase Boats – when substantially operating in fishers active fishing zones, PGS will favour the chartering of a chase boat from the fisher, subject to availabilityo Providing bathymetric data where available within the relevant fishing zones from its existing 3D data library. Providing raw data from its sounders when acquiring seismic within fisher's fishing zone that could be of future benefit to the fisher. Licence holders can request access to a web based near real time acquisition map along with a 72 hour forward plan Approximately every six (6) months an update of activities associated with the Rollo MC MSS EP will be updated on the PGS EP website.Following on from the meetings, PGS has developed cooperation protocols and ongoing consultation plans for the individual fishers we have met with. Fishers were also invited to comment on and participate in the revision and editing of the protocols prior to the inclusion in the Rollo MC MSS EP, which will be submitted to NOPSEMA for acceptance. • PGS informed DoF which fisheries licence holders and representative bodies have thus far, participated in face-to-face meetings.
		21-Sep-2016	21-Sep-2016	email	• DoF confirmed receipt of the update letter and requested a login and password in order to read the background information for the CSEM.	• PGS provided website login.
			24-Oct-2016	email	• DoF requested PGS to direct them to the Section in the EP that clearly explains how the CSEM technology works.	• PGS provided specific EP Sections to DoF: • Rollo EP Chapter 3 contains survey parameters and survey techniques. For the CSEM surveys, Chapter 3 - Section 2.3 contains survey parameters and background information on the Electromagnetic source and electromagnetic streamer cable.
			8-Nov-2016	email	• DoF informed PGS: • They were hoping to get a better understanding of the electromagnetic survey technique and the potential impacts to fish, are you aware of any research that has been undertaken, and how do this compare to the use of noise.	• PGS requested information from DoF regarding the agenda for the DoF PGS meeting. • Following the meeting PGS provided DoF with the following electromagnetic survey reference papers: • A copy of the IAGC Electromagnetic Survey Risk Assessment 2011. • Copy of reference paper titled Effects of Electromagnetic Fields on Fish and Invertebrates (Shultz et al., 2010), where research has been undertaken on captured Coho salmon. • The second report is not referenced in the Rollo EP as the fish were exposed to much higher EM fields than the levels proposed in the Rollo EP. • Fish were exposed to 3mT Millitesla mT or 3,000 Microtesla (µT) in a 24 inch cube (or 0.6 m) compared to the proposed Rollo CSEM survey which is predicted to generate 0.04 Millitesla (mT) or 40 Microtesla (µT) in at 5 m from the source.
			7-Mar-2017	email	DoF provided PGS with the following additional comments regarding the survey: • Seismic component of the survey In December 2016, the Department facilitated a risk assessment workshop examining the potential impacts of seismic air gun surveys on finfish and invertebrates. The outcomes from this workshop are currently being finalised, and will be published by the **end of June 2017**. In the interim, and in line with the preliminary assessment undertaken at the workshop, the *Department formally objects to any seismic surveys being undertaken in waters less than 50m in depth*. This objection is based on scientific evidence in published papers that relate to unacceptable impacts to sessile and mobile invertebrates and finfish stocks. The Department expects that titleholders will undertake their own impact assessments relevant to finfish and invertebrates in WA for seismic survey activities. The Department also expects that key spawning times for major species published in the Department's guidance statement[1] are also considered in the impact assessment. This includes referring to published scientific literature around spawning locations/ preferred habitats and species behaviour for finfish indicator species[2] and key invertebrates species.	• PGS responded to DoF: • The complete Rollo EP has been made publicly available, which includes a thorough impacts and risk assessment and all mitigation measures and controls proposed. • PGS responded to NOPSEMA's latest Opportunity to Modify at the end of February 2017. • The updated EP will be made available to stakeholders within a weeks' time. • We are currently preparing an update letter to inform stakeholders of the proposed changes to the EP and when the EP will be available for stakeholder review. • PGS believe that the updated EP provided to the Department addresses all impacts to fish and invertebrates and details the mitigation procedures and controls which will be implemented to minimise impacts and risks to the receiving environment.

					During the consultation process, sufficient information should be provided to the Department to allow an informed assessment of planned activities and possible consequences to fish stocks, including the assessment of known and potential impacts to fish stocks based on the scientific literature. This information may also need to be provided to WAFIC and fishers if requested during consultation. 1- *Guidance statement on undertaking seismic surveys in Western Australian waters* http://www.fish.wa.gov.au/Documents/occasional_publications/fop112.pdf 2- *Resource Assessment Framework (RAF) for Finfish Resources in Western Australia* http://www.fish.wa.gov.au/documents/occasional_publications/fop085.pdf • Electromagnetic component of the survey The Department formally objects to the proposed electromagnetic survey. This objection is based on the limited scientific evidence in published papers that could appropriately inform your impact assessment and therefore there is the potential for unacceptable impacts to sessile and mobile invertebrates and finfish stocks. Given the use of electromagnetic technology, the Department requests that PGS/Scope Resources include in its impact assessment information relevant to finfish and invertebrates in Western Australia. Consultation with relevant scientists to understand the potential impacts should also be undertaken to further inform your impact assessment, for example Professor Shaun Collins is a world leader in comparative neurobiology and vision with a particular focus on sharks, and as you may be aware sharks and rays can detect electrical signals. The Department requests a written response that: • Addresses all impacts to fish and invertebrates described above; and • • Details strategies that PGS will implement to mitigate or minimise these impacts or address unacceptable known impacts	
			19-Apr-2017	email	• DoF contacted PGS: • Currently reviewing all open files and, with respect to the PGS / Rollo Multiclient Marine Seismic and SCEM Survey, noted that NOPSEMA finalised their decision on the second draft of this proposal on 29/3/2017 and requires some additional information and/or changes to the proposal before re-submission. I understand that the comments provided by the Department (as set out in the email below) were received after you had already submitted the second version of the proposal. • Given that there may be some changes to the third version of the proposal that we may wish to provide additional comment on and also given the Department's concerns with respect to this proposal in general (as set out in the below email) we request an opportunity to comment on the third version of the proposal prior to submission to NOPSEMA. I hope that this request can be accommodated. • You had provided access to the full EP, in acknowledgement of the concerns around the SCEM component of the proposed survey. If that offer is still on the table, I would much appreciate the extra info on this component (and current knowledge of the effects of SCEM on marine life) as well. Thank you.\ • Once I've had some time to come to grips with the EP-related work I think it might pay to catch up for an informal chat if that suits you. Perhaps early to mid-May sometime? • DoF informed PGS they will be in touch in a couple of weeks to set up a meeting.	• PGS responded to DoF: • PGS agree that it would be good to catch up informally around the time suggested. • Informed DoF that the previous log in should still work: • Re provision of next version, will determine what relevant sections will be updated, but it may be more efficient to send you relevant excerpts once ready rather than waiting for the whole revision.
			10-May-2017	email	• DoF provided PGS with availability.	• PGS requested a meeting with DoF.
			18-May-2017	email	• DoF confirmed receipt of the login and provided PGS with email. • DoF confirmed receipt of the WAFIC APPEA MOU.	• PGS provided DoF with a new login to EP website. • PGS provided DoF with WAFIC APPEA memorandum of understanding
			31-May-2017	email	• DoF Informed PGS: • Another request has been sent for additional guidance on red emperor and goldband snapper, but am not confident this work has been completed as yet. When it comes through I'll forward it immediately.	• PGS provided DoF with response sent on 8 March 2017. • PGS acknowledged DoF request to review PGS' Rollo EP prior to the final re-submission to NOPSEMA. PGS has provided log in to access to the Rollo EP website. • PGS would like to request from the Department information regarding spawning areas and times for the key species fished in the Northern Demersal Scalefish Fishery (NDSF). Northern Wildcatch has identified Goldband snapper and Red emperor as being the key indicator

					• From our meeting I understood that the Department would be notified when the revised EP was ready for consultation before submission. I didn't get the idea the EP had been finalised and access to the EP was merely provided for background info. • In order for consultation to be appropriate as well as effective, the Department (i) needs to be formally informed when a revised EP is to be submitted, (ii) given all relevant information required to make an informed assessment of risks/impacts and (iii) given a reasonable timeline to for this assessment to be completed before submission. It is my understanding that none of this info (apart from what was provided for the meeting) has been provided to date. • Can you please ensure that the appropriate consultation process is followed? I have plenty of work on at the moment and need proponents/consultants to be clear and concise in what they are proposing, what they require from the Department and when this advice is required. Thank you!	species for the NDSF. Unfortunately Northern Wildcatch was not able to meet face-to-face during an Adelaide visit by PGS to discuss the concerns of the NDSF prior to his sending the last correspondence. It would be ideal to get this data from DoF prior to continuing our discussions with Northern Wildcatch. • Any additional information regarding spawning timing and / or sensitive spawning areas for the key indicator species of the NDSF fishery will help inform PGS when implementing additional management controls and operational commitments in the Rollo EP. It would also provide a good opportunity to demonstrate to DoF how PGS can use this data for an EP submission, yet still be able to consider future DoF inputs should new data result in amended information being available.
			6-Jun-2017	email	• DoF requested information on Rollo EP proposed timeline.	• PGS informed DoF: • PGS EP is currently being revised and at this stage we do not have a completion date. However, we will inform the Department as soon as we have one, alternatively we can send through sections of the EP once they are completed.

			14-Jun-2017	email	• No response received from DoF.	• PGS requested a meeting with DoF to discuss the recent requests put forth by Northern Wildcatch Seafood Australia. For your reference please see attached email correspondence received by one our clients.
						• As you are aware Scope Resources is currently working with multiple clients on large scale strategic seismic and electromagnetic surveys Environment Plans. For this meeting our clients will not be attending and therefore we do not wish to discuss individual projects. We are not seeking views on acoustic impacts or seismic surveys.
						• Scope consultants will attend and we would like the focus of the discussion to be on understanding the fishery and target species.
						• In particular we are seeking clarification regarding the Kimberley, Pilbara and Gascoyne Demersal Fisheries key indicator species, Goldband snapper and Red Emperor:
						  ○ spawning timing
						  ○ sensitive spawning areas
						  ▪ how this relates to zones of the fisheries
						• larval development and nursery areas

			22-Aug-2017	email	• Read receipt received.	• No action is required from PGS regarding this response. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
		7-Sept-2017 14-Sept-2017	7-Sept-2017	email	• DoF requested access to the Rollo EP.	• PGS provided DoF with link to download the EP via DropBox
				email	Response from DoF received	
		7-Sept-2017	7-Sept-2017	email	DoF requested access to the Rollo EP.	PGS provided DoF with link to download the EP via DropBox
			14-Sept-2017	email	Thank you for the consultation package provided on 18 August 2017 in relation to the revised PGS Rollo Multi-Client Marine Seismic and CSEM Survey and for access to the EP (Rev 4). The Department of Primary Industries and Regional Development Fisheries Division (Fisheries) considers itself a 'relevant person' and provided preliminary feedback during our meeting in May 2017. We have considered the information provided and provide the following comments: Fisheries facilitated a qualitative assessment of risks posed by seismic surveys on finfish and invertebrates in December 2016. This took the form of an ecological risk assessment (ERA) workshop that was attended by representatives of all key stakeholders. The consensus risk levels agreed to on the day indicated that airgun arrays with capacities between 2000 and 4500 cui pose a 'high' or 'severe' risk of impact to demersal fish and both mobile and immobile invertebrates in shallow waters <100 m depth (and for immobile invertebrates and demersal fish up to 250 m depth) and directly in the path of a seismic vessel. These risk levels recognise the considerable degree of uncertainty that exists around seismic-related impacts and we expect them to be recognised by proponents.	On 9 October 2017, PGS thanked the Department for their review of the EP and provided the following responses to the concerns and questions raised: PGS appreciated Fisheries carrying out this workshop but believes that there were significant biases given the attendees. There was certainly no consensus on risk levels (as suggested above), but rather a weight of numbers and hence the introduced bias. The workshop's risk assessment may be useful for internal guidance and highlighting areas that need further research, but PGS argues that our current practice of using peer-reviewed, scientific literature to inform and support environmental impact and risk assessments take precedence. Chapter 3 contains the full methodology description for the environmental risk assessment.

					2. Fisheries appreciates the various changes made to the proposal and acknowledges PGS' effort in addressing its concerns. The proposed spatial and exclusion buffers is one example of a change that goes some way to address some of Fisheries' major concerns. However, Fisheries generally objects to 'strategic' EPs, i.e. EPs that typically are in place for two or more years and cover very large areas and 3D surveys that are poorly defined in terms of survey area location (within the project envelope), start date and duration. Strategic EPs increase risks to fisheries and aquatic resources and reduce the capacity of Fisheries to make an informed assessment of the potential consequences and ensure proponents are provided with project-specific and up-to-date advice. The Rollo MSS is an extreme case as it includes proposed activities in shallow waters over an enormous area with a relatively high capacity airgun array within a 5-year timeframe. Fisheries is of the view that the risks of impact to aquatic resources and fisheries associated with the possible seismic activities are not adequately assessed in the EP (as provided) and, hence, potentially underestimated.	1. PGS disagrees that strategic EPs increase risk to fisheries. The existence of the EP does not drive the amount of seismic activity. Demand from oil companies drives the amount of seismic data acquired within any period, and this will be spread over various EPs and various seismic service providers. If an EP timeframe up to two years is acceptable to Fisheries, the additional timeframe of up to five years should not have a significant effect. The key is to assess environmental impacts and risks over a full calendar year and for all temporal variables. Once achieved, any EP activity must adhere to regulatory requirements to assess new information routinely. PGS believes that the Rollo EP contains an accurate and robust environmental impacts and risks assessment to aquatic resources and fisheries. Furthermore, the control measures are conservative, precautionary and adaptive to ensure adequate and appropriate protection to the receiving, marine environment. Both Chapters 2 and 3 include environmental impacts and risks assessment for aquatic resources and fisheries.
					3. In this case, Fisheries is expected to be able to make an informed assessment of the possible consequences of the 'worst case' survey within the proposed project envelope of more than 830,000 km2, given poorly-defined survey activities. The following is noted: a. 3D seismic activities will be capped at 35,000 km2 per year – allowing a number of 3D surveys covering a total of 175,000 km^2 in the five years of the plan. In order to get a sense of the potential duration of a 35,000 km^2 3D seismic survey, Fisheries assumed an area 250 x 140 km with acquisition lines 500 m apart and a vessel speed of 4.5 knots which led to 500 lines of 140 km in length being sailed in ~350 days. Assuming 5% extra for steaming time (between lines): ~ 365 days, i.e. an entire year. According to this calculation it will be possible for seismic activities to be conducted uninterrupted for 5 years – covering 175,000 km^2. Fisheries notes that surveys of this spatial and temporal scale are inappropriate in waters off Western Australia where available information on (even) key species is typically incomplete. Without accurate data on key ecological characteristics such as spawning grounds, spawning times and the distribution of key habitats, 3D seismic surveys at such massive spatial and temporal scales have a markedly increased risk of, inadvertently, causing a significant adverse effect on aquatic resources and/or fisheries by potentially enveloping a number of key habitats or fishing grounds over an extended period of time (e.g. over entire fishing seasons, spawning periods, etc.). Fisheries is of the view that the precautionary principle should steer proponents towards smaller seismic survey areas and shorter durations (with appropriate intervals between surveys conducted in the same broader area) in order to ensure that risks and potential impacts are ALARP and acceptable.	2. PGS is required to provide sufficient information in order for all stakeholders to achieve an informed assessment and believes that the assessment PGS itself completed demonstrated that this is achievable. Further, it should be kept in mind that the total surveyed area would be acquired slowly and sequentially over time, and potential environmental impacts are localised and temporary at any point in time. The entire survey area would not be surveyed simultaneously, with the potential for seasonal adjustments in location and line plan. As the vessel moves at slow speeds along designated survey line paths, recovery from any impact commences. Respectfully, PGS believes that these are two, separate issues. PGS agrees that more research would be invaluable and thus developed a multi-client sales process (in conjunction with stakeholders) that will hopefully create a funding resource to support future research. However, the lack of this data does not change how the appropriateness of a large or small survey is assessed. PGS agrees that accurate data are required for environmental impacts and risks assessment. However, the converse of not having accurate data does not preclude implementation of conservative and precautionary control measures and mitigation procedures that protect the receiving marine environment, such as those contained in the Rollo EP (see Chapters 2 and 3). By historical and world-wide standards, the proposed scope is far from massive, either spatially or temporally. The activity proposed, as you have calculated, effectively only equates to one seismic vessel in operation per year. Even if five different titleholders proposed collectively this equivalent amount of work, this would only equate to five seismic vessels each year. In normal market conditions, it is not at all unusual for five seismic vessels to be operating in an oil and gas province of this size. PGS assessed cumulative impacts within the EP to ensure to address such concerns (e.g. appropriate intervals between surveys conducted in the same area) and mitigate potential environmental impacts and risks. For example, based on the best available scientific data and industry standards and best practice, cumulative impacts and risks from acoustic exposure were assessed and relevant control measures were justified in Chapter 2 Section 3.3.2 Underwater Noise Emissions from Discharge of Acoustic Array.
					b. No information is provided on the timing of a survey other than it occurring within 5 years of acceptance of the EP. Within this timeframe the status of key aquatic resources may change considerably due to changes in both environmental events/conditions and anthropogenic pressure. This makes determining (or limiting) the potential consequences of seismic activities, in the context of cumulative impacts, extremely difficult.	Changes may occur within days of EP approval and regardless of the size or duration of the activity. As such, government regulations are designed to ensure that proponents assess and evaluate all new information appropriately. PGS developed an Implementation Strategy for Environmental Management Framework, including a detail Pre-survey Planning process that requires an in-depth review of all new information relevant to the activity as well as subsequent risk assessment to consider all control measures and mitigation procedures (Chapter 3 Section 4). Thus, determining the potential consequences of seismic activities, particularly in the context of cumulative impacts, is undertaken routinely before each survey commences. Also, NOPSEMA undertakes routine inspections and audits to ensure compliance with these requirements.
					c. Once the EP is accepted, PGS proposes to inform stakeholders of new 3D surveys 4 weeks before commencement. This timeframe is barely long enough for stakeholders to review information and provide comment let alone for the proponent to consider and address comments and adapt the survey parameters should there be merit to do so.	If PGS routinely assesses new information as it arises and subsequently disseminates this assessment with all relevant persons, then there will be no critical timing issue ahead of a survey commencing. Also, the protocols established with various fishers have set in motion an agreed means of pre-start communications, demonstrating acceptability by relevant commercial fishers.

						The Stakeholder Consultation Plan is detailed in Chapter 1, and pre-survey planning is described in Chapter 3.
					d. No information is provided on proposed 3D survey boundaries, i.e. the location of the 3D survey areas within the envelope (or the shape of the survey areas). It may be appreciated by the proponent that it would take a considerable amount of effort on Fisheries' behalf to come up with a series of worst case surveys (shape and timing) to assess the worst possible consequences of the proposed activities as covered by this EP. It should, evidently, not be the responsibility of Fisheries to determine the worst possible case, only to go through the exercise again at every new revision of the EP.	Agreed, and as discussed above, the Rollo EP's Stakeholder Consultation Plan (Chapter 1) will ensure that sufficient information will be provided to all relevant persons before each survey commences.
					e. No information is provided on cumulative impacts. One or more other proponents may imminently be submitting strategic EPs covering seismic activities in an area with a large amount of overlap with the NWSR North MC MSS area. It is impossible for Fisheries (or any other stakeholder) to make an informed assessment of the possible consequences of seismic activities covered by numerous strategic EPs in the face of so much uncertainty and plasticity and over time periods extending over multiple years. Note also that a cumulative impact assessment should include consideration of pressures from all relevant sources (not just impacts associated from other seismic surveys), which – at least – may lead to the identification and/or refinement of "environmental windows of opportunity". For example, if estimated impacts on molluscs are expected to leave a significant proportion of a population/stock vulnerable to increased mortality (as suggested to be a possibility by Day *et al* 2016), then any other pressures (e.g. dredging plumes, high water temperatures) should be avoided, which may have consequences for when surveys are best conducted.	As stated above, PGS completed an accurate and robust environmental assessment on cumulative impacts and risks in Chapter 2, justification for all control measures, and an accurate Description of the Environment with all vulnerable and sensitive marine receptors and fauna species. We acknowledge that there are some limitations in how this can be assessed across multiple projects, but that is not a limitation unique to strategic EPs. And again, the pre-survey planning process will ensure than an accurate environmental risk assessment is undertaken before each survey commences, as well as stakeholder engagement and consultation.
					4. Several recent and relevant reports have demonstrated that hitherto generally accepted assumptions may have led to the underestimation of potential impacts, e.g. Day *et al* (2016) RE lobsters and scallops (crustaceans and molluscs) and McCauley *et al*. (2017)/Richardson *et al* (2017) RE zooplankton. The findings of these very recent Australian studies are relevant to Fisheries and it expects concerns flowing from the results to be appropriately addressed in risk assessments (in EPs). Some examples of sections in the EP that could better reflect these findings: a. Section 3.2.2.2 Description of risk of the EP (summarising the risks associated with underwater noise emissions from the airgun array in general) states: "It should be noted that mortality and pathological damage has not been observed and the assessment is based on a theoretical worst-case scenario." However, both mortality and/or pathological damage in lobster and scallops have been reported (Day et al. 2016, also see next point) as has significant pathological damage in fish – both after exposure to sound levels expected to be encountered during the Rollo MSS. For instance, extensive damage to the sensory hair cells surrounding the otolith in pink snapper (WA) – resulting in hearing damage lasting at least 58 days – was observed after fish had been exposed to sound levels approximately 185 dB re 1µPa mean squared pressure (McCauley et al. 2003, Rob McCauley pers.comm.). This level of exposure is commonly achieved hundreds of meters from a seismic source with similar capacities as proposed here. b. The potential impacts on benthic invertebrates also appear to be under-represented in the EP. Fisheries considers the findings of Day et al. (2016) to be broadly relevant to crustaceans and molluscs and expects these to be adequately considered/discussed in the context of benthic invertebrate taxa found in the proposed survey areas. This Australian study is important as it was conducted in the field and effort was made to reflect realistic sound exposure levels associated with, and the ground excitation produced by, a commercial seismic survey.	PGS disagrees and completed a thorough and robust acoustic impact and risk assessment for benthic invertebrates, including an exhaustive literature review and detailed analysis of the Day et al. (2016) research findings (Chapter 2 Section 3.3.2.7). PGS agrees that the Day et al. (2016) study was important and invested a significant effort to incorporate its results into the Rollo EP. This assessment was in addition to more than 20 other scientific publications that discussed impacts to benthic invertebrate species, such as snow crabs, prawns, rock lobsters, molluscs, clams and the pearl oyster. Similarly, PGS completed a comprehensive environmental impact and risk assessment for fish based on more than 20 different scientific publications (Chapter 2, Section 3.3.2.8), including an assessment of the McCauley et al. (2003) research. PGS understands and agrees that impacts are likely to occur, however the extent and severity of these impacts range beyond the results of one publication and were considered collectively in the Rollo EP. Finally, PGS developed conservative and precautionary control measures and stakeholder engagement protocols to ensure that these impacts and risks are ALARP and acceptable.
					c. In relation to impacts on zooplankton, section 3.2.2.9 of the EP does not acknowledge the findings of McCauley *et al* 2017 and Richardson *et al*. 2017, resulting in an underestimation of potential impacts. Only Attachment 2 of the information package provided contained a review of these findings, which fell short of addressing Fisheries' concerns flowing from the 2017 McCauley et al. paper and the Richardson CSIRO modelling study. For example: • The review fails to mention that the significant impacts on zooplankton as reported by McCauley *et al*. (2017) occurred at intensities ≥178 dB re 1 µPa PK-PK and, instead, uses 207 dB re 1 µPa (SPL peak) without explanation.	c. PGS will reduce the maximum source array size to 3,260 cu in. The recent attachment provided the current assessment of acoustic impacts to zooplankton and was sent separately to highlight this new section and to assist stakeholders in their review. Please be assured that this will be included in the Rollo EP. Also, the estimated horizontal distances were provided in the assessment (and likewise the Rollo EP) and based on JASCO Applied Sciences (JASCO) accurate and robust underwater modelling for the array and at several locations within the OA (Chapter 2). These impact distances were based on the accepted acoustic threshold criteria for mortality and injury in fish eggs and larvae, which is Popper et al. 2014. However, for comparison, the JASCO

					The review fails to give an assessment as to how far from the source (4120 cui) this sound intensity is expected to be achieved, noting that the smaller array modelled by CSIRO (3000-3200 cui) was estimated to achieve this level at 2.5 km from the source	results have similar predictions for received sound levels at approximately 2.5 km from the source. Finally, PGS advises Fisheries that comparing airgun array volumes requires caution, as the volumes sizes do not increase on a linear scale (See Chapter 2 Section 3.2.2.6 Sound Source Justification for further details). However, PGS appreciated Fisheries' concerns and have taken the initiative to provide further analysis and modelling to address this specific concern. After our meeting (19 September 2017), PGS commissioned JASCO to model the acoustic signatures for a 3,260 in3 array and compare these signatures to those of the other arrays in the EP – 4,130 and 3,090 in3. In terms of peak pressure levels in the broadside direction, the level for the 3260 in³ airgun array was only 0.2 dB less than the equivalent for the 4130 in³ array, so ensonified areas are likely to be similar. Thus, based on independent, expert modelling results, PGS are confident that reducing the array would not provide significant environmental benefit and that the received sound levels from the 4,130 in³ array is ALARP. The full Technical Note is attached below.
					The review fails to give an indication of the scale and duration of the impact on zooplankton populations and availability in the survey area. Such an assessment would require the proponent to scale up the results of the CSIRO modelling, given that the CSIRO study assumed a survey area of only 2,900 km^2 with a duration of just 43 days while the proposed EP covers seismic activity occurring in blocks of 35,000 km^2 each for up to 12 months each (based on 'worst case' figures as set out above). Presumably this could result in reduced availability of zooplankton within these blocks over the duration of the survey.	PGS disagrees with this comparison, as comparisons of survey areas in square kilometres are more complex and depend more on survey line plans. As per the CSIRO review, longer lines will result in a lower impact so assessing larger areas will result in an improved model. Also, the Rollo EP contains a cumulative impact assessment and will implement control measures to ensure that acoustic impacts are reduced to ALARP and acceptable levels. These control measures include but are not limited to exclusion zones, using a racetrack method and both spatial and temporal restrictions on adjacent lines (e.g. 24 hour limit and 10 km spatial distance between adjacent lines).
					The review fails to outline what the potential consequences are of this scale of impact to aquatic resources and fisheries, especially when the 3D surveys are conducted at the worst possible time at the worst possible location within the project envelope.	The Rollo EP contains a full environmental impact and risk assessment to commercial fisheries and catch rates (see Chapter 2 Section 3.2.2.3). Furthermore, PGS made significant efforts to engage with fishers, discuss concerns and agree to communications protocol and temporal restrictions. Thus, the Rollo EP will implement temporal restrictions in certain fisheries as a result of consultation with fishers.
					The review also fails to investigate the risk of impact to ecosystem function and integrity, given that the plausible cause of mortality in invertebrate zooplankton as suggested by McCauley et al. (2017) may also occur in similarly vulnerable epifaunal/infaunal taxa with presumably longer-lasting effects.	PGS and others (i.e. Richardson *et al.,* 2017) agreed that impacts to zooplankton on a localised scale are likely to occur. However, the suggestion from McCauley *et al.* (2017) for large-scale modifications to the ecosystem were not based on the data measured in the study. Rather, Richardson *et al*. (2017) completed modelled simulations to determine if potential large-scale impacts are possible, the results of which only confirmed localised impacts and not on a regional scale. Thus, the Rollo risk assessment evaluated the best available scientific data, which included both the McCauley *et al* (2017) and Richardson *et al.* (2017) conclusions based on the results measured.
					5. With respect to the impact on key fish species, the EP notes that for 'pelagic species and the more nomadic demersal species' of fish (section 3.2.2.10 of the EP), avoidance may be expected at >140 dB re 1 µPa2·s. This level is expected to be exceeded within approximately 3km from the source. In combination with findings suggesting large-scale migration of fish out of survey areas for the duration of a survey (e.g. Engas et al 1996; Lokkeborg and soldal 1993; Kenchington 2000), there appears to be a significant risk of impact on spawning success and/or fisheries in the context of the worst case 3D surveys. For example, it may be reasonable to assume the principal goldband snapper depth range to be 80-140 m and the total area of this preferred habitat for the north Kimberley goldband snapper stock to span 94,000 km2. One scenario (possible under the EP) would see 5 consecutive surveys (each with a duration of 12 month) each overlapping 20% of the north Kimberley snapper spawning habitat. Should this result in mass migration out of the impacted area, then spawning success could be depressed for a period of five years.	As discussed above, the Rollo EP contains a full environmental impact and risk assessment to commercial fisheries and catch rates (see Chapter 2 Section 3.2.2.3), and PGS made significant efforts to engage with fishers, discuss concerns and agree to communications protocol and temporal restrictions. Thus, the Rollo EP will implement temporal restrictions in certain fisheries as a result of consultation with fishers. Specifically for the Northern Demersal Scalefish Fishery (NDSF), the following control measures will be implemented: • No 3D surveys will be conducted in the NDSF Zone B during October and during March. • Outside of this temporal restriction, the maximum area that can be acquired as part of a single 3D survey in Zone B of the fishery is <5% overlap). I.e. the maximum 3D survey area for a single survey will be <3,700 km2 per year. • In the event that new information regarding the timing and area of spawning of key target species (e.g. goldband snapper and red emperor) is identified, acquisition plans will be reviewed in line with Chapter 3 Section 4.1.1. Also, please know that the total survey area would be slowly acquired over time, and associated impacts would be localised and temporary at any point in time.
					On the basis of the above, and unless all concerns can be appropriately addressed by the proponent, Fisheries objects to the proposed Rollo Marine Seismic Survey and CSEM.	As discussed, PGS has gone to considerable lengths to engage and consult with a large number of potentially affected fishermen and has positive protocols in place. In addition, as discussed, PGS offers the following: • Full access to the EP via the project site • Commercial opportunities for the most affected fisher in any one project area

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• Sharing of bathy and raw sounder data with fishers, along with temperature and salinity data if requested
• A mechanism that may result in research funding being generated
• A commitment to proceed with the attached pilot study with CSIRO upon commencement of the first project under this EP
• A commitment to proceed with routine plankton sampling during the first seismic project to compares live/dead rations source on/source off as discussed, subject to CSIRO developing a simple and cost effective protocol to guide such work
• Make reasonable efforts to seek industry funding to cover the costs of testing a prototype of PGS marine vibrator as an alternative source of marine seismic.
So while PGS accepts that you may not support strategic EPs generally, PGS would appreciate Fisheries' consideration for qualified support of many of the elements we bring to this EP. PGS maintains that strategic EPs prepared well will reduce stakeholder fatigue without eroding stakeholder rights which remain protected by the regulations.
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<td rowspan="2">27</td>
<td rowspan="2">WA Department of Mines and Petroleum</td>
<td rowspan="2">n/a</td>
<td rowspan="2">29-Sep-2016</td>
<td rowspan="2">email</td>
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• 29 Sep 2016 WA Department of Mines and Petroleum (DMP) acknowledged receipt of the stakeholder consultation letter relating to the PGS Rollo Multi-client MS and CSEM Survey to be conducted in Commonwealth waters.
• DMP requests further information about this proposed survey work as detailed in the DMP Consultation Guidance Note:
http://www.dmp.wa.gov.au/Documents/Environment/ENV-PEB-176.pdf
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• 5 Oct 2016 PGS responded to the DMP, and resent DMP the original Rollo stakeholder correspondence letter (first contact) sent to DMP which contained the following information targeted to DMP:
<u>Proximity of operational area to Western Australian State waters</u>
• The closest point of proximity to WA State waters is ~6km.
<u>Survey Coordinates</u>
• PGS has attached the GIS shape files for the Rollo MS MSS Operational area along with this email correspondence.
<u>Provide details on spill zone of potential impact</u>
• The Rollo MC MSS EP Chapter 2 contains the complete Oil Spill assessment, including zones of potential impact.
<u>Confirm survey vessel (or acoustic streamers) will not enter WA state waters at any time during the survey and how this will be achieved</u>
• During seismic operations the survey vessel and equipment will not enter WA State waters, unless in the event of an emergency. The following Environmental Performance Standard (EPS) has been included in the EP and therefore can be inspected for conformance by NOPSEMA at any time during and after operations.
<table>
<tr><td>39</td><td>No acquisition in water depths shallower than 39 m isobath.</td><td>Records of incidents involving the discharge of the seismic source within the 39 m isobath (chart depth)

Records of any non-compliance</td></tr>
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<u>Environmental incidents that have the potential to impact state waters will be reported to the relevant state regulators (including but not limited to the Department of Mines and Petroleum)</u>
• The Rollo MC MSS EP Chapter 3 contains the complete Oil Pollution Emergency Plan.

Within 24 hours of the oil spill event, the PGS VM will contact the DoE regarding any impacts to protected marine fauna. Therefore, in the event of an oil spill in Commonwealth waters that is determined a reportable incident, the PGS VM will be responsible for the following communications:

1. If determined a reportable incident, contact NOPSEMA within two hours.
2. Contact DoE within 24 hours.
3. Provide written report to NOPSEMA within three days.
4. Provide copy of the written report to NOPTA and relevant WA State departments (i.e. DMP, DoT and DPaW) within seven days of the incident.
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• Specifically DMP requested details on the following:
a) Provide a description of the receiving environment;
b) Provide a summary of the major environmental hazards;
c) Confirm if the survey vessel or streamers will be entering state waters at any time during the survey. If not could you please confirm how close the proposed survey comes to Western Australian State waters?
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<td>
a) Chapter 2 Section 2 of the Rollo MC MSS EP contains a thorough description of the receiving environment.
The Rollo EP operational area is located entirely within Commonwealth waters, offshore from WA from Shark Bay to Wyndam.
b) See Appendix 1D for the table of major environmental hazards provided to DMP.
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					d) Confirm the zone of potential impact from a spill; • DMP notes that the letter accompanying the email states that access to the full Environment Plan is available upon request. DMP does not require access to the full Environment Plan but would like clarification (an email will suffice) on the points mentioned above.	c) Confirm if the survey vessel or streamers will be entering state waters at any time during the survey. If not could you please confirm how close the proposed survey comes to Western Australian State waters? During seismic operations the survey vessel and equipment will not enter WA State waters, unless in the event of an emergency. The following Environmental Performance Standard (EPS) has been included in the EP and therefore can be inspected for conformance by NOPSEMA at any time during and after operations. **39** | No acquisition in water depths shallower than 39 m isobath. | Records of incidents involving the discharge of the seismic source within the 39 m isobath (chart depth) Records of any non-compliance d) Confirm the zone of potential impact from a spill; • Section 1: Shark Bay to Point Cloates - 44 km ZPI in Winter • Section 2: Point Cloates to NWC - 35 km ZPI in Winter • Section 3: NWC to Broome (Gantheaume Point) 30 km ZPI in Winter • Section 4: Broome (Gantheaume Point) to Troughton Island - 40 km ZPI in Summer • Section 5: Troughton Island to Cambridge Gulf - 34 km ZPI in Summer
			06-Oct-2016	email	• DMP thanked PGS for providing the information on Rollo Multiclient MS Survey & CSEM Survey Environment Plan (EP). DMP noted that the EP will be assessed under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 by the National Offshore Safety and Environmental Management Authority (NOPSEMA). • No further information is required at this stage, however please ensure that a pre-start notification is sent through in accordance with regulation 30 of the OPGGS(E)R.	• 6 Oct 2016 PGS responded to DMP request. • PGS will adhere to the DMP requests and provide pre-survey notification.
			28 Aug 2017	Email	• DMIRS confirmed the following information received from PGS: A reduction in scope: no more than two PGS surveys will be undertaken at one time no more than 35,000km2 of data acquired with 12 months ○ Increase in spatial and temporal exclusion buffers • Can you please confirm if the amended survey boundary has had any impacts on the following: • 1. Zone of potential impact from a spill? If so please provide the updated details for the zone of impact. • 2. Confirm if the amended survey boundary will now require the survey vessels to enter WA State waters?	• 6 Sept 20017 PGS responded to DMIRS and provided information as requested. • To confirm: the operational boundary of the EP has not changed since the last update letter sent out in March 2017. • In response to your queries: • *1- Zone of potential impact from a spill? If so please provide the updated details for the zone of impact.* • The oil spill information previously provided to DMP has not changed. • For your convenience here is the list of predicted ZPI provided to DMP: • Section 1: Shark Bay to Point Cloates - 44 km ZPI in Winter • Section 2: Point Cloates to NWC - 35 km ZPI in Winter • Section 3: NWC to Broome (Gantheaume Point) 30 km ZPI in Winter • Section 4: Broome (Gantheaume Point) to Troughton Island - 40 km ZPI in Summer • Section 5: Troughton Island to Cambridge Gulf - 34 km ZPI in Summer • *2-Confirm if the amended survey boundary will now require the survey vessels to enter WA State waters?* • No there are no changes to the operational area boundary and no activities will be conducted in WA State waters under the Rollo EP, vessels and equipment will not enter WA State waters, unless in the event of an emergency.
28	WA Department of Parks and Wildlife	05-Oct-2016	05-Oct-2016	email	• WA DPaW requested a login to the website.	• PGS provided website login.
			03-Oct-2016	email	• Read receipt received.	• No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
29	WA Department of Transport	n/a	14-Sep-2016	email	• Read receipt received.	• No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.

			22-Aug-2017	Email	• Read receipt received.	• No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
			5- Sep-2017	email	• 5 Sept 2017 DoT requested from PGS: information around spill risk and the mitigation measures in place to prevent this occurring. ○ Information regarding the notification procedures in place to notify the Department of Transport if a spill was to occur in/or to enter State waters.	• 6 Sept 2017 PGS responded and provided DoT website login for complete EP access. • PGS provided DoT with a table of the impact and risk assessment highlighting EP chapters relevant to DoT.
			6-Oct-2017	Email	Thank you for sending through the Rollo EP. Can you please ensure that it is captured somewhere in your spill plans that, in the event of spill occurring that has the potential to impact State waters, the Department of Transport (DoT) are notified as soon as possible. Details on reporting to DoT can be found on our website: • http://www.transport.wa.gove.au/imarine/pollution-emergency-response.asp.	• On 7 October 2017, PGS email a confirmation that this information will be captured in the Rollo EP.
30	WA Seafood Exporters	n/a	05-Aug-2016	email and phone	• 5 Aug 2016 phone message and email received from WA Seafood Exporters informing PGS of the following: a) WA Seafood Exporters have great concerns over possible damage to their fisheries and they have recently attended meetings for other surveys and noticed noise levels from the PGS array has doubled from the levels any scientific reports use to measure the negative effects. b) WA Seafood Exporters believe PGS need more science to support the applications for surveys and advised PGS they would be happy to help.	• 5-Aug-2016 PGS responded to WA Seafood Exporters via phone conversation.
			09-Aug-2016	email	• WA Seafoods advised PGS of the NTF Industry contact person.	• 9 Aug 2016 PGS advised WA Seafoods that they would follow up with NTF Industry contact and how they are aiming to help with research under the Rollo EP.
			11-Aug-2016	email	• No response from WA Seafoods.	• 11 Aug 2016 PGS advised WA Seafoods that they followed up on the Nautilus Shell with a researcher from Curtin Uni and if they were able to meet up, they would like to discuss further.
			16-Aug-2016	email	• No response from WA Seafoods.	• 16 Aug 2016 PGS sent WA Seafood Exporters a draft Cooperation Protocol and Ongoing Consultation Plan, plus a summary of the phone conversation. • Informed WA Seafood exporters phone meeting with NTF Industry the following day. • Restated that the Curtin University researcher would like to catch up regarding WA Seafoods comments on Nautilus shells.
			6-Sep-2016	email	• No response from WA Seafoods.	• 6 Sep 2016 PGS requested information as to when WA Seafood Exporters was heading to Perth.
			7-Sep-2016	email	• WA Seafoods informed PGS they just got back to Darwin yesterday and they are pretty booked up and will be back down for xmas.	• 7 Sep 2016 resent consultation plan – edits made: • Company name. • Bathymetry commitment. • NPF Industry thought concept was good, although still waiting for formal response from NPF Industry.
			7-Sep-2016	email	• No response from WA Seafoods.	• 7 Sep 2016 sought permission to pass on contact details of WA Seafoods to Curtin University researcher.
			27-Sep-2016	email	• No response from WA Seafoods.	• 27 Sep 2016 informed WA Seafoods that PGS would be submitting the EP shortly and sought confirmation that they were happy with the protocols and phone meeting summary.
31	WAFIC	n/a	02-Sep-2016	email	• WAFIC thanked PGS for the personal effort to engage on a personal and face-to-face basis with as many commercial fishers as possible who will be working and potentially be impacted in the significant area of the proposed Rollo Multi-client five year marine seismic survey (MSS). • WAFIC requested the following points being reviewed and included as part of your overall environment plan approval and stakeholder engagement requirements with NOPSEMA: 1) WAFIC does not support five-year environment plans. The time span is too great; it is our understanding that NOPSEMA audits approximately ten per cent of follow-up stakeholder engagement compliance, we believe it leaves the door wide open for less scrupulous operators to expedite MSS schedules to the detriment of commercial fishing activity. 2) WAFIC appreciates the significant effort you have taken to engage in an open and transparent manner, however, should you leave or should your contract with PGS expire, I hold concerns that your successor in this role will not exercise the same diligence and relationship development and maintenance.	• 7 Sep 2016 PGS thanked WAFIC for providing feedback and responded with the following clarifications: 1) Understood on this point. However, while I cannot speak on behalf of the regulator, I expect that if significant issues were raised that were not adequately addressed by PGS, then notification to NOPSEMA of these concerns by an organisation such as WAFIC would probably trigger an audit if NOPSEMA saw merit in the issues raised. 2) I have to admit that I have enjoyed meeting with you and your members, and agree that the relationships are important, particularly those built on trust. It is certainly important that we deliver on our commitments regardless of who is involved. Prior to commencing work on this project, I sought and gained full commitment from PGS toward what we were trying to achieve. The culture of PGS in terms of social responsibility is such that I remain confident that every effort will be made to deliver regardless of whether I remain contracted to PGS or not. It's probably time that I introduced you to some other PGS staff so that you can get a better feel for this aspect yourself. I will endeavour to do so in the near future

					3) Ongoing issues and concerns for commercial fishers still principally revolve around seismic activities and the ongoing impacts of multiple seismic surveys, often within the same calendar year or within the same fishing season, in the same or similar locations. At one of our meetings you noted that 2D surveys are not conducted over the same site but in the adjacent "tramlines", however, for our licence holders whether it is the exact same site is not relevant, being immediately adjacent still means this same area of commercial fishing is being impacted and disrupted – on the water with the MSS vessels and fish dispersement – more than once in the same fishing season or same calendar year. 4) Commercial fishing stakeholders hold significant concerns regarding the long term cumulative impacts of seismic activity on fishing, on fish stocks, the food chain and on ecosystems in general off the Western Australian coast as this remains largely unknown. We do however, very much welcome the PGS initiative to work towards including a research "levy" within their commercial arrangements with their clients operating in Western Australian waters. 5) I note on page two of your communication regarding activity notification that you note "in line with agreed protocols established as part of the stakeholder engagement process, or a minimum two weeks, whichever is the longer in each respective case". A two week notification can in many instances be too short, some fishermen will be at sea for that period of time or if not at sea, getting ready for a longer fishing trip. We have reservations that there will be occasions where current fishing trips and commercial departures due in this two week time frame will be potentially impacted with very little room to move. Would PGS envisage making changes to their schedule to meet arrangements which commercial fishers may have had in place for some time? 6) I would like to take this opportunity to also acknowledge PGS's generosity with scientific information gleaned from their seismic work which may assist commercial fishers to identify new fishing locations or fishing hot spots. • We appreciate at this point in time that PGS does not have a commercial contract with any Oil and Gas operators in Western Australian waters for the Rollo MSS and that this environment plan approval process may not result in any commercial activity. Should PGS be successful in gaining seismic contracts we look forward to meeting again to continue this engagement and to ensure all commercial fishing stakeholders are fully informed of future PGS MSS activities.	3) The example I provided was for a typical "infill" 2D survey that might be of the approximate same vintage (e.g. less than 3 years' time separation) and would therefore typically have new lines positioned between existing recent lines. PGS can commit to not carrying out such an infill project within WAFIC members' fishing zones under this EP within 12 months of any preceding Rollo project without gaining the prior consent of the affected fishers. This commitment would exclude projects that are adjacent to previous areas and have a slight overlap tying the previous area, or that are just infill lines acquired under the initial single project 4) No further response from PGS regarding this comment. 5) Certainly the two week notification period would be a worst case that may be the result of a sudden change in plans typically due to external factors. With regard to this, we will be controlled by our individual protocols where these have been established. It probably affects the deep sea crab fishers, and line and trap fishers more than others such as the trawl fishers. But regardless, PGS would seek to commence work in a location that considered the impact of any such short notice period. 6) No further response from PGS regarding this comment.
			14-Sep-2016	email	Read receipt received.	No action is required from PGS.
32	West Coast Deep Sea Crustacean Fishery - Chaceon	n/a	06-Jul-2016	email	• 6 Jul 2016 Chaceon informed PGS that they believe the proposed EP will impact fishing operations from Exmouth and south. • WCDSCF are concerned about the potential for detrimental effects from seismic surveys on the Crystal crab stock. • Chaceon informed PGS that WAMRL have informed WCDSCF of cases where this has happened in the past. • Chaceon informed PGS that there would be an impact on their fishing operations, as they fish using fixed surface floats between the depths of 500-800m. • Chaceon requested PGS keep them informed of the progression of these surveys and to be included in all consultation.	• 6 Jul 2016 PGS requested a meeting with Chaceon and other fishers in order to get a better understanding of their concerns and to work how to manage operations to keep impacts minimal.
			11-Jul-2016	email	• 11 Jul 2016 Chaceon sent apologies to all meeting attendees for missing the meeting scheduled for today.	• 11 Jul 2016 PGS responded to Chaceon. • PGS hopes to meet with Chaceon in the future. • PGS was able to gain an understanding of their fishery operations during the meeting today. • PGS will write up the meeting minutes and operating protocol and will send for their review.
			11-Jul-2016	email	• No feedback received from Chaceon	• 11 Jul 2016 In response to concerns of impacts to the Crystal crab stock, PGS sent members of the WCDSCMF a new 2016 scientific research paper mentioned during the meeting. Egg-bearing female spiny lobsters in Tasmania and undertaken by Fisheries and Aquaculture Centre, Institute for Marine and Antarctic Studies, University of Tasmania, and the Centre for Marine Science and Technology, Curtin University, Perth.
			08-Sep-2016	email	• No feedback received from Chaceon	• 8 Sep 2016 PGS forwarded a draft document containing meeting minutes, and a draft operating protocol to members of the WCDSCMF to review and approve.

						• PGS would still like an opportunity to meet with one of your skippers when an opportunity presents. • The more PGS understands about the operations in this fishery the easier it will be to find ways for our operations to minimise any potential interference.
			12-Sep-2016	phone	• Discussion on phone – see **Table 2-2** below.	12 Sep 2016 PGS follow up call to Chaceon to check if stakeholder would still like to meet.
			14-Sep-2016	email	• Read receipt received.	• No action is required from PGS.
			06-Oct-2016	email	• No feedback received from Chaceon	• 6 Oct 2016 PGS sent WCDSCMF reminder regarding the proposed operations protocol and ongoing consultation plan and informed fishers that the Rollo EP will be submitted to NOPSEMA in one weeks' time. • PGS informed fishers that they have had further discussions with Chaceon in order to gain a better understanding of their fishing operations and confirmation on the type of set-gear in the water. • From this additional discussion, PGS believe that the proposed protocols of interaction for the West Coast Deep Sea Crustacean Managed Fishery will be satisfactory to the needs of your fishery. • PGS requested fishers that were not happy with the proposed protocol to let them know and they will amend accordingly.
				email	• No feedback received from Chaceon	• 6 Oct 2016 PGS sent David Hand an email update in response of the concerns raised in the initial contact letter received in 2016: • PGS notes previous concern from Chaceon about the potential for detrimental effects from seismic surveys on the Crystal crab stock and WAMRL have informed WCDSCF of cases where this has happened in the past. • PGS recalls previous discussions with license holders of WCDSCMF mentioning the lack of measured surface and bottom sea temperature data, and crustaceans may be sensitive to certain temperature ranges. PGS can make a further commitment to work with you and/or other fishers of deep sea crustaceans to do some "local science" by using available tools, such as collecting temperature data to assist WARML with research to better understand your managed fishery. • PGS assessment of catch rates and impacts on crustaceans and crustacean fisheries is available for your review via the EP website, alternatively we can send an EP extract of this assessment upon request. • PGS has committed to seeking funding for further research from the sales of seismic data as per our protocol • As a further step towards new technology, as discussed, PGS has been researching alternative sound sources, and has spent considerable time and money of Marine Vibrator research • PGS will commit to holding a Technology Day that discusses this research with oil companies with a view to seeking additional funding to further progress this promising alternative • Recent research on Crustaceans: • In March 2017 PGS informed stakeholders they have reviewed and assessed the recent FRDC publication relating to the impact of marine seismic surveys on crustacean, and bivalve fisheries as it relates to the proposed Rollo EP and is available for your review via the EP website, alternatively we can send an EP extract of this assessment upon request. • FRDC publication 2012/008: Assessing the Impact of Marine Seismic Surveys on South-east Australian Scallop and Lobster Fisheries (2016).
			19-Aug-2017	email	• Read receipt received.	• August 2017 – PGS contacted Chaceon with an email update addressing concerns previously raised. • No action is required from PGS.
33	West Coast Deep Sea Crustacean Fishery - Deep Water Services	12-Jul-2016	11-Jul-2016	email	• No feedback received from Deep Water Services	• 11 Jul 2016 In response to concerns of impacts to the Crystal crab stock, PGS sent members of the WCDSCMF a new 2016 scientific research paper mentioned during the meeting. • Egg-bearing female spiny lobsters in Tasmania and undertaken by Fisheries and Aquaculture Centre, Institute for Marine and Antarctic Studies, University of Tasmania, and the Centre for Marine Science and Technology, Curtin University, Perth.

			12-Jul-2016	email and phone	• Deep Water Services requested a login to the website via phone call	• 12 Jul 2016 PGS sent stakeholder website log-in.
			14-Sep-2016	email	• Read receipt received.	• 14 Sep 2016 No action is required from PGS.
			08-Sep-2016	email	• No feedback received from Deep Water Services	• 8 Sep 2016 PGS forwarded a draft document containing meeting minutes, and a draft operating protocol to members of the WCDSCMF to review and approve. • PGS would still like an opportunity to meet with one of your skippers when an opportunity presents. • The more PGS understands about the operations in this fishery the easier it will be to find ways for our operations to minimise any potential interference.
			09-Sep-2016	phone	• 9 Sep 2016 Deep Water Services is unable to comment as they are very busy and they will try to look at protocols over the weekend.	• 9 Sept 2016 PGS follow up call to see if licence holders have been able to review the operations protocol.
			06-Oct-2016	email	• No feedback received from Deep Water Services	• 6 Oct 2016 PGS sent WCDSCMF reminder regarding the proposed operations protocol and ongoing consultation plan and informed fishers that the Rollo EP will be submitted to NOPSEMA in one weeks' time. • PGS informed fishers that they have had further discussions with Chaceon in order to gain a better understanding of their fishing operations and confirmation on the type of set-gear in the water. • From this additional discussion, PGS believe that the proposed protocols of interaction for the West Coast Deep Sea Crustacean Managed Fishery will be satisfactory to the needs of your fishery. • PGS requested fishers that weren't happy with the proposed protocol to let them know and they'll amend accordingly.
			18-Aug-2017	email	• Read receipt received.	• 14 Sep 2016 No action is required from PGS.
34	West Coast Deep Sea Crustacean Fishery - Panorama Management	n/a	11-Jul-2016	email	• Panorama management thanked PGS for the paper.	• 11 Jul 2016 In response to concerns of impacts to the Crystal crab stock, PGS sent members of the WCDSCMF a new 2016 scientific research paper mentioned during the meeting. • Egg-bearing female spiny lobsters in Tasmania and undertaken by Fisheries and Aquaculture Centre, Institute for Marine and Antarctic Studies, University of Tasmania, and the Centre for Marine Science and Technology, Curtin University, Perth.
			08-Sep-2016	email	• No feedback received from Panorama Management	• 8 Sep 2016 PGS forwarded a draft document containing meeting minutes, and a draft operating protocol to members of the WCDSCMF to review and approve. • PGS would still like an opportunity to meet with one of your skippers when an opportunity presents. • The more PGS understands about the operations in this fishery the easier it will be to find ways for our operations to minimise any potential interference.
			06-Oct-2016	email	• No feedback received from Deep Water Services	• 6 Oct 2016 PGS sent WCDSCMF reminder regarding the proposed operations protocol and ongoing consultation plan and informed fishers that the Rollo EP will be submitted to NOPSEMA in one weeks' time. • PGS informed fishers that they have had further discussions with Chaceon in order to gain a better understanding of their fishing operations and confirmation on the type of set-gear in the water. • From this additional discussion, PGS believe that the proposed protocols of interaction for the West Coast Deep Sea Crustacean Managed Fishery will be satisfactory to the needs of your fishery. • PGS requested fishers that weren't happy with the proposed protocol to let them know and they'll amend accordingly.
			18-Aug-2017	Email	• Read receipt received.	• No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.
35	Westmore Seafoods	n/a	15-Sep-2016	email	• Read receipt received.	• No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.

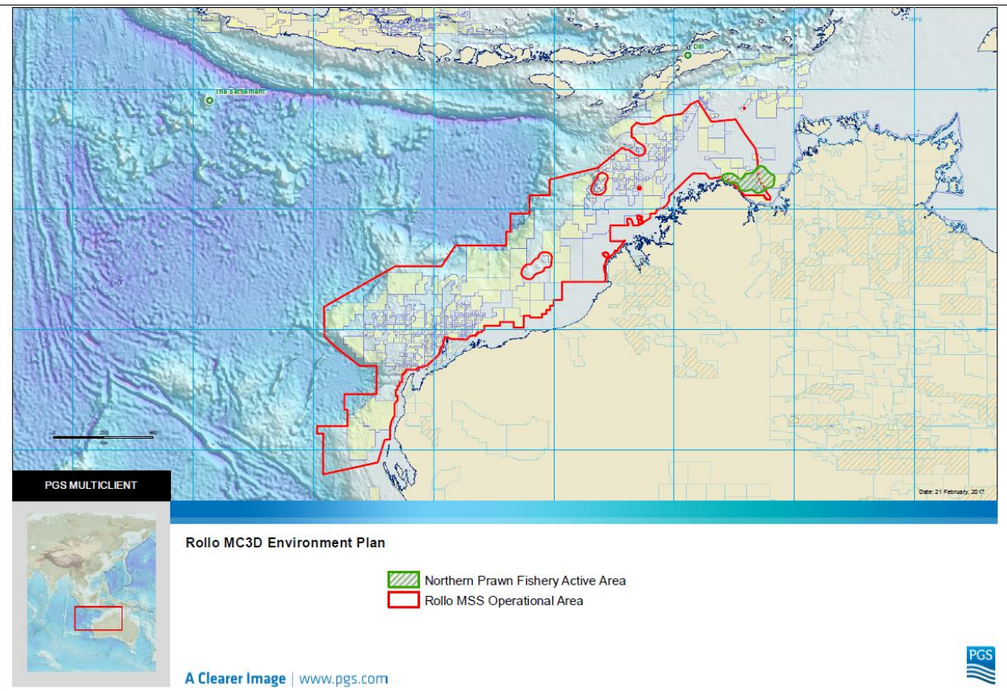
36	Kalbarri Professional Fishermen's Association	n/a	28-Apr-2017	email	• No response received.	• PGS contacted Kalbarri Professional Fishermen's Association and acknowledged that they had not consulted with Western Rock Lobster Fishery Licence Holders. • The proposed EP is a strategic basin wide EP and the proposed operational area is located from Shark Bay to the WA/NT border. • Are you able to confirm with me if there are Western Rock Lobster Fishery licence holders who are actively fishing north of Steepe Point, within Zone B, as this area of the fishery overlaps the proposed survey area. If so, I'll send through the official stakeholder consultation letter. PGS provided Kalbarri Professional Fishermen's Association with the following maps: 1. Proposed Rollo operational area; and • Zoomed in WRLF - Zone B overlap with the proposed operational area.
37	Western Rock Lobster Council (WRLC)	n/a	1-May-2017	email	• WRLC responded and informed PGS: • John has left the organisation and I have forwarded your email to the WRLC Executive Officer. • Responded and advised PGS they will look into the request and see how they can assist and will get back to PGS asap.	• PGS sent the request above on to Western Rock Lobster Council (WRLC): • PGS contacted Kalbarri Professional Fishermen's Association and acknowledged that they had not consulted with Western Rock Lobster Fishery Licence Holders. • The proposed EP is a strategic basin wide EP and the proposed operational area is located from Shark Bay to the WA/NT border. • Are you able to confirm with me if there are Western Rock Lobster Fishery licence holders who are actively fishing north of Steepe Point, within Zone B, as this area of the fishery overlaps the proposed survey area. If so, I'll send through the official stakeholder consultation letter. PGS provided Kalbarri Professional Fishermen's Association with the following maps: • Proposed Rollo operational area; and • Zoomed in WRLF - Zone B overlap with the proposed operational area.
			2-May-2017	email	• WRLC provide PGS with information from WAMRL – advising PGS that licence holders actively fishing in the area just north of Steepe Point, along the mainland coast.	• PGS confirmed receipt of the information and advised WRLC once the EP risk assessment was completed they will provide WRLC with information regarding the proposed activity.
			26-Aug-2017	email	• Read receipt received.	• No action is required from PGS. • No assessment of merits undertaken as no feedback or comments received from stakeholder.

Table 2-2 - Phase 1: Preparatory meetings – stakeholder submissions and PGS responses

No.	Stakeholder	Date Response Received	Location	Meeting Summary	PGS Assessment on Feedback and Response
7	Cape Conservation Group (CCG) - Secretary	05-Aug-2016	Exmouth, WA	Aug 2016 PGS met with CCG representative in Exmouth. • Purpose of the meeting was to discuss the forthcoming Rollo EP and improved industry cooperation. The proposed Rollo EP is for a large scope 5-year plan covering most of the Northwest shelf. A map of the proposed area was provided. • Discussed the strategic EP approach and unpredictability in NOPSEMA assessment timing. CCG receives updates and information on a weekly basis from multiple geophysical and petroleum companies: PGS explained that under the regulations no rights would be lost as PGS would have to assess any new issues raised. PGS explained how previous PGS EP's such as the Outer Exmouth EP commits to "future consultation", and how the Rollo EP is different. Discussed the mutual benefits to 5 year plans, particularly in reducing stakeholder fatigue and the excessive communications currently going on. Putting agreed protocols in place for a 5year EP would save a lot of effort from both parties. How consultation with CCG has changed since the change from DoE Referrals to NOPSEMA. Each time they are starting from scratch. They will now send out the same generic letter to all strategic EP's. PGS agrees that the preparation of consultation document is a good idea • Main concern of CCG is with potential long term and cumulative impacts of seismic surveys. PGS outlined the nature of the Multiclient and proprietary business models, and clarified the misperception that there were multiple repeat surveys over the same areas in relative short periods of time. It should be noted here that CCG assesses the environmental impact taking into account the maximum activity the approval allows. CCG deals with all environmental issues in the area; offshore, local shire (Cape Range), and local development. PGS sent (11/8/2016) latest research papers on Sound Exposure Guidelines, Popper 2014. • The PGS Rollo EP (interim and final versions) will be posted on a specific website for review by relevant parties. While not all stakeholders would necessarily want to read the full EP, the step was taken in the interests of transparency • Advised CCG that specific issues raised by CCG in their response/feedback letter to PGS(received 30th July 2016) will be assessed and responded to formally shortly	CCG and PGS agreed to a cooperation protocol and on-going consultation plan that included: • More information provided: • EP accessible via web login. • CCG strongly supports this concept as it significantly reduces the correspondence in ascertaining basic information regarding mitigation commitments. • MFO data accessible via web login. • Advanced survey notice. • Improved communications. • Opportunities for MFO training and hiring for surveys conducted in the vicinity of Ningaloo Reef. CCG expressed interest in this potential opportunity for their members. • Consideration for future research. • Opportunities for collaboration.
15	MG Kailis Group	05-Aug-2016	Exmouth and Fremantle, WA	Aug 2016 PGS met with MG Kailis representative in Exmouth and on the 12 Aug 2016 PGS met with MG Kailis representative in Fremantle. • Purpose of the meeting was to discuss the forthcoming Rollo EP and improved industry cooperation. The proposed Rollo EP is for a large scope 5-year plan covering most of the Northwest shelf. A map of the proposed area was provided. • Discussed areas of potential assistance based on discussions with other fishers in the Pilbara and recent learnings on other projects: Provision of 3D bathymetry data. Chase boat work to fishers from areas potentially impacted by its activities under the Rollo EP. • Discussed the nature of the Multiclient and proprietary business models Advised that the EP (interim and final versions) would be posted on a specific website for review by relevant parties including the fishing industry. While not all fishermen would necessarily want to read the full EP, the step was taken in the interests of transparency. Discussed the mutual benefits to 5 year plans, particularly in reducing stakeholder fatigue and the excessive communications currently going on. Putting agreed protocols in place for a 5year EP would save a lot of effort from both parties. • Skipper experience (fishing vessels): Positive interactions during previous surveys. Seismic crews have been very professional. Very easy to coordinate since AIS. Trawlers work generally in depths 50-110m. Catch goes up when trawling around 3Nm from seismic vessel as shark numbers drop. Shark numbers immediately increase again when seismic stops. Interested in sample bathymetry and other raw data. • MG Kailis Happy with our approach of drawing up protocols and looking at on the water interactions and cooperation.	PGS and MG Kailis agreed to a cooperation protocol and on-going consultation plan that included: • More information provided: • EP accessible via web login. • A web site provided for access to near real time vessel positions. • A 72-hour forward plan will be added to this site (or other plan as mutually agreed). • Advanced survey notice. • Improved communications. • Consideration for future research. • Opportunities for collaboration.

No.	Stakeholder	Date Response Received	Location	Meeting Summary	PGS Assessment on Feedback and Response
				Very keen to work with seismic industry on commercial basis. Vessel, fuels, and other services. Management system in good shape; good HR management practices – full fit-to-work policy been active for many years. PGS to look at providing opportunities on commercial terms. PGS to arrange meeting with PGS operations personnel opportunistically when they are in Perth.	
16	Ningaloo Coast World Heritage Advisory Committee (NCWHAC)	06-Aug-2016	Exmouth, WA	Aug 2016 PGS met with NCWHAC representative in Exmouth. • Purpose of the meeting was to discuss the forthcoming Rollo EP and improved industry cooperation. The proposed Rollo EP is for a large scope 5-year plan covering most of the Northwest shelf. A map of the proposed area was provided. • Discussed the strategic EP approach and unpredictability in NOPSEMA assessment timing. NCWHAC receives updates and information on a weekly basis from multiple geophysical and petroleum companies: PGS explained that under the regulations no rights would be lost, as PGS would have to assess any new issues raised. PGS explained how previous PGS EP's such as the Outer Exmouth EP commits to "future consultation", and how the Rollo EP is different. Discussed the mutual benefits to 5-year plans, particularly in reducing stakeholder fatigue and the excessive communications currently going on. Putting agreed protocols in place for a 5year EP would save a lot of effort from both parties. • NCWHAC explained how consultation with petroleum and geophysical companies with the committee has changed since the streamlining from DoE Referrals to NOPSEMA. Each new activity they are starting from scratch for each operator. Advised that they will be informing operators to ensure that the EP for the activity adheres to the values and KPI's of the Ningaloo WHP Management Plan. Informed PGS of a video survey conducted at Scott Reef whilst a seismic survey was undertaken – report to be advised, possibly Gigas and Tridachna. Suggested PGS contact the Exmouth Gamex competition – Jenny Gates PGS will include EGFC in the Rollo MC MSS Consultation Plan • The PGS Rollo EP (interim and final versions) will be posted on a specific website for review by relevant parties. While not all stakeholders would necessarily want to read the full EP, the step was taken in the interests of transparency. NCWHAC explained that the committee would not be reviewing the EP and stated that it is up to the Regulator to ensure that the EP does not impact the Ningaloo WHP values and KPI's. NCWHAC will provide a response to PGS in the coming week.	PGS and NCWHAC agreed to a cooperation protocol and on-going consultation plan that included: • More information provided: • EP accessible via web login. • Advanced survey notice. • Improved communications. • Consideration for future research.
		30-Aug-2017		Aug 2017 PGS met with NCWHAC representative in Exmouth. 30-Aug-2017 NCWHAC responded informing PGS they be in touch soon with the committee's response in relation to the previous feedback provided.	PGS sent NCWHAC update letter and confirmed they are waiting for internal response to PGS query and they expect to revert soon.
		21-Aug-2017		NCWHAC-DPaW responded apologising for not being able to attend the meeting.	• 24-Aug-2017 PGS confirmed receipt, and apologised for not being able to stay in Exmouth longer. • No action is required from PGS.
17	NDSF - Northern Wildcatch Seafood Australia (NWSA)	May 2016	Darwin, NT	May 2016 PGS met with NWSA in Darwin. • Fisheries Stakeholder Presentation given to NWSA. • Purpose of the meeting was to discuss the forthcoming Rollo EP and improved industry cooperation. The proposed Rollo EP is for a large scope 5-year plan covering most of the Northwest shelf. A map of the proposed area was provided. • Discussed areas of potential assistance based on discussions with other fishers and recent learnings on other projects: Provision of 3D bathymetry data. Chase boat work to fishers from areas potentially impacted by its activities under the Rollo EP. • Discussed the nature of the Multiclient and proprietary business models	PGS and NDSF agreed to a cooperation protocol and on-going consultation plan that included: • More information provided: • EP accessible via web login. • A web site provided for access to near real time vessel positions. • A 72-hour forward plan will be added to this site (or other plan as mutually agreed). • Advanced survey notice.

No.	Stakeholder	Date Response Received	Location	Meeting Summary	PGS Assessment on Feedback and Response
				Advised that the EP (interim and final versions) would be posted on a specific website for review by relevant parties including the fishing industry. While not all fishermen would necessarily want to read the full EP, the step was taken in the interests of transparency. Discussed the mutual benefits to 5 year plans, particularly in reducing stakeholder fatigue and the excessive communications currently going on. Putting agreed protocols in place for a 5year EP would save a lot of effort from both parties.	• Improved communications. • Consideration for future research. • Opportunities for collaboration.
		9-Aug-2017	Broome, WA	PGS met with NWSA for a general discussion regarding the August 2017 update for the Rollo EP.	PGS followed-up the meeting with an email response and letter with the following information: • Thanked NWSA for meeting. • Restrictions on 3D survey to reduce impacts to NDSF. • Proposed compromise on 2D acquisition with justification that 2D has a sparse footprint compared to 3D surveys and that restrictions to surveys would be implemented during peak spawning months of October and March, unless agreed otherwise on a case-by-case basis. • Additional publications from NDSF were included in the Rollo EP and assessment of these publications (from the Rollo EP) as well as other new research and reports were provided. PGS requested further information regarding NDSF conclusions about seismic activities.
18	NPF Industry Pty Ltd	23-Feb-2017	Phone discussion	February 2017 PGS discussion with NPFI. • Purpose of the discussion was to discuss the forthcoming Rollo EP and improved industry cooperation and the sharing of data. The proposed Rollo EP is for a large scope 5-year plan covering most of the Northwest shelf. A map of the proposed area was previously provided. • NPFI raised concerns about shallow water areas Intends to send details through to TV • PGS had learnt in prior discussions that NPFI was to lead the review of potential research into seismic and prawn fisheries with FRDC Discussed PGS' approach to research in the Rollo EP PGS will request voluntary contributions from all purchasers of MultiClient data acquired under the Rollo EP, with such funds to be directed towards seismic/fishing interaction research • NPFI advised that they would be interested in receiving temperature data from the vessel during any surveys in areas of interest to NPF INDUSTRY PTY LTD. • During a discussion by telephone on Feb 9 2017, AJ advised that fishing activity data provided by NPF INDUSTRY PTY LTD could possibly be provided to PGS for assessment. Santos subsequently confirmed it received permission to provide this data which is shown on the next page. • While no direct request has been received from NPF INDUSTRY PTY LTD with respect to operating restrictions, PGS has noted certain timing restrictions being employed by nearby operators whereby efforts will be made to restrict seismic data acquisition to the non-active fishing periods, understood to be June 16 to July 31, and December 1 to March 31. PGS will self-impose this restriction for dense 2D (e.g. line spacing closer than 4 km) and 3D seismic surveys, whereby no such surveys will be undertaken outside the two above mentioned periods unless NPF INDUSTRY PTY LTD is not active at the time within the area in question. This restriction will apply to the polygon labelled "Northern Prawn Fishery Active Area" below, plus a 4 km buffer. For more broadly spaced 2D (typical lines no closer than 4 km to each other) where there may be some impact but such impact is relatively sparse, PGS will ensure it maintains good communications protocols to limit any possible impact on NPF INDUSTRY PTY LTD's operations.	PGS and NPFI agreed to a cooperation protocol and on-going consultation plan that included: • More information provided: • EP accessible via web login. • A web site provided for access to near real time vessel positions. • A 72-hour forward plan will be added to this site (or other plan as mutually agreed). • Advanced survey notice. • Improved communications. • Consideration for future research. • Opportunities for collaboration. • Temporal exclusions, mitigation measures implemented during the identified prawn trawling season.

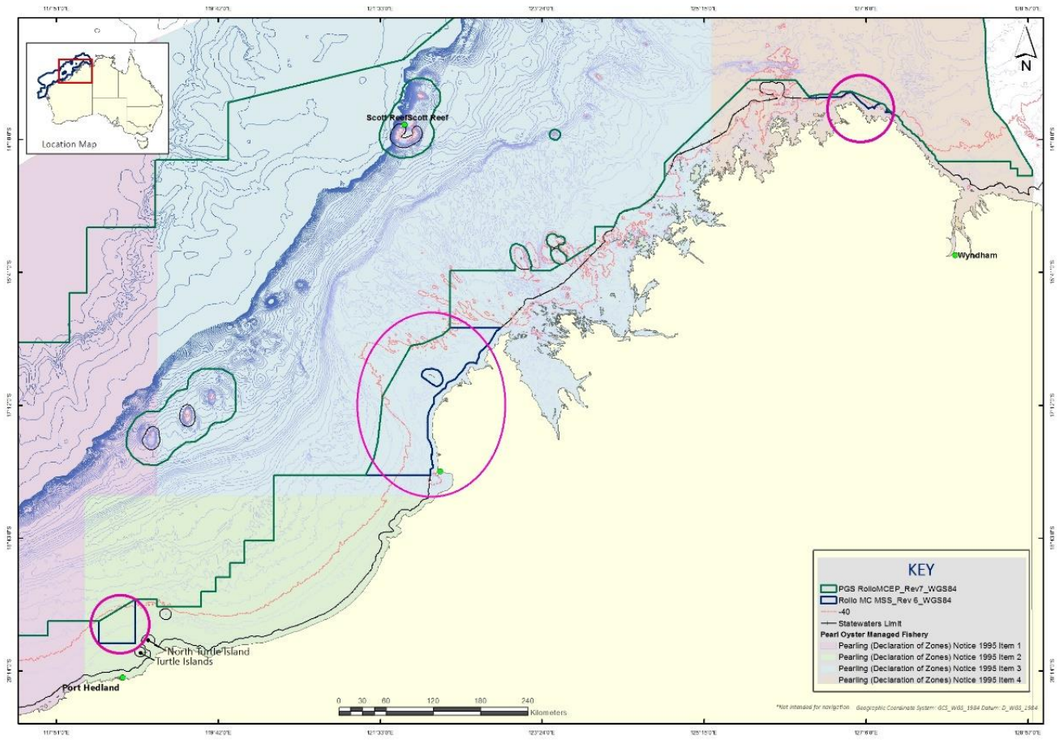
No.	Stakeholder	Date Response Received	Location	Meeting Summary	PGS Assessment on Feedback and Response
					
20	Pilbara Line Fishery - Fat Marine Pty Ltd	27-May-2016	Fremantle, WA	May 2016 PGS met with Licence Holder and WAFIC in Fremantle. • Fisheries Stakeholder Presentation given to Licence Holder. • Purpose of the meeting was to discuss the forthcoming Rollo EP and improved industry cooperation. The proposed Rollo EP is for a large scope 5-year plan covering most of the Northwest shelf. A map of the proposed area was provided. • Discussed areas of potential assistance based on discussions with other fishers and recent learnings on other projects: Provision of 3D bathymetry data. Chase boat work to fishers from areas potentially impacted by its activities under the Rollo EP. • Discussed the nature of the MultiClient and proprietary business models, and clarified the misperception that there were multiple repeat surveys over the same areas in relative short periods of time: Advised that the EP (interim and final versions) would be posted on a specific website for review by relevant parties including the fishing industry. While not all fishermen would necessarily want to read the full EP, the step was taken in the interests of transparency. Licence Holder agreed this would be good, as there was some distrust as to what was actually contained within a final EP. Discussed the mutual benefits to 5-year plans, particularly in reducing stakeholder fatigue and the excessive communications currently going on. Putting agreed protocols in place for a 5year EP would save a lot of effort from both parties. Licence Holder advised that they are concerned about agreeing to 5-year plans and what that would mean to their future rights. PGS explained that under the regulations no rights would be lost, as PGS would have to assess any new issues raised. However, agreed protocols would be captured in the EP, and these would then be binding on PGS. Fat Marine agreed that with this understanding, 5-year plans did have merit. • Licence Holder initial position was a dislike of the 5-year plans given the unknowns involved: Believe from past experience that there are direct impacts on his operations when a survey causes displacement to his planned activities at preferred fishing grounds. Main issue is being denied access to their key fishing grounds. Noted direct impacts on fish behaviour near seismic operations and for a period after. PGS did not dispute that this type of behaviour could occur.	PGS and Licence Holder agreed to a cooperation protocol and on-going consultation plan that included: • More information provided: • EP accessible via web login. • A web site provided for access to near real time vessel positions. • A 72-hour forward plan will be added to this site (or other plan as mutually agreed). • Advanced survey notice. • Improved communications. • Fishing Liaison Officer (FLO) drawn from the local fishing community if available (in the event a fishing industry chase boat is not used). • Consideration for future research. • Opportunities for collaboration.

No.	Stakeholder	Date Response Received	Location	Meeting Summary	PGS Assessment on Feedback and Response
				Also felt that there had been changes in some areas where fish did not return to previous good locations for relatively long periods of time. • PGS outlined areas of potential assistance based on the issues raised above and recent learnings on other projects: Provide bathymetry data within 3D surveys as previously provided to Licence Holder. Licence Holder expressed interest in all relevant bathy data. PGS is committed to looking at digital formats of this data to upload on to on board systems. PGS offered to commit to using a Fishing Liaison Officer (FLO) drawn from the local fishing community if available (should we not be using a fishing industry chase boat) in order to improve on water cooperation and ensure better understanding of fishermen's requirements. Reviewing how PGS could provide a forward plan in a simpler format in addition to the standard web based. E.g., a simple daily broadcast polygon highlight areas of seismic vessel activity that could be uploaded onto navigation systems. PGS could offer chase boat work to fishers from areas potentially impacted by its activities under the Rollo EP. Licence Holder and PGS recognized that local research on impacts of seismic on fishing was lacking, and that most fishermen did not accept that research in different environments (e.g. North Sea) was necessarily applicable to the local environment. PGS advised that it was difficult for an individual seismic company to do much as we had to maintain an even playing field from a commercial perspective. The most workable solution was for PGS to request voluntary contributions from its customers on sales of any multi-client data over active fishing areas. Supportive customers would be named to the fishing industry. This concept was well received by Licence Holder who believes this is a good first step towards a research fund.	
		21-Aug-2017	Exmouth, WA	August 2017 – PGS provided an email update addressing concerns raised, and a copy of the August update letter. • Your observation continues to be that catch is affected for 3-4 years after a 3D seismic survey. Typical 2D surveys are of less concern. However, you do note that research doesn't currently support your observations. You also note that there is a significant cost involved in having to fish new areas further from your preferred home port of Exmouth. • In addition, you were concerned about the recent research on Zooplankton	PGS assessment of catch rates and impacts on fish and fisheries is available for your review via the EP website, alternatively we can send an EP extract of this assessment upon request. However, PGS has committed to seeking funding for further research from the sales of seismic data as per our protocol While we have left the primary decision making with WAFIC as to where any such money generated would be spent, we believe that further research is warranted directly around your issue of concern In the meantime, PGS can make a further commitment to work with you and/or other fishers of Goldband snapper to do some "local science" by using available tools, such as advanced sounders, to try to observe behavior of this species in known aggregation areas both before and after nearby seismic shots We would work with you and/or other fishers in designing this survey While the resultant data will not necessarily be robust enough to qualify as accepted research, we would share it with you, and it may form the basis or driver for further studies In addition, PGS will commit to carrying out the research described in the attached proposal from CSIRO. PGS believes that this research could result in better ways to monitor and understand fish behavior around airguns As a further step towards new technology, as discussed, PGS has been researching alternative sound sources, and has spent considerable time and money on Marine Vibrator research. PGS will commit to holding a Technology Day that discusses this research with oil companies with a view to seeking additional funding to further progress this promising alternative While the attached letter does cover this issue, PGS will also look at whether methods of obtaining a reasonable quantity of plankton samples during the first Rollo survey for onboard analysis is viable If this review demonstrates that useful data can be gathered in a cost effective and viable manner, PGS will commit to carrying out such data collection and analysis and sharing results with you PGS certainly understands the concerns and frustration of your interactions with seismic over the years, and hope that our approach can go some way toward finding answers. You've made it very clear that you would prefer no seismic surveys were carried out at all! But I certainly appreciate the honesty of your comments and look forward to being able to work together on this.

No.	Stakeholder	Date Response Received	Location	Meeting Summary	PGS Assessment on Feedback and Response
21	Pilbara Line Fishery – RNR Fisheries	26-May-2016	Dongara, WA Kalbarri	May 2016 PGS met with Licence Holder and WAFIC in Dongara. • Fisheries Stakeholder Presentation given to Licence Holder. • Purpose of the meeting was to discuss the forthcoming Rollo EP and improved industry cooperation. The proposed Rollo EP is for a large scope 5-year plan covering most of the Northwest shelf. A map of the proposed area was provided. • PGS outlined the nature of the MultiClient and proprietary business models, and clarified the misperception that there were multiple repeat surveys over the same areas in relative short periods of time: PGS advised that the EP (interim and final versions) would be posted on a specific website for review by relevant parties including the fishing industry. While not all fishermen would necessarily want to read the full EP, the step was taken in the interests of transparency. Licence Holder agreed this would be good, as there was some distrust as to what was actually contained within a final EP. PGS advised that there were mutual benefits to 5-year plans, particularly in reducing stakeholder fatigue and the excessive communications currently going on. Putting agreed protocols in place for a 5year EP would save a lot of effort from both parties. Licence Holder advised that he was concerned about agreeing to 5 year plans and what that would mean to their future rights. PGS explained that under the regulations no rights would be lost, as PGS would have to assess any new issues raised. However, agreed protocols would be captured in the EP, and these would then be binding on PGS. Licence Holder agreed that with this understanding, 5-year plans did have merit. • Licence Holder initial position was a dislike of the 5 year plans given the unknowns involved. Believe from past experience that there are direct impacts on their operations when a survey causes displacement to his planned activities at preferred fishing grounds. Noted direct impacts on fish behaviour near seismic operations and for a period after. PGS did not dispute that this type of behaviour could occur. Also felt that there had been changes in some areas where fish did not return to previous good locations for relatively long periods of time. Expressed concern about possible food chain impact and impacts of multiple surveys. • PGS outlined areas of potential assistance based on the issues raised above and previous discussions with RNR and recent learnings on other projects: Provide bathymetry data within 3D surveys as previously provided to Licence Holder. Licence Holder expressed interest in all relevant bathymetry data Provide raw data from sounders when acquiring within the PLF. PGS is committed to looking at digital formats of this data to upload on to on board systems. PGS offered to commit to using a Fishing Liaison Officer (FLO) drawn from the local fishing community if available (should we not be using a fishing industry chase boat) in order to improve on water cooperation and ensure better understanding of fishermen's requirements. Reviewing how PGS could provide a forward plan in a simpler format in addition to the standard web based. E.g., a simple daily broadcast polygon highlight areas of seismic vessel activity that could be uploaded onto navigation systems. PGS could offer chase boat work to fishers from areas potentially impacted by its activities under the Rollo EP. PGS and Licence Holder both recognized that local research on impacts of seismic on fishing was lacking, and that most fishermen did not accept that research in different environments (e.g. North Sea) was necessarily applicable to the local environment: PGS advised that it was difficult for an individual seismic company to do much as we had to maintain an even playing field from a commercial perspective. The most workable solution was for PGS to request voluntary contributions from its customers on sales of any multi-client data over active fishing areas. Supportive customers would be named to the fishing industry. This concept was well received by Licence Holder who believes this is a good first step towards a research fund. Licence Holder requested that PGS consider doing a before and after survey of a known reliable fishing spot should the seismic pass over such a location so that we could both get an idea of short-term impact. PGS advised that this could be done.	PGS and Licence Holder agreed to a cooperation protocol and on-going consultation plan that included: • More information provided: • EP accessible via web login. • A web site provided for access to near real time vessel positions. • A 72-hour forward plan will be added to this site (or other plan as mutually agreed). • Advanced survey notice. • Improved communications. • Fishing Liaison Officer (FLO) drawn from the local fishing community if available (in the event a fishing industry chase boat is not used). • Consideration for future research. • Opportunities for collaboration.

No.	Stakeholder	Date Response Received	Location	Meeting Summary	PGS Assessment on Feedback and Response
		28-Aug-2017	email	August 2017 – PGS provided an email update addressing concerns raised, and a copy of the August update letter. 1. Believe from past experience that there are direct impacts on your operations when a survey causes displacement to your planned activities at preferred fishing grounds and have noted direct impacts on fish behaviour near seismic operations and for a period after. Also felt that there had been changes in some areas where fish did not return to previous good locations for relatively long periods of time. 2. In addition, you were concerned about food web impacts. There has been recent research on Zooplankton.	PGS assessment of catch rates and impacts on fish and fisheries is available for your review via the EP website, alternatively we can send an EP extract of this assessment upon request. PGS has committed to seeking funding for further research from the sales of seismic data as per our protocol While we have left the primary decision making with WAFIC as to where any such money generated would be spent, we believe that further research is warranted directly around your issue of concern In the meantime, PGS can make a further commitment to work with you and/or other fishers of Goldband snapper to do some "local science" by using available tools, such as advanced sounders, to try to observe behavior of this species in known aggregation areas both before and after nearby seismic shots We would work with you and/or other fishers in designing this survey While the resultant data will not necessarily be robust enough to qualify as accepted research, we would share it with you, and it may form the basis or driver for further studies In addition, PGS will commit to carrying out the research described in the attached proposal from CSIRO PGS believes that this research could result in better ways to monitor and understand fish behavior around airguns As a further step towards new technology, as discussed, PGS has been researching alternative sound sources, and has spent considerable time and money on Marine Vibrator research PGS will commit to holding a Technology Day that discusses this research with oil companies with a view to seeking additional funding to further progress this promising alternative While the attached letter does cover this issue, PGS will also look at whether methods of obtaining a reasonable quantity of plankton samples during the first Rollo survey for onboard analysis is viable If this review demonstrates that useful data can be gathered in a cost effective and viable manner, PGS will commit to carrying out such data collection and analysis and sharing results with you PGS certainly understand the concerns and frustration of your interactions with seismic over the years, and hope that our approach can go some way toward finding answers. I certainly appreciate the honesty of your comments and look forward to being able to work together on this. Look forward to catching up with you in the near future!
22	Pilbara Trap Managed Fishery – Old Brown Dog Fishing Co	27-May-2016	Fremantle, WA	May 2016 PGS met with OBD in Fremantle. • Fisheries Stakeholder Presentation given to Licence Holder. • Purpose of the meeting was to discuss the forthcoming Rollo EP and improved industry cooperation. The proposed Rollo EP is for a large scope 5-year plan covering most of the Northwest shelf. A map of the proposed area was provided. • PGS outlined the nature of the MultiClient and proprietary business models, and clarified the misperception that there were multiple repeat surveys over the same areas in relative short periods of time: PGS advised that the EP (interim and final versions) would be posted on a specific website for review by relevant parties including the fishing industry. While not all fishermen would necessarily want to read the full EP, the step was taken in the interests of transparency. OBD agreed this would be good, as there was some distrust as to what was actually contained within a final EP. PGS advised that there were mutual benefits to 5-year plans, particularly in reducing stakeholder fatigue and the excessive communications currently going on. Putting agreed protocols in place for a 5year EP would save a lot of effort from both parties OBD advised that he was concerned about agreeing to 5 year plans and what that would mean to their future rights. PGS explained that under the regulations no rights would be lost, as PGS would have to assess any new issues raised. However, agreed protocols would be captured in the EP, and these would then be binding on PGS. OBD agreed that with this understanding, 5 year plans did have merit.	PGS and OBD agreed to a cooperation protocol and on-going consultation plan that included: • More information provided: • EP accessible via web login. • A web site provided for access to near real time vessel positions. • A 72-hour forward plan will be added to this site (or other plan as mutually agreed). • Advanced survey notice. • Improved communications. • Fishing Liaison Officer (FLO) drawn from the local fishing community if available (in the event a fishing industry chase boat is not used). • Consideration for future research. • Opportunities for collaboration.

No.	Stakeholder	Date Response Received	Location	Meeting Summary	PGS Assessment on Feedback and Response
				• OBD initial position was a dislike of the 5 year plans given the unknowns involved. Believe from past experience that there are direct impacts on their operations when a survey causes displacement to his planned activities at preferred fishing grounds. • PGS outlined areas of potential assistance based on the issues raised above and previous discussions with Licence Holder and recent learnings on other projects: Provide bathymetry data within 3D surveys as previously provided to Licence Holder. OBD expressed interest in all relevant bathymetry data Provide raw data from sounders when acquiring within the PTMF. PGS is committed to looking at digital formats of this data to upload on to on board systems. PGS offered to commit to using a Fishing Liaison Officer (FLO) drawn from the local fishing community if available (should we not be using a fishing industry chase boat) in order to improve on water cooperation and ensure better understanding of fishermen's requirements. Reviewing how PGS could provide a forward plan in a simpler format in addition to the standard web based. E.g., a simple daily broadcast polygon highlight areas of seismic vessel activity that could be uploaded onto navigation systems. PGS could offer chase boat work to fishers from areas potentially impacted by its activities under the Rollo EP. OBD felt that normally his vessels would be too busy for this work, but appreciated the offer was on the table. PGS and OBD both recognized that local research on impacts of seismic on fishing was lacking, and that most fishermen did not accept that research in different environments (e.g. North Sea) was necessarily applicable to the local environment: PGS advised that it was difficult for an individual seismic company to do much as we had to maintain an even playing field from a commercial perspective. The most workable solution was for PGS to request voluntary contributions from its customers on sales of any multi-client data over active fishing areas. Supportive customers would be named to the fishing industry. This concept was well received by OBD who believes this is a good first step towards a research fund. • PGS has worked with OBD and 3rd party marine electronics supplier to look at data formats for bathymetry data, and how best to supply raw sounder data.	
23	Pearl Producers Association (PPA)	27-May-2016	Fremantle, WA	May 2016 PGS met with PPA in Fremantle. • Purpose of the meeting was to discuss the forthcoming Rollo EP and improved industry cooperation. The proposed Rollo EP is for a large scope 5-year plan covering most of the Northwest shelf. A map of the proposed area was provided. • Full EP to be accessible on web via login. This is done in the spirit of transparency, and with a view to enhancing mutual understanding between the industries. A web site will be provided to PPA for access so that near real time vessel positions can be viewed. Direct interaction with fishing operations. • Research – PGS will request voluntary contributions from all purchasers of MultiClient data acquired under the Rollo EP, with such funds to be directed towards seismic/fishing interaction research. • PGS will provide bathymetric data where available within the relevant fishing zones from its existing 3D data library. PGS will provide additional bathymetric data from any new 3D surveys acquired under the Rollo EP within PPA fishing zones. • PGS will provide raw data from its sounders when acquiring seismic within PPA fishing zones that could be of future benefit to PPA.	PGS and PPA agreed to a cooperation protocol and on-going consultation plan that included: • More information provided: • EP accessible via web login. • A web site provided for access to near real time vessel positions. • A 72-hour forward plan will be added to this site (or other plan as mutually agreed). • Advanced survey notice. • Improved communications. • Consideration for future research. • Opportunities for collaboration.
		29-Jul-2016	Fremantle, WA	July 2016 PGS met with PPA in Fremantle. • 12 August 2016 PGS sent PPA a summary of the key points from the meeting for PPA to review: • PGS described new approach to long term EP, and how stakeholders retain rights to bring up new issues should they arise. • PGS described approach taken to operational area restrictions built into draft version of EP based on prior project consultation with PPA. These may be varied in future based on new research, and this is described in the draft EP. • PPA happy in principle with new approach by PGS, including carved out areas. Needs to review maps further though, and may ask for more detailed mapping outside the 80 Mile beach area before confirming feedback, but is otherwise supportive. PPA described research to be conducted with Searcher, Quadrant and Apache on potential impact of seismic on adult oysters.	

No.	Stakeholder	Date Response Received	Location	Meeting Summary	PGS Assessment on Feedback and Response
				PPA continues to have concerns about potential impacts and is happy that PGS has acknowledged this need and taken it into consideration. • Discussed PGS commitment to seek voluntary contributions from purchasers of MultiClient data that will be directed to impacts of seismic and fishing industry. PPA agrees this is a positive approach. • PPA had a login issue on EP site, PGS has reset access Updated version of EP to be loaded on the following Monday. • PPA can provide a better "Condi" map. TV has updated website with some amendments to relevant section; these amendments were already contained in printed extract provided to AI. • PGS would like to follow up next week once PPA has reviewed. • PGS will then capture key discussion points in a single reference document and send on for PGS review.	
		10-Oct-2016	Fremantle, WA	October 2016 PGS met with PPA in Fremantle. • PPA informed PGS of areas of concern for pearl lease sites in the Kimberley and Northern Kimberley regions and south of Eighty Mile Beach, offshore from Port Hedland. PGS clipped the polygon at the request of the PPA so that the operational area does not overlap the POMF fishing area south of Eighty Mile Beach, Port Hedland PGS removed areas of concern within the Rollo MC MS OA, see map below, Blue line = Rev 6 Rollo OA, Green Line = Rev 7 Rollo OA, which includes the cropped areas as suggested by the PPA: Area adjacent to Broome and north to Lacapede Islands. Area adjacent to WA State waters in the northern Kimberley. Prior to individual surveys within the Rollo OA, PGS will consult with the PPA to determine if there are any new pearl lease areas of concern, and incorporate a 10 km spatial buffer from any new pearl lease areas.  	

No.	Stakeholder	Date Response Received	Location	Meeting Summary	PGS Assessment on Feedback and Response
		14-Oct-2016	Fremantle, WA	PGS met with the PPA to confirm the changes to the Rollo operational area and operations protocol changes. PGS sent PPA the revised survey area map and protocol of operations.	
26	WA Department of Fisheries (DoF)	11-Jul-2016	Perth, WA	• Fisheries Stakeholder Presentation given to DoF. • PGS met with DoF for a general discussion to inform the DoF of what PGS was doing different for the PGS Rollo MC MSS EP. Items discussed as follows: -Brief overview of the progress of the fisheries face-to-face meetings. -What data can PGS collect for fisheries licence holders? -Operations protocols -Research gaps	No action is required from PGS following on from the meeting with DoF.
		8-Nov-2016	Perth, WA	• PGS met with DoF for a general discussion regarding CSEM survey techniques.	No action is required from PGS following on from the meeting with DoF.
30	WA Seafood Exporters	09-Aug-2016	phone	• 9 Aug 2016 PGS contacted WA Seafoods and discussed the following: • Purpose of the meeting was to discuss the forthcoming Rollo EP and improved industry cooperation. The proposed Rollo EP is for a large scope 5-year plan covering most of the Northwest shelf. A map of the proposed area was provided. • PGS outlined the nature of the MultiClient and proprietary business models, and clarified the misperception that there were multiple repeat surveys over the same areas in relative short periods of time: PGS advised that the EP (interim and final versions) would be posted on a specific website for review by relevant parties including the fishing industry. While not all fishermen would necessarily want to read the full EP, the step was taken in the interests of transparency. • Full EP to be accessible on web via login. This is done in the spirit of transparency, and with a view to enhancing mutual understanding between the industries. A web site provided for access to near real time vessel positions. • Provide bathymetry data within 3D surveys. Provide raw data from sounders when acquiring within the NPF.	PGS and WA Seafoods agreed to a cooperation protocol and on-going consultation plan that included: • More information provided: • EP accessible via web login. • A web site provided for access to near real time vessel positions. • A 72-hour forward plan will be added to this site (or other plan as mutually agreed). • Advanced survey notice. • Improved communications. • Consideration for future research. • Opportunities for collaboration.
32	West Coast Deep Sea Crustacean Fishery - Chaceon	12-Sep-2016	email	• Chaceon was unable attend the meeting held on 11 July 2016 in Scarborough, PGS forward the meeting summary and protocol. • 12 Sep 2016 PGS contacted Chaceon via phone and follow up email and discussed the following: • In summary: Typically you run four sets of gear, each set with floats approximately 8 km apart subject to winds and tides, eight floats in total. Typically, lines are dropped running east west, and moved north or south over time, operating typically in depths of 400m to max 800m. The most recent seismic survey over their fishing grounds worked out well due to good communications, and use of AIS when picking up/moving gear. Chaceon informed PGS that they have the least flexibility when pulling gear in as they are attached to the crab lines. Vessels are normally only out on the water around two days in eight or so. • PGS confirmed as per discussion with Chaceon, the suggested protocol will work well, and this will be adopted. PGS acknowledge that for surveys that overlap their fishing area, during the pre-survey planning stage, PGS must contact WCDSCF to get initial lat/longs of any set gear.	PGS and Chaceon agreed to a cooperation protocol and on-going consultation plan that included: • More information provided: • EP accessible via web login. • A web site provided for access to near real time vessel positions. • A 72-hour forward plan will be added to this site (or other plan as mutually agreed). • Advanced survey notice. • Improved communications. • Consideration for future research. • Opportunities for collaboration.
33	West Coast Deep Sea Crustacean Fishery - Deep Water Services	11-Jul-2016	Scarborough, WA	PGS met with Deep Water Services and Panorama Management in Scarborough: • Fisheries Stakeholder Presentation given. • Purpose of the meeting was to discuss the forthcoming Rollo EP and improved industry cooperation. The proposed Rollo EP is for a large scope 5-year plan covering most of the Northwest shelf. A map of the proposed area was provided. • Discussed the strategic EP approach and unpredictability in NOPSEMA assessment timing. PGS explained how previous PGS EP's such as the Outer Exmouth EP commits to "future consultation", and how the Rollo EP is different. • Outlined the nature of the MultiClient and proprietary business models, and clarified the misperception that there were multiple repeat surveys over the same areas in relative short periods of time. • A advised that the EP (interim and final versions) would be posted on a specific website for review by relevant parties including the fishing industry. While not all fishermen would necessarily want to read the full EP, the step was taken in the interests of transparency.	PGS, Southern Trading Australia and Deep Water Services agreed to a cooperation protocol and on-going consultation plan that included: • More information provided: • EP accessible via web login. • A web site provided for access to near real time vessel positions. • A 72-hour forward plan will be added to this site (or other plan as mutually agreed). • Advanced survey notice. • Improved communications. • Consideration for future research. • Opportunities for collaboration.
34	West Coast Deep Sea Crustacean Fishery - Panorama Management	11-Jul-2016	Scarborough, WA		

No.	Stakeholder	Date Response Received	Location	Meeting Summary	PGS Assessment on Feedback and Response
				Deep Water Services requested to access the website, in particular to review the fisheries presentation. • PGS advised that there were mutual benefits to 5-year plans, particularly in reducing stakeholder fatigue and the excessive communications currently going on. Putting agreed protocols in place for a 5year EP would save a lot of effort from both parties. PGS explained that under the regulations no rights would be lost, as PGS would have to assess any new issues raised. However, agreed protocols would be captured in the EP, and these would then be binding on PGS. • Deep Water Services explained that the main concern of WCDSCMF is interactions with set fishing gear (crab traps): Interactions with the survey vessel towing equipment but just as importantly interactions with supply vessel undertaking supply runs and crew changes. PGS explained that due to the nature of the WCDSCMF and the set fishing gear, interaction protocols will need to include "no-go zones". The no-go zones will need to clearly identify where the set gear is located in the event of an emergency the vessel will be able to clearly identify areas to avoid. E.g. In the event of bad weather or a cyclone. PGS will need to highlight areas of WCDSCMF activity to be uploaded onto navigation systems. PGS raised issue of confidentiality agreement between all parties including survey and support vessel whereby no commercial information will be passed on to third-party, including but not limited to WCDSCMF fishing locations. • Deep Water Services explained set gear fishing methods: Approx. 1.5 km of set fishing gear with marked buoys at each end, crap traps spaced approx. every 100 m. When retrieving catch the line is continuously fed on board and traps are removed for cleaning and re-baiting. It is not possible for the WCDSCMF is pick up all their gear and move to an entirely different location. • Southern Trading also identified that WCDSCMF are concerned with potential long term impacts of seismic surveys on the fishery. • PGS will send latest research paper on effects of seismic array on egg-bearing female spiny lobsters in Tasmania. • PGS outlined areas of potential assistance based on previous discussions with other demersal fishers and recent learnings on other projects. Provision of 3D bathymetry data. Southern Trading informed TV they are interested in data that will provide information about the sea floor habitat of their target species [crystal (snow) crab]: • Sea floor temperature. • Nature of sea floor. • Current at sea floor etc. Deep Water Services expressed interest in deep water sounding data. Deep Water Services requested to meet with vessel master to discuss areas of sounding data interest. PGS will opportunistically meet with vessel masters to discuss sounding data areas of interest and what other potential data PGS can collect for fishers. Chase boat work to fishers from areas potentially impacted by its activities under the Rollo EP. • Acknowledged that local research on impacts of seismic on fishing was lacking, and that most fishermen did not accept that research in different environments (e.g. North Sea) was necessarily applicable to the local environment. Advised that it was difficult for an individual seismic company to do much as we had to maintain an even playing field from a commercial perspective. The most workable solution was for PGS to request voluntary contributions from its customers on sales of any multi-client data over active fishing areas. Supportive customers would be named to the fishing industry. This concept was well received. • Southern Trading and Deep Water Services discussed how they contribute money to research their fishery, i.e. exploratory areas, and new commercial species.	
38	Gascoyne Demersal Scalefish Fishery – Licence Holder	23-Aug-2017	Kalbarri	PGS met with Licence Holder in Kalbarri: • Purpose of the meeting was to discuss the forthcoming Rollo EP and improved industry cooperation. The proposed Rollo EP is for a large scope 5-year plan covering most of the Northwest shelf. A map of the proposed area was provided. • Licence Holder believes from past experience that there are direct impacts on his operations when a survey causes displacement to his planned activities. In the recent 2D survey DG made sure he fished well away from the seismic operation	PGS and Licence Holder Fisheries agreed to a cooperation protocol and on-going consultation plan that included: • More information provided: • EP accessible via web login. • A web site provided for access to near real time vessel positions.

No.	Stakeholder	Date Response Received	Location	Meeting Summary	PGS Assessment on Feedback and Response

				• Licence Holder has noted impacts on fish behaviour near seismic operations for a period after completion
				  ○ PGS did not dispute that this type of behaviour could occur.
				  ○ Licence Holder also felt that there had been changes in some areas where the Pink Snapper, a main target species, did not return to previous good locations for around 4-5 months
				  ▪ However, also noted that this period also included a typically bad time of the year (Nov –Dec), so the extent of the impact was difficult to assess
				• Licence Holder noted that mackerel were caught closer to the coast and there would not be much of an issue there
				• Other than Mackerel, Licence Holder's main catch were Red Emperor, Red Throat, Pink Snapper, Rankin Cod and Goldband Snapper
				• Licence Holder noted the peak spawning season for the Pink Snapper around June-July, and felt that 3D seismic could negatively impact spawning (approx. area shown on attachment)
				  ○ TV committed to reviewing this area by looking into the fisheries data
				• Licence Holder noted that there may be additional Pink Snapper closures applied from later this year
				• PGS outlined areas of potential assistance based on recent learnings on other projects
				  ○ Can provide bathy within future 3D surveys area
				  ▪ Licence Holder expressed interest in all relevant bathy data
				  ○ While paper plots of this data can be provided, also committed to looking at digital formats of this data to see if Licence Holder can upload direct into on-board systems
				  ○ PGS could offer chase boat work to fishers from areas potentially impacted by its activities under the Rollo EP
				  ○ PGS and Licence Holder both recognized that local research on impacts of seismic on fishing was lacking
				  ▪ PGS advised that it was difficult for an individual seismic company to do much as we had to maintain an even playing field from a commercial perspective
				  ▪ The most workable solution was for PGS to request voluntary contributions from its customers on sales of any multi-client data over active fishing areas. Supportive customers would be named to the fishing industry
				Advised that the EP would be posted on a specific website for review by relevant parties including the fishing industry. While not all fishermen would necessarily want to read the full EP, the step was taken in the interests of transparency.
					○ A 72-hour forward plan will be added to this site (or other plan as mutually agreed).
					• Advanced survey notice.
					• Improved communications.
					• Fishing Liaison Officer (FLO) drawn from the local fishing community if available (in the event a fishing industry chase boat is not used).
					• Consideration for future research.
					• Opportunities for collaboration.

		23-Aug-2017	email	August 2017 – PGS provided an email update addressing concerns raised, and a copy of the August update letter. 1 From past experience you believe there can be direct impacts on your operations when a survey causes displacement to your planned activities. In the recent 2D survey you made sure you fished well away from the seismic operation. 2 You have noted impacts on fish behaviour near seismic operations for a period after completion, and there had been changes in some areas where the Pink Snapper, a main target species, did not return to previous good locations for around 4-5 months. You also noted that this period also included a typically bad time of the year (Nov –Dec), so the extent of the impact was difficult to assess 3 You identified the peak spawning season for the Pink Snapper around June-July, and felt that 3D seismic could negatively impact spawning (approx. area shown on attachment) 4 Recent research on Zooplankton	1 PGS assessment of catch rates and impacts on fish and fisheries is available for your review via the EP website, alternatively we can send an EP extract of this assessment upon request. 2 PGS has committed to seeking funding for further research from the sales of seismic data as per our protocol. While we have left the primary decision making with WAFIC as to where any such money generated would be spent, we believe that further research is warranted directly around your issue of concern In the meantime, PGS can make a further commitment to work with you and/or other fishers (eg Goldband snapper fishers) to do some "local science" by using available tools, such as advanced sounders, to try to observe behavior of this species in known aggregation areas both before and after nearby seismic shots during a suitable project under this EP We would work with you and/or other fishers in designing this survey While the resultant data will not necessarily be robust enough to qualify as accepted research, we would share it with you, and it may form the basis or driver for further studies In addition, PGS will commit to carrying out the research described in the attached proposal from CSIRO should any projects proceed under this EP PGS believes that this research could result in better ways to monitor and understand fish behavior around airguns As a further step towards new technology, as discussed, PGS has been researching alternative sound sources, and has spent considerable time and money of Marine Vibrator research

No.	Stakeholder	Date Response Received	Location	Meeting Summary	PGS Assessment on Feedback and Response
					PGS will commit to holding a Technology Day that discusses this research with oil companies with a view to seeking additional funding to further progress this promising alternative 3 Please see the attached map of the spawning area you requested avoidance of during the months of June-July. I haven't been able to find spawning location information for the Gascoyne Demersal Scalefish Fishery on the Department of Fisheries (DoF) website or DoF scientific publications, and therefore hope the area has been correctly estimated. PGS believes there will not be significant impacts from the activity to species spawning within Shark Bay. However, due to the small scale of the area identified and defined timing, PGS is happy to avoid this area as requested and as such will include a commitment in the EP to avoid seismic acquisition within this area during the peak spawning months of June-July. 4 While the attached letter covers this issue, PGS will also look at whether methods of obtaining a reasonable quantity of plankton samples during the first Rollo survey for onboard analysis is viable If this review demonstrates that useful data can be gathered in a cost effective and viable manner, PGS will commit to carrying out such data collection and analysis and sharing results with you. PGS certainly understands your concerns with interactions with seismic over the years, and hope that our approach can go some way toward finding answers. I certainly appreciate the honesty of your comments and look forward to being able to work together on this.

2.2 PHASE 1 - PREPARATORY STAKEHOLDER ENGAGEMENT – NCB AND BEAGLE

For the updated Rollo areas, the following stakeholder process was undertaken:

1. Review of stakeholders for the NCB and Beagle operating areas and identify if still relevant or not and if there are any new stakeholders. This was done as described in Section 2.1.1 Stakeholder Engagement Letters. Table 2-3 details the assessment outcome.
2. For those stakeholders identified as relevant the following was undertaken:
    - If they had responded to previous information/engagement for the broader Rollo EP an update with information specific to their activities and an updated Cooperation Protocol and Ongoing Consultation Plan, if previously developed, was provided. This is recorded in the Stakeholder Engagement Assessment of Objections and Claims table in Appendix 1A.
    - If they had not responded to previous information/engagement for the broader Rollo EP a generic letter providing information on the new Rollo operating areas was provided. The aim of this letter was to initiate contact and identify those stakeholders who were active in the area and/or wanted to receive more specific information regarding the Rollo seismic program. This is recorded in the Stakeholder Engagement Assessment of Objections and Claims table in Appendix 1A.
3. For those stakeholders identified as not relevant the following was undertaken:
    - If they had responded to previous information/engagement for the broader Rollo EP an update was provided. This is not recorded in the Stakeholder Engagement Assessment of Objections and Claims table in Appendix 1A.
    - If they had not responded to previous information/engagement for the broader Rollo EP an updated was not provided. This decision was made to reduce stakeholder fatigue. If a person was interested in what had happened to the PGS Rollo seismic survey program, they could contact PGS or obtain updated information form the NOPSEMA website.
4. Post engagement classification of stakeholders as summarised in Table 2-3. The following classifications are used:
    - Not relevant – the seismic activity will not impact on a stakeholder's functions, interests or activities this was determined by:
        - For fisheries – no overlap of the operating areas with the fishery area.
        - For Commonwealth Government Agencies – the Australian Government Guidance: Offshore Petroleum and Greenhouse Gas Activities: Consultation with Australian Government agencies with responsibilities in the Commonwealth Marine Area.
    - Ongoing consultation – for stakeholders that are relevant and maybe affected by the activity, they have requested to obtain updates and information or there is a legal requirement. Ongoing consultation requirements are detailed in Table 2-4.
    - Complete no further consultation – consultation has been undertaken for the EP but there is no further requirement to provide ongoing information or undertake consultation for each survey.
    - Ongoing review – for fisheries that the operating areas overlap but there is currently no fishing effort and they have not provided any response to information provided. As part of the pre-survey consultation these fisheries will be reviewed to determine if there has been or is likely to be future fishing effort within the operating area. If there is, these licensees will become relevant for the pre-survey consultation.

Table 2-3 Phase 1 - Preparatory consultation – stakeholder submissions and PGS responses on NCB and Beagle OAs

Stakeholder	Status	Notes
ABF - Australian Border Force SBC - Strategic Border Command	Not relevant	Stakeholder assessed as not relevant as the updated Rollo EP areas are not in an area where border control is an issue. ABF and SBC do not need to be notified directly of surveys as receive notifications via AHS Notice to Mariners.
AFMA - Australian Fishing Management Authority	Ongoing Consultation	Activity is within a Commonwealth fishery area or will impact or potentially impact a Commonwealth fishery area or resource.
AHS - Australian Hydrographic Service	Ongoing Consultation	Required to provide information at least three weeks prior to commencement of any oil and gas activity to allow for publication of notices to mariners.
AIMS - Australian Institute of Marine Science	Ongoing Consultation	Potential impacts to divers at Rankin Bank and Glomar Shoal where AIMS are undertaking research studies. Agreed to contact AIMS annually (end of July) to determine any planned activity at Rankin Bank or Glomar Shoal and to notify them of any activity planned within 60 km of Rankin Bank or Glomar Shoal.
AMSA - Australian Maritime Safety Authority	Ongoing Consultation	Obtain details of shipping activities within the area of the activity. AMSA-JRCC and AHS required to be notified of commencement of activities.
Apache Fishing Charters	Not relevant	For the updated Rollo EP areas, no impacts to areas where Apache Fishing Charters operate (Montebello Islands, Abrolhos Islands, Shark Bay) were identified and hence they are no longer a relevant stakeholder. Apache Fishing Charters had not responded to any consultation for the broader Rollo EP area hence an update in relation to the new Rollo areas was not provided.
ASBTIA - Australian Southern Bluefin Tuna Industry Association	Ongoing Consultation	The updated Rollo EP areas overlap the SBTF fishery, however, there is no fishing effort in this area. This was confirmed by ASBTIA who advised that the previous broader Rollo OA and the NCB and Beagle OAs are not an area of concern. ASBTIA have been included in ongoing consultation to identify any changes to the fishery within the Rollo OAs.
Austral Fisheries	Ongoing Consultation	Licence holder in Western Deepwater Trawl Fishery which the Rollo OA overlaps. Does not currently fish in area but would like to obtain updates and notifications of surveys.
Australian Recreational Fishing Foundation (ARFF)	Not relevant	Stakeholder assessed as not relevant as the updated Rollo EP areas are not within an area where recreational fishing occurs. No response was obtained from consultation for the broader Rollo OA.
Blue Horizon Fishing Charters	Not relevant	For the updated Rollo EP areas, no impacts to areas where Blue Horizon Fishing Charters operate (Exmouth, Long Island, Thevenard Island, Barrow Island, Tyral Rocks, Montebello Islands. Murion Island.) were identified and hence they are no longer a relevant stakeholder. Blue Horizon Fishing Charters had not responded to any consultation for the broader Rollo EP area hence an update in relation to the new Rollo areas was not provided.
Blue Juice Fishing Charters	Not relevant	For the updated Rollo EP areas, no impacts to areas where Blue Juice Fishing Charters operate (Montebello Islands, Abrolhos Islands) were identified and hence they are no longer a relevant stakeholder. Blue Juice Fishing Charters had not responded to any consultation for the broader Rollo EP area hence an update in relation to the new Rollo areas was not provided.
Blue Lightning Fishing Charters	Not relevant	For the updated Rollo EP areas, no impacts to areas where Blue Lightning Charters operate (Montebello Islands, Abrolhos Islands) were identified and hence they are no longer a relevant stakeholder. Blue Lightning Charters had not responded to any consultation for the broader Rollo EP area hence an update in relation to the new Rollo areas was not provided.
Bluesun2 Boat Charters	Not relevant	For the updated Rollo EP areas, no impacts to areas where Bluesun2 Boat Charters operate (Montebello Islands, Carnarvon, Shark Bay, Abrolhos Islands, Rowley Shoals, Ningaloo, Broome, Kimberley) were identified and hence they are no longer a relevant stakeholder. A Bluesun2 Boat Charters had not responded to any consultation for the broader Rollo EP area hence an update in relation to the new Rollo areas was not provided.

Stakeholder	Status	Notes
Broome Fishing Club (BFC)	Not relevant	Stakeholder assessed as not relevant as the updated Rollo EP areas are not within an area where the Broome Fishing Club fishes. No response was obtained from consultation for the broader Rollo OA.
Broome Prawn Management Fishery (BPMF)	Not relevant	Stakeholder assessed as not relevant as the updated Rollo EP areas are not within the fishery. No response was obtained from consultation for the broader Rollo OA.
Cape Conservation Group	Not relevant	Stakeholder assessed as not relevant as the updated Rollo EP areas are ~ 200km away from the Ningaloo WHA and 114 km from the Gascoyne MP. As significant consultation was undertaken with CCG regarding the broader Rollo OA an update was provided regarding changes to Rollo EP OA to NCB and Beagle OAs. No response was received.
Centre for Whale Research Western Australia	Not relevant	Stakeholder assessed as not relevant as the updated Rollo EP areas and associated activities will not have an impact on whale research. No response was obtained from consultation for the broader Rollo OA. An update was provided regarding changes to Rollo EP OA to NCB and Beagle OAs. No response was received.
CFA - Commonwealth Fisheries Association	Ongoing Consultation	Activity or impact to Commonwealth fishing area. Consultation complete for EP. CFA relevant stakeholder for ongoing communication and updates.
Chaceon Pty Ltd	Ongoing Consultation	Activity or impacts from the activity overlaps West Coast Deep Sea Crustacean Fishery. Data from Fish Cube showed no fishing effort for West Coast Deep Sea Crustacean Fishery within the NCB or Beagle OA. Stakeholder confirmed activity did not conflict with their fishing.
Deep Sea Water Services & Yennett Pty Ltd	Ongoing Consultation	Activity or impacts from the activity overlaps West Coast Deep Sea Crustacean Fishery. Data from Fish Cube showed no fishing effort for West Coast Deep Sea Crustacean Fishery within the NCB or Beagle OA. Stakeholder confirmed activity did not conflict with their fishing. Stakeholder requested to obtain updates.
DFAT - Department of Foreign Affairs and Trader	Not relevant	Stakeholder assessed as not relevant as for the updated Rollo EP areas as activity does not impact other internal jurisdictions. Activity does not cross into or impact on waters outside of Australia's maritime jurisdiction. Foreign individuals or governments will not be impacted by the activity
DNP - Director of National Parks	Complete no further consultation	A diesel spill within the Beagle OA could impact 80 Mile Beach Commonwealth Marine Park. Consultation complete for EP. DNP only need to be consulted if there are changes that could impact on a CMP. EP details the requirement to contact the Marine Reserve Compliance Duty Officer in the event of a diesel spill.
DoD - Department of Defence	Ongoing Consultation	Obtain information regarding defence operational requirements, training areas and/or restricted airspace and UXO risk. NCB OA overlaps the North West Exercise Area. DoD require notification 8 weeks prior to the commencement of activities located within or within proximity (40 km) to the NWXA. Requirement for ongoing consultation included in EP.
DoEE - Department of the Environment and Energy (DoEE) including the Australian Antarctic Division (AAD)	Not relevant	As per the Australian Government Guidance: Offshore Petroleum and Greenhouse Gas Activities: Consultation with Australian Government agencies with responsibilities in the Commonwealth Marine Area, consultation with the DoEE is not required. It is AAD's expectation that cetacean fauna sightings, ship strikes, and entanglements that occur during offshore oil and gas activities will be reported via the National Marine Mammal Data Portal. This requirement is included in Chapter 3 Section 3.11 of the EP.
Exmouth Gulf Game Fishing Club	Not relevant	Stakeholder assessed as not relevant persons as for the updated Rollo EP areas as the activity or any potential impacts will not affect fishing off Exmouth. Exmouth Gulf Game Fishing Club had not responded to any consultation for the broader Rollo EP area hence an update in relation to the new Rollo areas was not provided.
Pilbara Line Fishery – Fat Marine Pty Ltd	Ongoing Consultation	Activity or impacts from the activity overlaps Pilbara Line Fishery. No objections or claims raised to information provided regarding change to Rollo EP OA to NCB and Beagle OAs. Sent updated information including updated controls. Retained as a stakeholder for updates and individual survey information.

Stakeholder	Status	Notes
Gascoyne Demersal Scalefish Managed Fishery (GDSF)	Not relevant	Stakeholder assessed as not relevant as the updated Rollo EP areas are not within the fishery.
IFAW - International Fund for Animal Welfare - Oceania	Not relevant	Stakeholder assessed as not relevant as for the updated Rollo EP areas as no impacts or potential impacts to fauna in sensitive areas such as Ningaloo, Great Australian Bight, Kimberley, Otway etc. IFAW was identified as a relevant stakeholder for the broader Rollo OA as potential impacts were identified to Ningaloo Marine Park and Camden Sound. Impacts to these areas are not identified for the new Rollo OAs. An update was provided to IFAW and they responded that they did not have the capacity to respond.
Image Dive	Not relevant	For the updated Rollo EP areas, no impacts to areas where Image Dive operate (Perth, Abrolhos) were identified and hence they are no longer a relevant stakeholder. Image Dive had not responded to any consultation for the broader Rollo EP area hence an update in relation to the new Rollo areas was not provided.
Kimberley Prawn Managed Fishery (KPMF)	Not relevant	Stakeholder assessed as not relevant as the updated Rollo EP areas are not within the fishery. No response was obtained from consultation for the broader Rollo OA.
Kimberley Professional Fishermen's Association (KPFA)	Not relevant	Stakeholder assessed as not relevant as the updated Rollo EP areas are not within an area where the Kimberley Professional Fishermen's Association fishes. No response was obtained from consultation for the broader Rollo OA.
Mackerel Managed Fishery (MMF) licence holders	Ongoing Consultation	The updated Rollo EP areas overlap the MMF where there is active fishing. An update regarding the updated Rollo EP areas was provided to licence holders. As at Sept 2018 there are nine MMF licence holders. One, RNR Fisheries, has responded to information provided. Letters were sent to the remaining eight licence holders providing an update on controls to managed impacts as do not have emails addresses for these licence holders.
Mary Island Fishing Club (Derby)	Not relevant	Stakeholder assessed as not relevant as the updated Rollo EP areas are not within an area where the Mary Island Fishing Club fishes. No response was obtained from consultation for the broader Rollo OA.
MG Kailis Group	Ongoing Consultation	Activity or impacts from the activity overlaps Pilbara Fish Trawl Interim Managed Fishery and Pilbara Line Fishery. EP consultation completed - no response received to information provided regarding change to Rollo EP OA to NCB and Beagle OAs and updated controls. Retained as a stakeholder for updates and individual survey information.
Montebello Island Safaris	Not relevant	For the updated Rollo EP areas, no impacts to areas where Montebello Island Safaris operate (Montebello Islands) were identified and hence no longer a relevant stakeholder. Montebello Island Safaris had not responded to any consultation for the broader Rollo EP area hence an update in relation to the new Rollo areas was not provided.
NCWHAC - Ningaloo Coast World Heritage Advisory Committee	Not relevant	Were a relevant stakeholder for the broader Rollo area. The updated NCB and Beagle OAs do not impact on the Ningaloo Coast World Heritage Area. An update in relation to the new operating areas was provided. The NCWHAC advised they had no further comments to make.
Nickol Bay Prawn Managed Fishery (NBPMF) licence holders	Ongoing review	The updated Rollo EP areas overlap the NBPMF but not where there is active fishing. An update regarding the updated Rollo EP areas was provided to licence holders with no response. No response was obtained from consultation for the broader Rollo OA.
North Coast Shark Fishery (WANCSF) licence holders	Ongoing review	The updated Rollo EP areas overlap the WA North Coast Shark Fishery (WANCSF), however, there has been no fishing in this fishery since the 2009/2010 season. However, this may change in the future. An update regarding the updated Rollo EP areas was provided to licence holders with no response.
Northern Demersal Scalefish Managed Fishery (NDSF)	Not relevant	Stakeholder assessed as not relevant as the updated Rollo EP areas are not within the fishery.

Stakeholder	Status	Notes
Northern Prawn Fishery (NPF) NPF Industry Pty Ltd (NPFI) Northern Prawn Fishery (Qld) Trawl Association Inc.	Not relevant	Stakeholder assessed as not relevant as the updated Rollo EP areas are not within the fishery. As consultation had been undertaken with the NPFI and updated in relation to the new operating areas was provided. No response was received.
Northern Shark Fishery (NSF) licence holders	Not relevant	Stakeholder assessed as not relevant as the updated Rollo EP areas are not within the fishery.
Northern Territory Seafood Council (NTSC)	Not relevant	Stakeholder assessed as not relevant as the updated Rollo EP areas or activities do not impact on NT waters. Via consultation for broader Rollo OA NTSC advised the survey did not cover NTSC members fishing areas.
North West Slope Trawl Fishery (NWSTF) licence holders	Ongoing Consultation	The updated Rollo EP areas overlap the NWST fishery where there is fishing effort. An update regarding the updated Rollo EP areas was provided to licence holders with no response. At Sept 2018 there are four licence holders of which three do not currently fish in the area (Raptis, Samson Seafoods, WA Seafood Exporters – fish in NPF from previous Rollo consultation). The other Seafresh Holdings have not responded.
Northern Wildcatch Seafood Australia (NWSA)	Not relevant	For the updated Rollo EP areas, NWSA is not a relevant stakeholder as the activity or any potential impacts will not affect the Timor Reef Fishery, WA Northern Demersal Scalefish Fishery or NT Demersal Fishery. NWSA had engaged on previous consultation for the broader Rollo area and was sent an update regarding the changes to the Rollo areas. No response was obtained.
NT DoT -NT Department of Transport	Not relevant	Stakeholder assessed as not relevant as the updated Rollo EP areas or activities do not impact on NT waters. No response was obtained from consultation for the broader Rollo OA.
Old Brown Dog Fishing Co	Ongoing Consultation	Activity or impacts from the activity overlaps Pilbara Trap Managed Fishery. EP consultation completed - no response received to information provided regarding change to Rollo EP OA to NCB and Beagle OAs and updated controls. Retained as a stakeholder for updates and individual survey information.
Onslow Prawn Managed Fishery (OPMF) licence holders	Ongoing review	The updated Rollo EP areas overlap the OPMF but there is no active fishing. An update regarding the updated Rollo EP areas was provided to licence holders with no response.
Panorama Management Pty Ltd and All Plains Corporation Pty Ltd	Ongoing Consultation	Activity or impacts from the activity overlaps West Coast Deep Sea Crustacean Fishery. Data from Fish Cube showed no fishing effort for West Coast Deep Sea Crustacean Fishery within the NCB or Beagle OA. No response received to information provided regarding change to Rollo EP OA to NCB and Beagle OAs. Retained as a stakeholder for updates and individual survey information.
Pilbara Line Fishery (PLF) licence holders	Ongoing Consultation	The updated Rollo EP areas overlap the PLF where there is active fishing. An update regarding the updated Rollo EP areas and updated controls was provided to licence holders. As at Sept 2018 there are seven licence holders in the PLF. Chaceon have responded they do not fish in the area. Fat Marine Pty Ltd and MG Kailis Pty Ltd. have consultation protocols and the remaining four have not responded to letters provided. Letters sent as no email contact could be found.
Pilbara Trap Managed Fishery (PTMF) licence holders	Ongoing Consultation	The updated Rollo EP areas overlap the PTMF where there is active fishing. An update regarding the updated Rollo EP areas was provided to licence holders with no response. A further emails was sent providing information on updated controls. As at Sept 2018 there are two licence holders Seafresh Holdings and Old Brown Dog Fishing Co. Old Brown Dog Fishing Co has a consultation protocol.
Pilbara Fish Trawl Interim Managed Fishery (PFTIMF) licence holders	Ongoing Consultation	The updated Rollo EP areas overlap the PFTIMF where there is active fishing. An update regarding the updated Rollo EP areas was provided to licence holders with no response. A further emails was sent providing information on updated controls.

Stakeholder	Status	Notes
		As at Sept 2018 there are three licence holders Seafresh Holdings, MG Kailis and Titleholder 1.
Port Bouvard Charters	Not relevant	For the updated Rollo EP areas, no impacts to areas where Port Bouvard Charters operate (Montebello Islands, Abrolhos Islands) were identified and hence they are no longer a relevant stakeholder. Port Bouvard Charters had not responded to any consultation for the broader Rollo EP area hence an update in relation to the new Rollo areas was not provided.
PPA - Pearl Producers Association	Ongoing Consultation	Activity is within an area where the pearling industry potentially operate and or impacts or potential impacts to an area where pearling industry potentially operate or where broodstock habitat likely.
Raptis Fishing Licenses Pty Ltd	Ongoing Consultation	Activity or impacts from the activity overlaps the NWST and WDTF fishery. EP consultation completed as responded that currently do not operate in the area. Retained as a stakeholder for updates and individual survey information.
Recfishwest (WA)	Not relevant	Stakeholder assessed as not relevant as the updated Rollo EP areas are not within an area where recreational fishing occurs. No response was obtained from consultation for the broader Rollo OA.
RNR Fisheries	Ongoing Consultation	Activity or impacts from the activity overlaps Pilbara Line Fishery. EP consultation completed - no response received to information provided regarding change to Rollo EP OA to NCB and Beagle OAs. Retained as a stakeholder for updates and individual survey information.
Sabea Fishing Co Pty Ltd	Ongoing Consultation	Activity or impacts from the activity overlaps Mackerel Managed Fishery Area 3. Review of Fish cube data did not identify any catch effort within the Rollo OAs for the Mackerel Managed Fishery Area 3. Sabea confirmed that the planned surveys do not impact MMF Zone 3 or the GDSF.EP consultation completed. Retained as a stakeholder for updates and individual survey information.
Samson Seafoods Pty Ltd	Ongoing Consultation	Activity or impacts from the activity overlaps the NWST. EP consultation completed as responded that currently do not operate in the area. Retained as a stakeholder for updates and individual survey information.
Seafresh Holdings Pty Ltd	Ongoing Consultation	Activity or impacts from the activity overlaps WDTF and NWST Fishery. EP consultation completed - no response received to information provided regarding change to Rollo EP OA to NCB and Beagle OAs. Retained as a stakeholder for updates and individual survey information.
Southern Bluefin Tuna Fishery (SBTF)	Not relevant	The updated Rollo EP areas overlap the SBTF fishery, however, there is no fishing effort in this area. This was confirmed by ASBTIA who advised that the previous broader Rollo OA and the NCB and Beagle OAs are not an area of concern. ASBTIA have been included in ongoing consultation to identify any changes to the fishery within the Rollo OAs.
Top Gun Charters	Not relevant	For the updated Rollo EP areas, no impacts to areas where Top Gun Charters operate (Montebello Islands, Carnarvon, Shark Bay and Abrolhos Island) were identified and hence they are no longer a relevant stakeholder. Top Gun Charters had not responded to any consultation for the broader Rollo EP area hence an update in relation to the new Rollo areas was not provided.
WA DBCA - WA Department of Biodiversity, Conservation and Attractions WA DPaW - Department of Parks and Wildlife	Complete no further consultation	Stakeholder relevant persons as a diesel spill could impact state waters and land of Bedout Island which is a State nature reserve. Information provided on the update Rollo operating areas and spill risk/impact and response. DBCA responded that the proposed survey appears to pose a low risk to lands and waters managed by DBCA. For an oil spill that enters State waters or impacts State land the WA DoT becomes the Hazard Management Agency which PGS would support. As the HMA the WA DoT would consult with state agencies such as WA DBCA. Thus, no further consultation required.
WA DMIRS - WA Department of Mines, Industry Regulation and Safety	Ongoing Consultation	For activities in Commonwealth waters: Under the OPGGS Env Regulations the Department of the relevant Minister is a relevant person. DMIRS activity pre-start and cessation notifications and incident reporting requirements.
WA DPIRD - Department of Primary	Ongoing Consultation	Activity is within a WA State fishery area or will impact or potentially impact a State fishery area or resource.

Stakeholder	Status	Notes
Industries and Regional Development: Fisheries		
WA DoT - WA Department of Transport	Ongoing Consultation	Potential for spill impacts within State waters of Bedout Island. Updated details regarding the changes to the Rollo areas and provided information as per the DoT's Offshore Petroleum Industry Guidance Note, Marine Oil Pollution: Response and Consultation Arrangements. DoT responded they did not have any further comments. Where consultation criteria are satisfied DoT requires the MEER unit be provided with an electronic copy of the approved/accepted OSCP/OPEP prior to the relevant offshore petroleum activity commencing.
WA Planning, Lands and Heritage	Not relevant	Stakeholder assessed as not relevant persons a no impacts on Aboriginal heritage, customary fishing areas or Aboriginal land were identified.
WAFIC - Western Australian Fishing Industry Council	Ongoing Consultation	Activity is within a WA State fishery area or will impact or potentially impact a State fishery area or resource.
West Coast Deep Sea Crustacean Managed Fishery (WCDSCMF) licence holders	Ongoing review	The updated Rollo EP areas overlap the WCDSCMF but not where there is active fishing. An update regarding the updated Rollo EP areas was provided to licence holders with three licence holders responding (Sabea Fishing Co Pty Ltd, Chaceon Pty Ltd, Deep Sea Water Services & Yennett Pty Ltd). No objections or claims where raised.
Western Deepwater Trawl Fishery (WDTF) licence holders	Ongoing review	The updated Rollo EP areas overlap the WDTF fishery, however, there has been no catch effort within the OAs since 2008-2009 season. Trial fishing undertaken in 2018, however, unlikely to be within OAs as no activity since 2008-2009 season. At Sept 2018 there are five licence holders of which two have had they boat denominated so don't fish in the fishery. The other three contacted: Austral Fisheries and Raptis have responded that they don't fish in the area and Seafresh Holdings have not responded.
Western Skipjack Tuna Fishery (WSTF) licence holders	Ongoing review	The updated Rollo EP areas overlap the WSTF, however, there has been no effort in the fishery since 2008 – 2009. When there was fishing in this fishery it was off South Australia.
Western Tuna and Billfish Fishery (WTBF) licence holders	Ongoing review	The updated Rollo EP areas overlap the WTBF sub-area 1, however, there is no fishing effort within this areas with fishing effort being south of Geraldton to south of Albany. Uptop Fisheries were sent an update regarding the updated Rollo EP areas (as advised by WAFIC), no response was received.

2.3 PHASE 2 - PRE-SURVEY CONSULTATION

PGS are aware of the importance of identifying new stakeholders during a five (5) year EP. Therefore, the list of relevant stakeholders will be reviewed as part of the six monthly updates and prior to all survey updates and / or notifications, and consultation will be carried out with any newly identified stakeholders every six (6) months. Details of how to access reports will be contained within the initial stakeholder letters.

Relevant stakeholders will be identified by PGS as described in Section 2.1.1, and using the following tools:

- Existing environmental knowledge
- Previous experience
- Internet research
- Initial project emails
- Existing networks and forums
- Social media
- Scientific literature
- Other research tools such as GIS shapefiles of commercial fishery license areas

Pre-survey planning will review the current fishing effort for all commercial fisheries with licensed areas overlapping the Rollo OA, primarily by requesting an updated and valid extract of entries from the Fisheries Public Register and through on-going and direct consultation with fishers, DPIRD-Fisheries and AFMA and via WA Fish Cube and review of catch and effort data in latest release of annual reports: WA State of the Fisheries Report and ABARES Fishery Status Report. Any commercial fishery changes (including changes to fishery status or license holders) will be evaluated for potential interactions with and impacts from the proposed survey activities, and if required, the EP will be revised accordingly (Chapter 3-Section 3.1.1). This will ensure information is supplied to all relevant persons as part of a staged process.

PGS shall notify relevant stakeholders of a potential survey to be carried out under this EP that may affect their interests or activities in line with agreed protocols established as part of the stakeholder engagement process, or a minimum of eight weeks, whichever is the longer in each respective case.

In addition, updates of plans as they occur will also be noted on the EP specific website, so that relevant stakeholders will always have access to the latest project specific information.

It is anticipated that by a minimum of eight weeks prior to commencing, unless otherwise agreed with the stakeholder, any survey within the Rollo OAs, PGS will have contacted relevant stakeholders to provide specific information for the proposed activity, including:

- size, location and geographical coordinates for the survey;
- likely commencement date and duration;
- survey parameters (airgun array and streamer spread);
- survey and support vessels details;
- access to a web based near real time acquisition map along with a 72 hour forward plan:
- additional information as agreed in any agreed Cooperation Protocols and Ongoing Consultation Plans that may result from stakeholder engagement;
- contact details of the titleholder for stakeholder submissions;
- requests for information, concerns or issues, additional face-to-face meeting request; and
- information regarding the potential impacts and risks of the proposed activities on the functions or interests of the relevant stakeholder.

Additionally:

- The stakeholder letter will contain a risk assessment summary of the Rollo MC MSS impacts and risk assessment and EP Sections relevant to the stakeholder groups - e.g. fisheries, marine safety.
- The complete EP will be made available for stakeholders to review via the EP website.
- Details of how to access the EP will be contained within the stakeholder letters.

Stakeholders that have an agreed Cooperation and Interaction Protocol Plan in place with PGS, will be contacted as specified in their respective agreements, to initiate meaningful discussions and feedback.

At any point during the Phase 2 consultation plan or the life of the Rollo EP, stakeholders will have a further opportunity to raise with PGS any new specific concerns or issues regarding the proposed survey. At any time during the lifetime of the EP, after the six (6) monthly update, or as soon as a potential issue or concern arises they can contact PGS. Stakeholders need not wait for a pre-survey notification, they have already been informed via the first contact notification that potential surveys could occur anywhere within the proposed Rollo OA. Any new specific concerns or issues regarding the proposed survey will be assessed as outlined in Section 2.4.

PGS and their environmental management team, through their experience in the industry, have good knowledge and understanding of the stakeholders within the area covered by the Rollo OA and their potential areas of concern. Those with concerns are generally limited to NGOs and specific fisheries licence holders. Consequently, PGS are confident that the approach and timeframes outlined above are acceptable to allow any claims or objections to be raised and appropriately dealt with.

A minimum of eight weeks prior to the commencement of a proposed survey, unless otherwise agreed with the stakeholder, PGS will consult additional stakeholders, primarily within the offshore exploration and petroleum industry. These consultations will include, as far as possible, other geophysical companies operating in or adjacent to the Rollo EP OA, plus holders of petroleum titles within and adjacent to any planned survey operational area within the Rollo OAs. The objective of this consultation is to identify if there are any other seismic surveys proposed for areas within or adjacent to the Rollo OA at the same time. Dependent upon local geology and data quality, concurrent seismic surveys usually require a minimum separation distance of 40 km between the two operating survey vessels to avoid noise interference with the received signals. If separation distances between the survey vessels are closer than 40 km then the two proponents routinely work out procedures for simultaneous operations to eliminate or minimise the potential for noise interference and data corruption. For instance, a time-sharing arrangement where, over a 24 hour period each vessel will acquire for a period of 12 hours whilst the airgun arrays of the other vessel are shutdown.

2.4 PHASE 3 - THROUGHOUT SURVEY CONSULTATION

Consultation with all relevant stakeholders will continue throughout the validity of the Rollo EP and as per the schedule outlined in Table 2-4. PGS will comply with reasonable requests by stakeholders for additional information and requests for updates during individual surveys undertaken within the Rollo OA.

In addition, existing and new stakeholders will be notified of any changes to scope of the EP that may affect their interests or activities a minimum of 8 weeks, or in line with agreed protocols, in advance of an individual survey to be undertaken under that change. Significant changes to scope will trigger a review of the EP, and a potential revision, as described in Chapter 3. Any notification to stakeholders will contain contact details of where any claims/objections/queries or concerns may be directed. Contact details will include the EP liaison person, telephone number and email address.

As required under sub regulation 16(b), PGS shall assess the merits of any new claims or objections made by a relevant stakeholder whereby they believe the activity may have adverse impacts upon their interest or activities.

If the claim has merit, where appropriate, PGS shall modify management of the activity. The assessment will be done using the methodology outlined for the internal risk assessment in Chapter 3.

PGS shall endeavour to finalise the assessment of merit of any claim or objection received during a survey within one (1) week of receipt and undertake any resulting management of change actions as soon as practicable, but preferably within that week timeframe. The assessment of merit and any resulting management of change actions shall be shared with the concerned stakeholder. If the outcome of the assessment of merit of a claim or objection received during a survey suggests that new or increased impacts and risks are significant then this will trigger a revision to the EP as described in Chapter 3 given that under

sub regulation 8(1) it is an offence for a titleholder to continue if a significant new impact or risk, or a significant increase in the impact or risk, is not provided for in the EP in force.

If a significant new or increased impact or risk is identified as a result of an internal risk assessment described in Chapter 3 and it is not already appropriately covered under the EP, as required under sub regulation 17 (6), PGS shall submit a proposed revision to the EP. PGS shall determine at the time of the internal risk assessment, whether a risk or impact is considered 'significant' (e.g. has resulted in an increased residual risk ranking) based on information available at that time (e.g. reviewed scientific information, stakeholder claims or concerns). Notification to existing and new stakeholders of significant new or increased risks will be issued prior to submission of the revised EP as part of a new consultation process for the revised EP.

2.4.1 Six Monthly Updates

PGS shall ensure that at six (6) monthly intervals from the date of EP acceptance the PGS Rollo EP website will be updated with information regarding all activities associated with the Rollo EP, including:

- Completed surveys and potential new locations for surveys (if known).
- MFO observation reports and the results of any third party reviews.
- Rollo MC MSS EP Annual Environmental Reports.

PGS believes this is a far more effective process that will:

- provide a level of access to satisfy any level of interest that may arise;
- provide an avenue to keep relevant stakeholders up to date; and
- reduce stakeholder fatigue as unaffected stakeholders will not receive unnecessary notifications[6] for the whole OA.

All critical updates (i.e. projects commencing/finishing) will be sent out directly to existing and new stakeholders via the process described in Section 2.3

As part of this process, every six months PGS shall check that identified existing stakeholders are still relevant and correct, and identify new stakeholders (via organisational bodies such as AFMA, AMSA, WAFIC, DPIRD-Fisheries, lessons learnt etc.). Updates may be a stand-alone notice or part of a notification associated with a survey.

2.5 PHASE 4 - POST SURVEY NOTIFICATION

On completion of individual surveys, notification will be sent to the relevant stakeholders and those that request post survey notification (Table 2-4).

[6] *PGS will provide a six monthly notifications to all stakeholders that specifically request one.*

Table 2-4 – Ongoing stakeholder consultation plan for the Rollo OA

Organisation	Requirement	Timing
AFMA - Australian Fisheries Management Authority	• Provide a 6-monthly update. • Identify any changes to Commonwealth fisheries within the OAs and any new licence holders.	6 monthly
Australian Hydrographic Service (AHS)	• Provide data on each individual survey to enable AHS to issue a notice to mariners (NTM). At a minimum the following will be provided: o Size, location and geographical coordinates for the survey. o Likely commencement date and duration. o Survey parameters (streamer spread). o Survey and support vessels details. o Contact details of the titleholder.	4 weeks prior to the commencement of a survey.
AIMS	• Determine upcoming programs at Glomar Shoal or Rankin Bank	Annually (end of July)
	• Engagement for surveys within 60 km of Glomar Shoal or Rankin Bank	8 weeks prior to the commencement of a survey.
Australian Maritime Safety Authority (AMSA) – Rescue Control Centre (RCC)	• Enable AMSA to issue a Marine Safety Notice. • AMSA's JRCC will require the vessels details (including vessel name, callsign and Maritime Mobile Service Identity (MMSI), satellite communications details (including INMARSAT-C and satellite telephone), area of operation, requested clearance from other vessels and will need notification of when operations commence and are complete.	4 weeks prior to the commencement of a survey.
	• Survey vessel(s) notify AMSA's Joint Rescue Coordination Centre (JRCC) through rccaus@amsa.gov.auu (Phone: 1800 641 792 or +61 2 6230 6811) for AUSCOAST warning broadcasts 24-48 hours before operations commence.	48 hrs prior to the commencement of a survey
Australian Southern Bluefin Tuna Industry Association (ASBTIA)	• Provide a 6-monthly update. • To identify any changes to the fishery	6 monthly
Austral Fisheries	• Provide a 6-monthly update.	6 monthly
Commonwealth Fisheries Association (CFA)	• Provide a 6-monthly update.	6 monthly
Chaceon Pty Ltd	• Provide a 6-monthly update.	6 monthly
	• Pre-survey notification.	8 weeks prior to the commencement of a survey.
Deep Sea Water Services and Yennett Pty Ltd	• Provide a 6-monthly update.	6 monthly
	• Pre-survey notification.	8 weeks prior to the commencement of a survey.
Department of Defence	• Determine if there are any training or practice activities within the NWXA during the timeframe of a planned survey. • 40 km proximity used as this is the distance used between seismic vessels to ensure no interference with seismic signals.	8 weeks prior to the commencement of a survey.

Organisation	Requirement	Timing
	• Pre-survey notification.	
Fat Marine Pty Ltd	• Provide a 6-monthly update.	6 monthly
	• Pre-survey notification.	8 weeks prior to the commencement of a survey.
Mackerel Managed Fishery (MMF) licence holders	• Provide a 6-monthly update.	6 monthly
	• Pre-survey notification.	8 weeks prior to the commencement of a survey.
MG Kailis Group	• Provide a 6-monthly update.	6 monthly
	• Pre-survey notification.	8 weeks prior to the commencement of a survey.
North West Slope Trawl Fishery (NWSTF) licence holders	• Provide a 6-monthly update.	6 monthly
	• Pre-survey notification.	8 weeks prior to the commencement of a survey.
Old brown Dog Fishing Co	• Provide a 6-monthly update.	6 monthly
	• Pre-survey notification.	8 weeks prior to the commencement of a survey.
Panorama Management Pty Ltd and All Plains Corporation Pty Ltd	• Provide a 6-monthly update.	6 monthly
	• Pre-survey notification.	8 weeks prior to the commencement of a survey.
Pilbara Line Fishery (PLF) licence holders	• Provide a 6-monthly update.	6 monthly
	• Pre-survey notification.	8 weeks prior to the commencement of a survey.
Pilbara Fish Trawl Interim Managed Fishery (PFTIMF) licence holders	• Provide a 6-monthly update.	6 monthly
	• Pre-survey notification.	8 weeks prior to the commencement of a survey.
PPA - Pearl Producers Association	• Provide a 6-monthly update.	6 monthly
	• Pre-survey notification. • As part of this consultation PGS will supply the survey track lines showing where the source will be activated and not activated.	8 weeks prior to the commencement of a survey.
	• For proposed surveys within the 100m contour of the POMF Zone 1 and Zone 2 the following is required: ○ at least 6 months' notice to PPA; ○ provision of sufficient information of the proposed survey; ○ published and peer reviewed outcomes of the AIMS project be publicly available as part of this assessment. Any grey literature or draft results will not be considered as new science for this proposal. ○ Any other new science that is published and peer reviewed and relevant to this area.	At least 6 months prior to a proposed survey within the 100m contour of POMF Zone 1 and Zone 2.

Organisation	Requirement	Timing
	○ PGS have undertaken extensive consultation with PPA and that any proposed survey is acceptable by PPA.	
Raptis Fishing Licenses Pty Ltd	• Provide a 6-monthly update.	6 monthly
	• Pre-survey notification.	8 weeks prior to the commencement of a survey.
RNR Fisheries	• Provide a 6-monthly update.	6 monthly
	• Pre-survey notification.	8 weeks prior to the commencement of a survey.
Sabea Fishing Co Pty Ltd	• Provide a 6-monthly update.	6 monthly
	• Pre-survey notification.	8 weeks prior to the commencement of a survey.
Samon Seafoods Pty Ltd	• Provide a 6-monthly update.	6 monthly
	• Pre-survey notification.	8 weeks prior to the commencement of a survey.
Seafresh Holdings Pty Ltd	• Provide a 6-monthly update.	6 monthly
	• Pre-survey notification.	8 weeks prior to the commencement of a survey.
WA DMIRS - WA Department of Mines, Industry Regulation and Safety	• Provide pre-start notification confirming the start date of the proposed activity and a cessation notification to inform DMP upon completion of the activity to petroleum.environment@dmirs.wa.gov.au.	10 days prior to the commencement of a survey. 5 days after the cessation of a survey
WAFIC	• Provide a 6-monthly update.	6 monthly
	• Pre-survey notification.	8 weeks prior to the commencement of a survey.
WA DPIRD - Department of Primary Industries and Regional Development: Fisheries	• Provide a 6-monthly update. • Identify any changes to State fisheries within the OAs and any new licence holders.	6 monthly
	• Pre-survey notification. • As part of this consultation PGS will supply the survey track lines showing where the source will be activated and not activated.	8 weeks prior to the commencement of a survey.
	• For proposed surveys within the 100m contour of the POMF Zone 1 and Zone 2 the following is required: ○ at least 6 months' notice to DPIRD; ○ provision of sufficient information of the proposed survey; ○ published and peer reviewed outcomes of the AIMS project be publicly available as part of this assessment. Any grey literature or draft results will not be considered as new science for this proposal. ○ Any other new science that is published and peer reviewed and relevant to this area.	At least 6 months prior to a proposed survey within the 100m contour of POMF Zone 1 and Zone 2.

Organisation	Requirement	Timing
	○ PGS have undertaken extensive consultation with PPA and that any proposed survey is acceptable by PPA.	
WA DoT - WA Department of Transport	• Provide a copy of the OSCP/OPEP prior to activity commencing.	Prior to the commencement of a survey.

3. IMPLEMENTATION STRATEGY

3.1 PERFORMANCE OUTCOMES, STANDARDS AND MEASUREMENT CRITERIA

Regulation 13(7) of the Environment Regulations requires that an EP include environmental performance outcomes (EPO), environmental performance standards (EPS) and measurement criteria (MC) that address legislative and other controls to manage the environmental impacts and risks of the activity.

From the Rollo EP stakeholder engagement undertaken, any additional EPO and EPS for surveys conducted within the proposed OA have been added to Rollo EP Chapter 2 – Interactions with other Mariners. These EPS set the standards against which PGS will measure environmental performance and implementation of the control measures identified in this EP. For each EPS, appropriate MC for determining whether the EPO have been met have been identified in Chapter 2 – Interactions with other Mariners.

4. APPENDICES

APPENDIX 1A STAKEHOLDER ENGAGEMENT ASSESSMENT OF OBJECTIONS AND CLAIMS

Stakeholder Name	Communication Type	Date	Record #	Description	Attachments Provided to NOPSEMA	PGS Repsonse
AFMA - Australian Fishing Management Authority	Email	6/04/2018	AFMA 01	PGS letter sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. PGS identified North West Slope Fishery as the only Commonwealth fishery active within the operating areas. Asked AFMA to confirm and provide advice on best way to engage with the 1 - 2 vessel licence holders in the fishery.	AFMA 01 PGS Rollo Update - AFMA Email 6 April 2018.pdf; AFMA 01 PGS Rollo Update - AFMA April 2018.pdf	Provision of information.
AFMA - Australian Fishing Management Authority	Email	9/04/2018	AFMA 02	Email from AFMA. AFMA commented that there are three Commonwealth fisheries within the Survey site, namely, the North West Shelf Trawl Fishery, the Western Tuna and Billfish Fishery and the Western Deepwater Trawl Fishery. As detailed on AFMA website, consultation on these surveys should be conducted through the relevant industry associations, which are listed at: http://www.afma.gov.au/sustainability-environment/petroleum-industry-consultation/	AFMA 02 PGS Rollo Update - AFMA Email 9 April 2018.pdf	The NWST fishery has catch effort within the NCB and Beagle OAs and impacts and risks to this fishery are assessed in the Rollo EP. EP Section 2.5.5.2.5 Western Tuna and Billfish Fishery (WTBF) details that the NCB and Beagle OAs overlap the WTBF sub-area 1, however, there is no fishing effort within these areas. Most of the fishing effort in this fishery is south of Geraldton to south of Albany. EP Section 2.5.5.2.3 Western Deepwater Trawl Fishery (WDTF) details that the NCB OA overlaps the WDTF fishery, however there has been no effort in this fishery since 2013 – 2014. Response provided to AFMA (AFMA 02).
AFMA - Australian Fishing Management Authority	Email	10/04/2018	AFMA 03	PGS email: Our understanding from the Fishery Status Report 2017 is that: There has been no effort in the Western Deepwater Trawl Fishery (WDTF) since the 2013 - 2014 season. Could you please let us know if this has changed? The Western Tuna and Billfish Fishery catch effort is off south-west Western Australia. Could you please let us know if this has changed? Also it is noted that there does not seem to be an industry association for the Western Tuna and Billfish Fishery. Is this correct and hence consultation is done via WAFIC? PGS is engaging directly with CFA and WAFIC which are the industry associations for the NWST and WDTF. Considering that we are engaging with the appropriate industry associations would you like to continue receiving information in regard to the Rollo Seismic Survey such as updates and notifications for individual surveys?	AFMA 03 PGS Rollo Update - AFMA Email 10 April 2018.pdf	Request for information
AFMA - Australian Fishing Management Authority	Email	10/04/2018	AFMA 04	AMFA replied: I have just reviewed fishing data and there are currently vessel actively fishing in all three fisheries, i.e., Western Tuna and Billfish Fishery, the North West Slope Fishery and Western Deepwater Trawl Fishery. Given the number of vessels currently fishing we are unable to release spatial data on their fishing activities, however, regardless of where fishing activity has occurred in the past there is a need to consult fishers, whose fishing activities may vary from year to year and who have an entitlement to fish in the area you are testing. By consulting through the CFA and WAFIC you should be able reach all relevant fishers. Given that I am only new to this role, I would appreciate if you could continue to include me on your distribution list. PGS Response: See AFMA 05. Summary: Information provided by WAFIC (WAFIC 01) have confirmed there is one operator in the WTBF and that 3 vessels in the WDTF had undertaken a trial. They also thought there was about three active vessels in the NWST. Have contacted AFMA licensing to obtain the licensee details and once obtained will consult directly with the licensees. We keep AFMA on our contact list for any updates.	AFMA 04 PGS Rollo Update - AFMA Email 10 April 2018.pdf	Contacted CFA who do not undertake consultation on behalf of their members. Contacted WAFIC (WAFIC 01) and obtained information regarding the NWST, WTBF and WDTF. Information on updated Rollo areas provided to the one operator in the WTBF, WDTF licence holders and NWST licence holders. No responses were obtained.
AFMA - Australian Fishing Management Authority	Email	12/04/2018	AFMA 05	PGS Response: Thanks for the further information regarding the Western Tuna and Billfish Fishery and Western Deepwater Trawl Fishery. We have spoken to WAFIC and they have confirmed that there is one operator in the WTBF and that the WDTF had ~ 3 vessels undertake a trial for about 6 weeks for pink snapper. They also thought there was about three active vessels in the NWST. We have contacted AFMA licensing to obtain the licensee details, once we have them we will consult directly with the licensees. We will keep you on our contact list for any updates.	AFMA 05 PGS Rollo Update - AFMA Email 12 April 2018.pdf AFMA 05 PGS Rollo Update - AFMA Email 12 April 2018.pdf	Provision of information. AFMA included as a stakeholder for ongoing consultation (Chapter 1 Table 2.4)
AFMA - Australian Fishing Management Authority	Phone call	22/08/2018	AFMA-06	PGS: Spoke to NWST and WDTF Fishery Manager. NWST and WDTF are open fisheries that have management plans. Currently no activity to low activity due to market forces. There are licence holders within the fishery that can choose to fish in the fishery.	NA	Provision of information.
AIMS - Australian Institute of Marine Science	Email	11/06/2018	AIMS 01	PGS Email to provide information in regard to Rollo EP areas as the Beagle OA is 11 km from Glomar Shoals and the NCB OA is 7 km from Rankin Bank where AIMS have an ongoing research program. Noise modelling shows that impacts thresholds to fish and	AIMS 01 PGS Rollo Seismic Survey Email 11 June 2018.pdf	Provision of information

Stakeholder Name	Communication Type	Date	Record #	Description	Attachments Provided to NOPSEMA	PGS Repsonse
				invertebrates are not reached at these distance. However, the safe diving threshold is exceeded at these distances. Wanted to confirm with AIMS that they do not dive at Glomar and Rankin and to agree a process for obtaining updates on any AIMS activities at Glomar and Rankin. PGS is adopting the draft the UK Diving Medical Advisory Committee (DMAC) that produce the Safe Diving Distance from Seismic Surveying Operations. This is being updated and recommends where diving and seismic activity are scheduled to occur within 60 km, all parties should be made aware of the planned activity. Thus, for any survey planned within 60 km of Glomar or Rankin PGS will contact AIMS as part of the planning to check if there are any projects planned to be undertaken.	AIMS 01 N17169-001_FF_006_FigF_Rollo Shoals_180424.pdf	
AIMS - Australian Institute of Marine Science	Email	12/06/2018	AIMS 02	Emails between PGS and AIMS. AIMS confirmed that they are scheduled to be conducting diverless benthic habitat surveys for Woodside at Rankin and Glomar between 30 Nov - 10 Dec 2018. This is the final planned survey and will not have any divers in the water. AIMS and PGS agreed that PGS would contact AIMS annually at the end of July to get an update of any field work in the area of Rankin and Glomar.	AIMS 02 PGS Rollo Seismic Survey Email 12 June 2018.pdf	AIMS requirements included as a stakeholder for ongoing consultation (Chapter 1 Table 2.4).
AMSA - Australian Maritime Safety Authority	Email	20/4/2018	AMSA 01	PGS email: Update regarding the PGS Rollo MultiClient Marine Seismic Survey on behalf of PGS. Since PGS last contact with you the Rollo survey area has been substantially reduced to two areas off the North West Shelf. The attached update provides information on the changes to the Rollo areas and feedback previously given by AMSA. Would we be able to obtain an updated AIS vessel plot for these areas. I have attached the shape files. If you would like any further information in regard to the changes to the Rollo survey please let us know.	AMSA 01 PGS Rollo Update - AMSA Email 20 April 2018.pdf AMSA 01 PGS Rollo Update - AMSA April 2018.pdf	Provision of information. Previous feedback in relation to pre-start survey provision of information to AMSA-JRCC and AHS has been including in ongoing consultation (Chapter 1 Table 2.4).
AMSA - Australian Maritime Safety Authority	Email	23/04/2018	AMSA 02	AMSA email: AMSA notes that the survey area has been substantially reduced to two areas. AMSA also notes PGS' intended actions which is based on AMSA's previous advice. Attached are two updated shipping plots of the survey areas. In the Beagle sub-basin survey area the majority of large commercial shipping navigates within the north-west shipping fairways. Outside of the fairways, Offshore Support Vessels are the most likely vessels to be encountered. In the North Carnarvon basin there are two major shipping routes. The first lies in the western section of the survey area and will include heavy concentrations of cargo ships and tankers transiting along Australia's west coast. There is also a secondary route heading in a north-east direction, with the majority of commercial traffic navigating within the shipping fairway.	AMSA 02 PGS Rollo Update - AMSA Email 23 April 2018.pdf PGS_Rollo_Beagle_MCMSS-2018.pdf PGS_Rollo_EP_NCB_MCMSS-2018.pdf	EP Section 2.5.7 Commercial Shipping updated with shipping maps and information provided by AMSA. Response provided to AMSA (AMSA 03).
AMSA - Australian Maritime Safety Authority	Email	27/04/2018	AMSA 03	PGS email: Thank you for the updated shipping plots and information. We will include this in the updated Rollo EP.	AMSA 03 PGS Rollo Update - AMSA Email 27 April 2018.pdf	EP Section 2.5.7 Commercial Shipping updated with shipping maps and information provided by AMSA.
ASBTIA - Australian Southern Bluefin Tuna Industry Association	Email	30/04/2018	ASBTIA 01	PGS email: update in regard to the PGS Rollo MultiClient Marine Seismic Survey. Since last contact with you the Rollo survey area has been substantially reduced to two areas off the North West Shelf. A map is attached showing the new areas in relation to the previous broader Rollo Operating Area is attached for your reference. Could you please confirm your previous advice that these areas are not an area of key concern for the purse-seine fishery operations for the ranching of Southern Bluefin Tuna? In your previous email you noted that the broader operating area overlapped the WTBF operations. The two new operating areas overlap the WTBF fishery, however, fishing effort is to the south from Geraldton to Albany. If you would like any further information in regard to the changes to the Rollo survey please let us know.	ASBTIA01 PGS Rollo Seismic Survey - Update Email 30 April 2018.pdf; N17169-001_FF_001_Rollo Location Map with coords and distances.pdf	Provision of information.
ASBTIA - Australian Southern Bluefin Tuna Industry Association	Email	23/05/2018	ASBTIA 02	Follow up email for ASBTIA 01. Just following up on my email dated 30.4.18 regarding the changes to the Rollo EP operating areas. Do you have any comments or require any further information prior to PGS resubmitting the Rollo EP to NOPSEMA?	ASBTIA02 PGS Rollo Seismic Survey - Update Email 23 May 2018.pdf; N17169-001_FF_001_Rollo Location Map with coords and distances.pdf	Follow-up on provision of information.
ASBTIA - Australian Southern Bluefin Tuna Industry Association	Email	24/05/2018	ASBTIA 03	ASBTIA response No further comments.	ASBTIA03 PGS Rollo Seismic Survey - Update Email 24 May 2018.pdf	ASBTIA included as a stakeholder for ongoing consultation (Chapter 1 Table 2.4) to ensure any changes to the SBTF or WTBF are identified.
Austral Fisheries	Email	30/04/2018	AF 01	PGS email: regarding PGS Rollo Seismic Survey EP. The survey area previously covered a large area from Carnarvon to the NT boarder and information had been sent to Austral Fisheries but I don't think there was any reply. The area has now been reduced to two areas off the North West Shelf - map attached. The areas overlap the Western	AF01 PGS Rollo EP Update - Email 30 April 2018.pdf N17169-001_SF_012_WDTF A4_180417.pdf	Provision of information

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				Deepwater Trawl Fishery which Austral Fisheries came up as a licensee. From meeting with you (on a previous project) I didn't think Austral Fisheries fished down this far so just wanted to check if you are interested in these new areas? If you are then I can put you on the stakeholder list but if your not interested we won't bother you further.		
Austral Fisheries	Email	2/05/2018	AF 02	AF email 30.4.2018: We do hold permits for this area but we are not fishing. When is the survey likely to proceed? Not that we really have any plans for here. PGS email 1.5.2018: There are currently no planned surveys as the EP is for 5 years and will depend on what PGS get work for. For each survey PGS will contact stakeholders to check if fishing has changed and work out protocols for working together etc. I can leave you on the stakeholder list to get updates so you can see if any of the surveys will impact you in the future. AF Email 2.5.2018: That is probably best.	AF02 PGS Rollo EP Update - Email 2 May 2018.pdf	Currently don't fish in the area. AF included as a stakeholder for ongoing consultation (Chapter 1 Table 2.4). Response provided to AF (AF 03).
Austral Fisheries	Email	3/05/2018	AF 03	PGS email: will do.	AF03 PGS Rollo EP Update - Email 3 May 2018.pdf	AF included as a stakeholder for ongoing consultation (Chapter 1 Table 2.4).
Cape Conservation Group	Email	17/04/2018	CCG 01	PGS email detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. Since PGS' last contact the Rollo survey area has been substantially reduced to two areas off the North West Shelf and do not impact on the Ningaloo Coast World Heritage Property. The attached update provides maps of the new areas and information in relation protected species that the CCG had commented on during previous consultation. If you would like any further information in regards to the changes to the Rollo survey please let me know.	CCG 01 PGS Rollo Update - CCG Email 17 April 2018.pdf CCG 01 PGS Rollo Update - CCG April 2018.pdf	Provision of information
Cape Conservation Group	Email	23/05/2018	CCG 02	Follow up on CCG 01. Just following up on my email dated 17.4.18 regarding the changes to the Rollo EP operating areas. Do you have any comments or require any further information prior to PGS resubmitting the Rollo EP to NOPSEMA?	CCG 02 PGS Rollo Update - CCG Email 23 May 2018.pdf; CCG 01 PGS Rollo Update - CCG April 2018.pdf	Follow-up on provision of information. No repsonse.
Centre for Whale Research Western Australia	Email	17/04/2018	CWR 01	PGS letter sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas.	PGS Rollo Update - CWR April 2018.pdf; CWR 01 PGS Rollo Update - CWR Email 17 April 2018.pdf	Provision of information
Centre for Whale Research Western Australia	Email	23/05/2018	CWR 02	Follow up on CWR 01. Not sure if you received the email below in regard to the changes to the Rollo Seismic Survey EP. Do you have any comments or require any further information prior to PGS resubmitting the Rollo Seismic Survey EP to NOPSEMA?	CWR 02 PGS Rollo Update - CWR Email 23 May 2018.pdf PGS Rollo Update - CWR April 2018.pdf	Follow-up on provision of information.
CFA - Commonwealth Fisheries Association	Email	13/04/2018	CFA 01	PGS email sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. Confirming Cth fisheries in area and that contacting directly with updates as requested in previous engagement.	CFA 01 PGS Rollo Update - CFA April 2018.pdf CFA 01 PGS Rollo Update - CFA Email 13 April 2018.pdf	Provision of information
CFA - Commonwealth Fisheries Association	Email	23/05/2018	CFA 02	Follow up for CFA 01. Just following up on my email dated 13.4.18 regarding the changes to the Rollo EP operating areas. Do you have any comments or require any further information prior to PGS resubmitting the Rollo Seismic Survey EP to NOPSEMA?	CFA 02 PGS Rollo Update - CFA Email 23 May 2018.pdf; CFA 01 PGS Rollo Update - CFA April 2018.pdf	Follow-up on provision of information.
CFA - Commonwealth Fisheries Association	Email	24/05/2018	CFA 03	CFA email. You have contacted the correct industry associations that work in the area. They will be the best ones to discuss potential impacts. Also note that our mailing address is 10 Warleigh Grove, Brighton VIC 3186.	CFA 03 PGS Rollo Update - CFA Email 24 May 2018.pdf	CFA mail address updated. CFA included as a stakeholder for ongoing consultation (Chapter 1 Table 2.4). Response provided to CFA (CFA 04).
CFA - Commonwealth Fisheries Association	Email	24/05/2018	CFA 04	PGS Email: Thanks, and we will update your details.	CFA 04 PGS Rollo Update - CFA Email 24 May 2018.pdf	CFA included as a stakeholder for ongoing consultation (Chapter 1 Table 2.4).
Chaceon Pty Ltd	Email	6/04/2018	WCDSCMF C01	PGS email sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. Requested to confirm that the WCDSCF active area is south of Exmouth and hence activity would not impact fishery.	WCDSCMF C01 PGS Rollo Update - WCDSCMF Chaceon Email 6 April 2018.pdf WCDSCMF C01 PGS Rollo Update - WCDSCMF Chaceon April 2018.pdf	Provision of information
Chaceon Pty Ltd	Email	23/05/2018	WCDSCMF C02	Follow up on WCDSCMF C01. Just following up on my email dated 6.4.18 regarding the changes to the Rollo EP operating areas. Do you have any comments or require any further information prior to PGS resubmitting the Rollo Seismic Survey EP to NOPSEMA?	WCDSCMF C02 PGS Rollo Update - WCDSCMF Chaceon Email 23 May 2018.pdf; WCDSCMF C01 PGS Rollo Update - WCDSCMF Chaceon April 2018.pdf	Follow-up on provision of information.
Chaceon Pty Ltd	Email	24/05/2018	WCDSCMF C03	Chaceon email: All good from our side with it not conflicting our fishing operation.	WCDSCMF C03 PGS Rollo Update - WCDSCMF Chaceon Email 24 May 2018.pdf	No conflict with fishing operations.
Chaceon Pty Ltd	Email	24/05/2018	WCDSCMF C04	PGS: Do you want to receive notifications and updates for surveys within the Rollo Area in the future?	WCDSCMF C04 PGS Rollo Update - WCDSCMF Chaceon Email 24 May 2018.pdf	No response received. Chaceon included as a stakeholder for ongoing consultation (Chapter 1 Table 2.4).
Deep Sea Water Services & Yennett Pty Ltd	Email	6/04/2018	WCDSCMF D01	PGS email sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. Requested to confirm that the WCDSCF active area is south of Exmouth and hence activity would not impact fishery.	WCDSCMF D01 PGS Rollo Update - WCDSCMF Deep Water Services Email 6 April 2018.pdf WCDSCMF D01 PGS Rollo Update - WCDSCMF Deep Water Services April 2018.pdf	Provision of information

Stakeholder Name	Communication Type	Date	Record #	Description	Attachments Provided to NOPSEMA	PGS Repsonse
Deep Sea Water Services & Yennett Pty Ltd	Email	221/05/2018	WCDSCMF D02	Reply from Deep Water Services & Yennett Pty Ltd. On behalf of Yennett and deep sea water services we operate in the WCDSC fishery! Please keep us updated as to your activities as we operate in the deep off shore areas currently we are a bit further south of your zones.	WCDSCMF D02 PGS Rollo Update - WCDSCMF Deep Water Services Email 22 May 2018.pdf	Deep Water Services & Yennett Pty Ltd included as a stakeholder for ongoing consultation (Chapter 1 Table 2.4). Response provided to Deep Water Services & Yennett Pty Ltd (WCDSCMF D03).
Deep Sea Water Services & Yennett Pty Ltd	Email	23/05/2018	WCDSCMF D03	PGS email: Thanks, and we have included you as a stakeholder for ongoing updates.	WCDSCMF D03 PGS Rollo Update - Email 23 May 2018.pdf	Deep Water Services & Yennett Pty Ltd included as a stakeholder for ongoing consultation (Chapter 1 Table 2.4).
DNP - Director of National Parks	Email	20/04/2018	DNP 01	PGS email update regarding the PGS Rollo MultiClient Marine Seismic Survey. Since PGS last contact the Rollo survey area has been substantially reduced to two areas off the North West Shelf. The attached update provides information on the changes to the Rollo areas and information relevant to Commonwealth Marine Parks. If you would like any further information in regard to the changes to the Rollo survey, please let us know.	DNP 01 PGS Rollo Update - DNP April 2018.pdf DNP 01 PGS Rollo Update - Email 20 April 2018.pdf	Provision of information
DNP - Director of National Parks	Email	22/05/2018	DNP 02	PGS email: Just following up on my email dated 20.4.18 (DNP01) regarding the changes to the Rollo EP operating areas. Do you have any comments or require any further information prior to PGS resubmitting the Rollo EP to NOPSEMA?	DNP 02 PGS Rollo Update - Email 22 May 2018.pdf	Follow-up on provision of information.
DNP - Director of National Parks	Email	24/05/2018	DNP 03	DNP email: Based on the information provided, we note that the planned activities do not overlap any Australian Marine Parks. Therefore, there is no authorisation requirements from the DNP. I can confirm that we do not require further notification of progress made in relation to this activity unless details regarding the activity change and result in an overlap with a marine park or for emergency responses (see details below). Emergency responses: In planning for emergency response actions that are likely to occur within a marine park, we ask that your Environment Plan and/or Oil Pollution Emergency Plan considers the potential impacts on the park values and demonstrate how the environmental impacts and risks of that activity will be of an acceptable level and reduced to ALARP. I note the inclusion of contacting the Marine Reserve Compliance Duty Officer in the event of a diesel spill. The DNP should be made aware of oil/gas pollution incidence which occur within a marine park or are likely to impact on a marine park as soon as possible. This function can be fulfilled through notification to the 24 hour Marine Compliance Duty Officer on 0419 293 465. The notification should include: titleholder details, time and location of the incident (including name of marine park likely to be affected) proposed response arrangements as per the OPEP (e.g. dispersant, containment, etc) contact details for the response coordinator. PGS email: Thanks for your replay. I can confirm that the Rollo EP: Considers the potential impacts on the park values from an oil spill and demonstrates how the environmental impacts and risks will be of an acceptable level and reduced to ALARP. Includes the requirement to contact the Marine Reserve Compliance Duty Officer in the event of a diesel spill. PGS will contact you if there is a change to the activity that result in an overlap with a marine park or for emergency responses.	DNP 03 PGS Rollo Update - Email 24 May 2018.pdf	EP Chapter 3 Section 3.4.3 Hydrocarbon Release Caused by Vessel Collision includes assessment of impacts to 80 Mile Beach Marine Park and demonstrates how the impacts and risks will be of an acceptable level and reduced to ALARP. EP Chapter 3 Section 3.11.4 Incident Reporting includes information provided by DNP. DNP included as a stakeholder for ongoing consultation (Chapter 1 Table 2.4) in relation to any changes that may impact Commonwealth Marine Parks.
DoD - Department of Defence	Email	4/06/2018	DoD 01	PGS email: PGS is planning to undertake a number of seismic surveys within the NCB and Beagle Operating Areas over a period of 5 years from October 2018. From information we have obtained it seems that the NCB Operating Area overlaps the Learmonth Military Exercise Area. The attached map shows the NCB and Beagle Operating Areas and military area. Could you please confirm we have the correct information for the Learmonth Military Exercise Area and if there are any other defence areas we need to take into account. Could you also let us know if any military exercises are planned in these operating areas in the next 5 years (Oct 2018 - Oct 2023) and if there is information on the timing of these exercises. If you would like any further information in regard to the changes to the Rollo survey, please let us know.	DoD 01 PGS Rollo Seismic Survey Email 4 June 2018.pdf DoD 01 PGS Rollo Seismic Survey and Defence Areas Map.pdf	Provision of information
DoD - Department of Defence	Email	22/06/2018	DoD 02	DoD Email: Provided confirmation that the NCB OA overlaps the North West Exercise Area (NWXA) and that Defence may conduct active training and practice activities within the area from time to time. To ensure PGS activities do not conflict with Defence training, Defence requires notification 6-8 weeks prior to the commencement of activities located within or within proximity to the NWXA. UXO may be present in the area and PGS should inform themselves of the risk associated with conducting activities in the area. Defence also advised ensure continued liaison with the Australian Hydrographic Service (AHS), in particular ensure that the AHS is notified prior to the actual commencement of activities. This information is critical to maritime safety and reduces negative impacts on other maritime users.	DoD 02 PGS Rollo Seismic Survey Email 22 June 2018.pdf	EP Section 2.5.8 Defence Activities updated within area of NWXA. DoD and AHS notification requirements included in ongoing consultation (Chapter 1 Table 2.4). UXO may be present in the area but is not a risk to seismic survey. Response provided to DoD (DoD 03).

Stakeholder Name	Communication Type	Date	Record #	Description	Attachments Provided to NOPSEMA	PGS Repsonse
DoD - Department of Defence	Email	22/06/2018	DoD 03	PGS email: Have updated the Rollo EP with the information in regard to the NWXA and LAWR areas and the potential for UXO.PGS have included the Defence requirement to contact them 8 weeks prior to the commencement of activities located within or within proximity to the NWXA in the Rollo EP ongoing consultation plan. We have interpreted proximity as 40 km as this is the distance use between seismic vessels to ensure no interference between vessels and seismic signals. The requirement to notify AHS prior to the actual commencement of activities is also included in the Rollo EP ongoing consultation plan.	DoD 03 PGS Rollo Seismic Survey Email 22 June 2018.pdf	EP Section 2.5.8 Defence Activities updated within area of NWXA. DoD and AHS notification requirements included in ongoing consultation (Chapter 1 Table 2.4). UXO may be present in the area but is not a risk to seismic survey.
DoD - Department of Defence	Email	29/06/2018	DoD 04	Defence email: Further to our previous response, are you able to advise whether this seismic survey will involve the usage of fixed bottom sensors and/or explosives or if it will just involve vessels towing equipment on the ocean surface. PGS email: No ocean bottom sensors or explosives, it is just vessels towing equipment on the ocean surface.	DoD 04 PGS Rollo Seismic Survey Email 29 June 2018.pdf	Response provided to DoD.
Fat Marine Pty Ltd	Email	23/01/2018	PLF FM05	PGS email: Just wondering if you could get back to us on the email below (dated 28/8/2017) when you get a chance.	PLF FM05 20170817_PGS_Rollo_Update-PLF_FatMarine.pdf PLF FM05 PGS Rollo Update - PLF Fat Marine Email 31 Jan 2018.pdf PLF FM05 Draft_PGS-CSIRO_Schools_Scattering_Layers_Proposal_V3.0.pdf	Follow-up on provision of information as part of Broader Rollo EP consultation.
Fat Marine Pty Ltd	Email	6/04/2018	PLF FM01	PGS email sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. Updated operating protocol to reflect changes to areas. Confirmation that controls and operating parameters previously committed to still apply.	PLF FM01 PGS Rollo Update - PLF Fat Marine April 2018.pdf; PLF FM01 PGS Rollo Update - PLF Fat Marine Email 6 April 2018.pdf; PLF FM01 PGS Rollo Cooperation Protocol and Ongoing Consultation Plan - Fat Marine.pdf	Provision of information
Fat Marine Pty Ltd	Email	26/04/2018	PLF FM02	Email from Fat Marine: My email is [redacted].	PLF FM02 PGS Rollo Update - PLF Fat Marine Email 26 April 2018.pdf	Contact details for Fat Marine updated. Response provided to Fat Marine (PLF FM03).
Fat Marine Pty Ltd	Email	27/04/2018	PLF FM03	PGS email: In response to PLF FM03. My apologies, we will update our records with the correct email. Are you okay with the updated protocol? Please let me know if you need anything else.	PLF FM03 PGS Rollo Update - PLF Fat Marine Email 27 April 2018.pdf	Contact details for Fat Marine updated.
Fat Marine Pty Ltd	Email	23/05/2018	PLF FM04	PGS email: Follow-up on PLF FM01Just following up on my email dated 6.4.18 regarding the changes to the Rollo EP operating areas and the updated protocol. Do you have any comments or require any further information prior to PGS resubmitting the Rollo EP to NOPSEMA?	PLF FM04 PGS Rollo Update - PLF Fat Marine Email 23 May 2018.pdf PLF FM01 PGS Rollo Cooperation Protocol and Ongoing Consultation Plan - Fat Marine.pdf PLF FM01 PGS Rollo Update - PLF Fat Marine April 2018.pdf	Follow-up on provision of information. No response. Fat Marine included in ongoing consultation (Chapter 1 Table 2.4).
Fat Marine Pty Ltd	Email	11/9/2018	PLF FM06	PGS email: Provision of Rollo MMSS Fact Sheet and updated Cooperation Protocol and Ongoing Consultation Plan with new controls. We are still working on the Rollo EP and realised that the Cooperation Protocol and Ongoing Consultation Plan that was sent you back in April was not the most up to date version. Attached is the updated version along with an updated fact sheet for your reference. Since our last email we have undertaken further consultation with the Department of Primary Industries and Regional Development (DPIRD) and WAFIC and from that consultation we have agreed to additional controls to manage impacts to commercial fisheries. These controls are: • A minimum of 8 weeks' notice will be provided to commercial fishers ahead of the commencement of any seismic survey under the Rollo EP that may impact fishing operations. This has been increased from two weeks. • No more than 25,000 km^2 of 3D will be acquired within a 12-month period, for the five-year validity of the EP. This has decreased from 35,000 km^2. • No discharge of the acoustic source outside of the NCB and Beagle OAs. • No more than two seismic surveys undertaken within the Rollo OAs at the same time, except for within a fishery where there has been catch effort. In this case only one survey will be undertaken at a time within the fishery area. • Seismic acquisition will not be undertaken within 40 km of another vessel that is also acquiring data. • Seismic acquisition will not be undertaken less than one year after a survey has been undertaken over the same area. This has been increased from one month.	PLF FM06 PGS Rollo Seismic Survey Update Fat Marine - September 2018.pdf PLF FM06 PGS Rollo Cooperation Protocol and Ongoing Consultation Plan - Fat Marine Sept 2018.pdf PGS Rollo MultiClient Marine Seismic Survey Fact Sheet Sept 2018.pdf	Follow-up on provision of information including updated controls. No response. Fat Marine included in ongoing consultation (Chapter 1 Table 2.4).

Stakeholder Name	Communication Type	Date	Record #	Description	Attachments Provided to NOPSEMA	PGS Repsonse
				• Seismic surveys will only be undertaken within the Mackerel and Pilbara line, trap and trawl fisheries catch effort areas (as defined by the last five years of data from the DPIRD Fish Cube) during May, June and July which is outside of known spawning timing. • If new information becomes available through consultation or new publications regarding key locations for spawning and/or fishing locations within the operational area, PGS shall determine the feasibility of avoiding these periods/locations. The attached Cooperation Protocol and Ongoing Consultation Plan has been updated with these controls which will further reduce potential impacts to your activities. Please don't hesitate to contact us if you have any questions on the above our would like more information.		
IFAW - International Fund for Animal Welfare - Oceania	Email	17/04/2018	IFAW 01	PGS letter sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas.	PGS Rollo Update - IFAW April 2018.pdf; IFAW 01 PGS Rollo Update - IFAW Email 17 April 2018.pdf	Provision of information
IFAW - International Fund for Animal Welfare - Oceania	Email	23/05/2018	IFAW 02	Follow up for IFAW 01Just following up on my email dated 17.4.18 regarding the changes to the Rollo EP operating areas. Do you have any comments or require any further information prior to PGS resubmitting the Rollo Seismic Survey EP to NOPSEMA?	IFAW 02 PGS Rollo Update - IFAW Email 23 May 2018.pdf; PGS Rollo Update - IFAW April 2018.pdf	Follow-up on provision of information.
IFAW - International Fund for Animal Welfare - Oceania	Email	26/05/2018	IFAW 03	Apologies for the delayed response. While we appreciate the opportunity to provide feedback on your proposal, unfortunately we no longer have the capacity or expertise in our office to provide comment at this time.	IFAW 03 PGS Rollo Update - IFAW Email 26 May 2018.pdf	No comment provided.
Mackerel Managed Fishery licence holders	Letter	2/5/2018	MMF 01	PGS letter sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. As seismic surveys are typically of concern to commercial fisheries, PGS is trying to identify licence holders who have activities or interests in the proposed new Rollo operating areas and want to obtain more information. PGS contact details provided.	Fishery Licensee PGS Rollo Update – Fisheries Letter May 2018 - Mail	Provision of information. No response received.
Mackerel Managed Fishery licence holders	Letter	11/9/2018	MMF 02	Letter and fact sent to four Pilbara Line Fishery titleholders for which emails were not available. Fact sheet provided details of the survey and generic controls. Letter provide more information on controls specific to the fishery.	MMF Licence Holder 1 PGS Rollo Update - Sept 2018.pdf MMF Licence Holder 2 PGS Rollo Update BARDSLEY FISHERIES PTY LTD - Sept 2018.pdf MMF Licence Holder 3 PGS Rollo Update - Sept 2018.pdf MMF Licence Holder 4 PGS Rollo Update MARETERRAM FISHERIES PTY LIMITED - Sept 2018.pdf MMF Licence Holder 5 PGS Rollo Update - Sept 2018.pdf MMF Licence Holder 6 PGS Rollo Update BILYARA HOLDINGS PTY LTD - Sept 2018.pdf MMF Licence Holder 7 PGS Rollo Update - Sept 2018.pdf PGS Rollo MultiClient Marine Seismic Survey Fact Sheet Sept 2018.pdf	Provision of information and updated controls. No response received.
MG Kailis Group	Email	6/04/2018	KG 01	PGS email sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. Updated operating protocol to reflect changes to areas. Confirmation that controls and operating parameters previously committed to still apply.	KG01 PGS Rollo Update - PFTIMF MG Kailis Group April 2018.pdf KG01 PGS Rollo Cooperation Protocol and Ongoing Consultation Plan - PFTIMF MG Kailis Group 2018.pdf KG01 PGS Rollo EP Update MG Kailis Group - Email 6 April 2018.pdf	Provision of information
MG Kailis Group	Email	23/05/2018	KG 02	Follow up on KG01 Just following up on my email dated 6.4.18 regarding the changes to the Rollo EP operating areas. Do you have any comments or require any further information prior to PGS resubmitting the Rollo Seismic Survey EP to NOPSEMA?	KG02 PGS Rollo EP Update MG Kailis Group - Email 23 May 2018.pdf KG01 PGS Rollo Cooperation Protocol and Ongoing Consultation Plan - PFTIMF MG Kailis Group 2018.pdf KG01 PGS Rollo Update - PFTIMF MG Kailis Group April 2018.pdf	Follow-up on provision of information. No response. MG Kailis Group included in ongoing consultation (Chapter 1 Table 2.4).
MG Kailis Group	Email	11/9/2018	KG 03	PGS email: Provision of Rollo MMSS Fact Sheet and updated Cooperation Protocol and Ongoing Consultation Plan with new controls. I am sending you the following update. We are still working on the Rollo EP, and since our last email we have undertaken further consultation with the Department of Primary	KG03 PGS Rollo Seismic Survey Update MG Kailis Group - September 2018.pdf KG03 PGS Rollo Cooperation Protocol and Ongoing Consultation Plan - PFTIMF Kailis MG Sept 2018.pdf	Follow-up on provision of information including updated controls. No response. MG Kailis Group included in ongoing consultation (Chapter 1 Table 2.4).

Stakeholder Name	Communication Type	Date	Record #	Description	Attachments Provided to NOPSEMA	PGS Repsonse
				Industries and Regional Development (DPIRD) and WAFIC. From that consultation we have agreed to additional controls to manage impacts to commercial fisheries. These controls are: • A minimum of 8 weeks' notice will be provided to commercial fishers ahead of the commencement of any seismic survey under the Rollo EP that may impact fishing operations. This has been increased from two weeks. • No more than 25,000 km2 of 3D will be acquired within a 12-month period, for the five-year validity of the EP. This has decreased from 35,000 km2. • There will be <5% annual overlap with Pilbara Fish Trawl Interim Managed Fishery Zone 2 actively fished areas based on the last five years of data from DPIRD Fish Cube. • No discharge of the acoustic source outside of the NCB and Beagle OAs. • No more than two seismic surveys undertaken within the Rollo OAs at the same time, except for within a fishery where there has been catch effort. In this case only one survey will be undertaken at a time within the fishery area. • Seismic acquisition will not be undertaken within 40 km of another vessel that is also acquiring data. • Seismic acquisition will not be undertaken less than one year after a survey has been undertaken over the same area. This has been increased from one month. • Seismic surveys will only be undertaken within the Mackerel and Pilbara line, trap and trawl fisheries catch effort areas (as defined by the last five years of data from the DPIRD Fish Cube) during May, June and July which is outside of known spawning timing. • If new information becomes available through consultation or new publications regarding key locations for spawning and/or fishing locations within the operational area, PGS shall determine the feasibility of avoiding these periods/locations. The attached Cooperation Protocol and Ongoing Consultation Plan has been updated with these controls which will further reduce potential impacts to your activities. Please don't hesitate to contact us if you have any questions on the above our would like more information.	PGS Rollo MultiClient Marine Seismic Survey Fact Sheet Sept 2018.pdf	
NCWHAC - Ningaloo Coast World Heritage Advisory Committee	Email	17/04/2018	NCWHAC 01	PGS email sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. Map provided showing the new operating areas are not near or impact the Ningaloo Coast World Heritage Property.	PGS Rollo Update - NCWHAC April 2018.pdf	Provision of information
NCWHAC - Ningaloo Coast World Heritage Advisory Committee	Email	23/05/2018	NCWHAC 02	Follow up on NCWHAC 01. Just following up on my email dated 17.4.18 regarding the changes to the Rollo EP operating areas. Do you have any comments or require any further information prior to PGS resubmitting the Rollo Seismic Survey EP to NOPSEMA?	NCWHAC 02 PGS Rollo Update - NCWHAC Email 23 May 2018.pdf; PGS Rollo Update - NCWHAC April 2018.pdf	Follow-up on provision of information.
NCWHAC - Ningaloo Coast World Heritage Advisory Committee	Email	23/05/2018	NCWHAC 03	NCWHAC email: The Ningaloo Committee is meeting on Friday. If we have any comments I will get back to you.	NCWHAC 03 PGS Rollo Update - NCWHAC Email 23 May 2018.pdf	Provision of information
NCWHAC - Ningaloo Coast World Heritage Advisory Committee	Email	4/6/2018	NCWHAC 04	Thank you for letting us know about the revised Rollo Seismic Survey EP. We have no further comments to make.	NCWHAC 04 PGS Rollo Update - NCWHAC Email 4 June 2018.pdf	No objections or claims.
Nickol Bay Prawn Managed Fishery licence holders	Letter	2/5/2018	NBPMF 01	PGS letter sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. As seismic surveys are typically of concern to commercial fisheries, PGS is trying to identify licence holders who have activities or interests in the proposed new Rollo operating areas and want to obtain more information. PGS contact details provided.	Fishery Licensee PGS Rollo Update – Fisheries Letter May 2018 - Mail	Provision of information. No response received.
North Coast Shark Fishery licence holders	Letter	2/5/2018	NCSF 01	PGS letter sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. As seismic surveys are typically of concern to commercial fisheries, PGS is trying to identify licence holders who have activities or interests in the proposed new Rollo operating areas and want to obtain more information. PGS contact details provided.	Fishery Licensee PGS Rollo Update – Fisheries Letter May 2018 - Mail	Provision of information. No response received.
North West Slope Fishery licence holders	Letter	5/6/2018	NWST 01	PGS letter sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. As seismic surveys are typically of concern to commercial fisheries, PGS is trying to identify licence holders who have activities or interests in the proposed new Rollo operating areas and want to obtain more information. PGS contact details provided.	Fishery Licensee PGS Rollo Update – Fisheries Letter May 2018 - Mail	Provision of information. No response received.

Stakeholder Name	Communication Type	Date	Record #	Description	Attachments Provided to NOPSEMA	PGS Repsonse
Old Brown Dog Fishing Co	Email	6/04/2018	OBD01	PGS email sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. Updated operating protocol to reflect changes to areas. Confirmation that controls and operating parameters previously committed to still apply.	PTMF OBD01 PGS Rollo Update - PTMF Old Brown Dog April 2018.pdf PTMF OBD01 PGS Rollo Cooperation Protocol and Ongoing Consultation Plan - PTMF Old Brown Dog April 2018.pdf PTMF OBD01 PGS Rollo Update - PTMF Old Brown Dog Email 6 April 2018.pdf	Provision of information
Old Brown Dog Fishing Co	Email	23/05/2018	OBD02	Follow up on PTMF OBD02Just following up on my email dated 6.4.18 regarding the changes to the Rollo EP operating areas. Do you have any comments or require any further information prior to PGS resubmitting the Rollo Seismic Survey EP to NOPSEMA?	PTMF OBD02 PGS Rollo Update - PTMF Old Brown Dog Email 23 May 2018.pdf PTMF OBD01 PGS Rollo Update - PTMF Old Brown Dog April 2018.pdf PTMF OBD01 PGS Rollo Cooperation Protocol and Ongoing Consultation Plan - PTMF Old Brown Dog April 2018.pdf	Follow-up on provision of information. No response. Old Brown Dog included in ongoing consultation (Chapter 1 Table 2.4).
Old Brown Dog Fishing Co	Email	11/9/2018	OBD03	PGS email: Provision of Rollo MMSS Fact Sheet and updated Cooperation Protocol and Ongoing Consultation Plan with new controls. I am sending you the following update. We are still working on the Rollo EP, and since our last email we have undertaken further consultation with the Department of Primary Industries and Regional Development (DPIRD) and WAFIC. From that consultation we have agreed to additional controls to manage impacts to commercial fisheries. These controls are: • A minimum of 8 weeks' notice will be provided to commercial fishers ahead of the commencement of any seismic survey under the Rollo EP that may impact fishing operations. This has been increased from two weeks. • No more than 25,000 km2 of 3D will be acquired within a 12-month period, for the five-year validity of the EP. This has decreased from 35,000 km^2. • There will be <5% annual overlap with Pilbara Trap Managed Fishery Schedule 1 actively fished areas based on the last five years of data from DPIRD Fish Cube. • No discharge of the acoustic source outside of the NCB and Beagle OAs. • No more than two seismic surveys undertaken within the Rollo OAs at the same time, except for within a fishery where there has been catch effort. In this case only one survey will be undertaken at a time within the fishery area. • Seismic acquisition will not be undertaken within 40 km of another vessel that is also acquiring data. • Seismic acquisition will not be undertaken less than one year after a survey has been undertaken over the same area. This has been increased from one month. • Seismic surveys will only be undertaken within the Mackerel and Pilbara line, trap and trawl fisheries catch effort areas (as defined by the last five years of data from the DPIRD Fish Cube) during May, June and July which is outside of known spawning timing. • If new information becomes available through consultation or new publications regarding key locations for spawning and/or fishing locations within the operational area, PGS shall determine the feasibility of avoiding these periods/locations. The attached Cooperation Protocol and Ongoing Consultation Plan has been updated with these controls which will further reduce potential impacts to your activities. Please don't hesitate to contact us if you have any questions on the above our would like more information.	PTMF OBD03 PGS Rollo Seismic Survey Update Old Brown Dog - September 2018.pdf PTMF OBD03 PGS Rollo Cooperation Protocol and Ongoing Consultation Plan - PTMF Old Brown Dog Sept 2018.pdf PGS Rollo MultiClient Marine Seismic Survey Fact Sheet Sept 2018.pdf	Provision of updated information including updated controls. No response. Old Brown Dog included in ongoing consultation (Chapter 1 Table 2.4).
Onslow Prawn Managed Fishery licence holders	Letter	2/5/2018	OPMF 01	PGS letter sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. As seismic surveys are typically of concern to commercial fisheries, PGS is trying to identify licence holders who have activities or interests in the proposed new Rollo operating areas and want to obtain more information. PGS contact details provided.	Fishery Licensee PGS Rollo Update – Fisheries Letter May 2018 - Mail	Provision of information. No response received.
Panorama Management Pty Ltd and All Plains Corporation Pty Ltd	Email	6/04/2018	WCDSCMF P01	PGS email sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. Requested to confirm that the WCDSCF active area is south of Exmouth and hence activity would not impact fishery.	WCDSCMF P01 PGS Rollo Update - WCDSCMF Panorama Management Email 6 April 2018.pdf; WCDSCMF P01 PGS Rollo Update - WCDSCMF Panorama Management April 2018.pdf	Provision of information

Stakeholder Name	Communication Type	Date	Record #	Description	Attachments Provided to NOPSEMA	PGS Repsonse
Panorama Management Pty Ltd and All Plains Corporation Pty Ltd	Email	23/05/2018	WCDSCMF P02	Follow up on WCDSCMF P02. Just following up on my email dated 6.4.18 regarding the changes to the Rollo EP operating areas. Do you have any comments or require any further information prior to PGS resubmitting the Rollo Seismic Survey EP to NOPSEMA?	WCDSCMF P02 PGS Rollo Update - WCDSCMF Panorama Management Email 23 May 2018.pdf WCDSCMF P01 PGS Rollo Update - WCDSCMF Panorama Management April 2018.pdf	Follow-up on provision of information. No response. Panorama Management Pty Ltd and All Plains Corporation Pty Ltd included in ongoing consultation (Chapter 1 Table 2.4).
PPA - Pearl Producers Association	Email	13/04/2018	PPA 01	PGS email sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. Updated operating protocol to reflect changes to areas. Confirmation that controls and operating parameters previously committed to still apply.	PPA 01 PGS Rollo Update - PPA April 2018.pdf PPA 01 PGS Rollo Update - PPA Email 13 April 2018.pdf PPA 01 PGS Rollo Ongoing Consultation plan - PPA Updated April 2018 Draft.pdf	Provision of information
PPA - Pearl Producers Association	Phone	11/05/2018	PPA 02	PGS rang PPA to follow up on email sent 13 April 2018 and to see if wanted to meet. Not available for 2 weeks but will send some good times to meet up. PPA not wanting to okay any activity until the results of their testing is complete (planning/methodology complete, and then about a year for testing once they have got a boat).		Follow-up on provision of information.
PPA - Pearl Producers Association	Email	21/06/2018	PPA 03	PGS Email: PGS recently met with DPIRD-Fisheries to discuss the new Rollo EP NCB and Beagle Operating Areas. At this meeting it was raised that the Department retains the position that the Beagle Survey area should not extend to depths less than 100m due to the severe risk rating to immobile invertebrates (i.e. pearls). PGS agreed that we would not undertake acquisition (seismic source would not be activated) within water depths to 100 m within POMF Zone 1 and Zone 2 (see attached map) pending research outcomes. PGS have not changed the operational area however as we want to retain this area within the Rollo EP in case the future research shows that it is not a significant area for broodstock. It was also agreed at the meeting that stakeholders would be given a minimum of 8 weeks notice to stakeholders for individual surveys. The Cooperation Protocol and Ongoing Consultation Plan has been updated to reflect the 8 week notification time for any survey within the PPA fishing zones. If you would like any further information in regard to the changes to the Rollo survey please let me know or happy to meet to discuss.	PPA 03 PGS Rollo Update - PPA Email 21 June 2018.pdf PPA 03 PGS Rollo EP Pearl Oyster Exclusion June 2018.pdf PPA 03 PGS Rollo Ongoing Consultation plan - PPA Updated June 2018 Draft.pdf	PGS agreed on a further control for the POMF of no seismic acquisition within water depths to 100 m within POMF Zone 1 and Zone 2 pending research outcomes. However, want to retain the area within the operational area so if research shows no impacts area can be accessed. Updated activity pre-notification for consultation to 8 weeks from 4 weeks.
PPA - Pearl Producers Association	Email	21/06/2018	PPA 04	PGS phoned PPA to discuss the information in PPA 03 regarding the exclusion zone where no acquisition (seismic source would not be activated) within water depths to 100 m within POMF Zone 1 and Zone 2 pending research outcomes. PPA were okay with the exclusion zone still being retained as part of the Beagle operational area.	PPA 04 PGS Rollo Update - PPA Email 21 June 2018.pdf	Further clarification is required in relation to this controls as detailed in further correspondence (PPA 05 and PPA 06)
PPA - Pearl Producers Association	Email	22/06/2018	PPA 05	PPA email: PGS have decided not to include the shallow areas where the Pearling Industry actively collects pearl oysters in your EP...With respect to your comment below that the PPA is okay with PGS keeping the Beagle survey operational area unchanged on the agreement that PGS will not operate in the shallow water area until the new science has been evaluated• and the comment in the previous email below that PGS have not changed the operational area however as we want to retain this area within the Rollo EP in case the future research shows that it is not a significant area for broodstock.• I would like to add a few points: The operational area you are talking about here in the proposed Rollo EP is the area that is proposed to house an expansive seismic survey, it is not the operational area. The pearling industry has been undertaking operations in this since the 1870s - the PGS' proposed survey site overlays this. We note that with respect to this overlap - and the premise that this area may be a significant broodstock area; this is but one component where research is needed, more importantly (as has always been our concern) is the effect of seismic energy on the more vulnerable Pinctada maxima lifecycle stages (larval, settlement and recruitment). It is these stages which will affect going forward the sustainability of the stock and the sustainable utilisations of oysters by the pearling industry. When we spoke to [redacted] he simply adjusted your proposed operational area to account for the presence of the pearling industry (noting that your approach contrasts with this); where you have decided to simply defer and wait for the requisite science to be consistent with PGS intentions. I note that in the current quadrant proposal funding for the pearl production research components is adequate, however currently there is no funding available to undertake requisite R&D on the more vulnerable Pinctada maxima lifecycle stages - but AIMS and others are working achieving this important research. So to conclude, the PPA has not articulated for the record that we are okay with PGS	PPA 05 PGS Rollo Update - PPA Email 22 June 2018.pdf	Based on Fish Cube data from 2012 - 20106 the NCB and Beagle operating area, where seismic surveys will be undertaken, does not overlap areas where the POMF have catch effort or pearl leases. PGS has increased the area where no seismic acquisition will be undertaken, pending research outcomes that are acceptable to the PPA, to include the Pearl Oyster Fishery Zone 1 and 2 out to the 100 m contour. This will ensure no impacts to the POMF, broodstock or associated spawn. The boundary of the Beagle OA is within the broader Rollo OA that was adjusted to account for the presence of the pearling industry. The closest POMF fishing area is 35 km from the Beagle OA. At this distance impacts to POMF are not predicted. PGS response to objections is detailed in PPA 06. The controls in the Rollo EP to minimise impacts to POMF are: • No survey acquisition in the Pearl Oyster Fishery Zone 1 and 2 out to the 100 m contour pending research outcomes that are acceptable to the PPA. • No survey acquisition within 10 km of a pearl lease. These controls reduce the impacts to the pearl oyster fishery. In relation to research the following has been committed to in the Rollo EP:

Stakeholder Name	Communication Type	Date	Record #	Description	Attachments Provided to NOPSEMA	PGS Repsonse
				keeping the Beagle survey operational area unchanged (subject to requisite science). On the contrary, this area is the last location in the World where this species of oyster can still be sustainably fished for the quality pearl production -there is nowhere else. We note that given that the Rollo Survey site is spatially expansive'; the proposed seismic operational area is adjacent to EVERY pearling site. Depending on the comprehensiveness of an R&D program - Information that provides robust information on the nature and extent of seismic effects on the sustainability aspects of P. maxima will still need to be addressed, before the pearling industry can be assured that seismic surveying won't adversely affect pearl oyster sustainability and resource utilisation for the purposes of producing pearls. So in short we are not okay• with the Rollo survey area being unchanged, as we know that one way or another the Rollo survey will impact on pearling - on the phone I was merely acknowledging that as a company you have decided to retain your "operational area“ - to this end depending on the comprehensiveness of the R&D program and the quality of the information that identifies and characterises the nature of seismic impacts with respect to wild Pinctada maxima oysters - it will be difficult for the PPA to support your seismic survey.		• PGS will request voluntary contributions from all purchasers of MultiClient data acquired under the Rollo EP, with such funds to be directed towards seismic/fishing interaction research. Response to PPA is provided in PPA 06.
PPA - Pearl Producers Association	Email	29/06/2018	PPA 06	PGS email: With respect to your concerns communicated in your email on Friday 22nd, PGS have the following comments and clarifications. The Rollo EP Operational Area (OA) was originally one large area (revision 6), you discussed the areas of concern for pearl leasing sites with PGS, PGS then had these areas removed from the OA (to your satisfaction according to the meeting minutes, revision 7). We have since reduced the Rollo OA to two smaller areas, with the Beagle OA being the area closest to your areas of concern. When the Beagle OA was carved out of the greater Rollo OA, the boundary of the OA was again moved further away, and we are now more than 40 kms away from the pearl lease sites (see attached map New Exclusions).Within our reduced Beagle OA, PGS had previously agreed not to activate the seismic source in water depths between 50m - 100m within POMF Zone 2 and an additional 40 km into Zone 1 during 1 Sept - 31 Dec (Spawning Exclusion Area) due to the uncertainty surrounding the presence of and the possible effects on pearl oyster brood stock (see attached map Original Exclusions). After discussion with DPIRD-Fisheries, PGS agreed to extend the 50m - 100m water depth exclusion at all times into POMF Zone 1 (i.e. no change to the OA, only additional restrictions on where the seismic source can be activated) (See map New Exclusions). As you are aware, there is research currently being undertaken by AIMS, The North West Shoals to Shore program which is intended to provide scientific insight into the importance of the 50m - 100m water depth zone. If this scientific study shows that this is not an area of importance and that there is no impact from seismic acquisition, PGS would expect the DPIRD-Fisheries and the PPA to accept seismic in this zone and in kind DPIRD-Fisheries and the PPA would expect PGS to avoid areas where new scientific studies show significant impact from seismic. While PGS acknowledges your comment that funding for additional research into the effects of seismic on pearl oysters is currently inadequate, please recall that PGS has committed to seeking further funds for this research as part of this EP.	PPA 06 PGS Rollo Update - PPA Email 29 June 2018.pdf; PPA 06 Rollo EP Pearl Oyster Original Exclusions.pdf; PPA 06 Rollo EP Pearl Oyster New Exclusions.pdf	The controls in the Rollo EP to minimise impacts to POMF are: • No survey acquisition in the Pearl Oyster Fishery Zone 1 and 2 out to the 100 m contour pending research outcomes that are acceptable to the PPA. • No survey acquisition within 10 km of a pearl lease. In relation to research the following has been committed to in the Rollo EP: • PGS will request voluntary contributions from all purchasers of MultiClient data acquired under the Rollo EP, with such funds to be directed towards seismic/fishing interaction research.
Pilbara Line Fishery licence holders	Letter	2/5/2018	PLF 01	PGS letter sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. As seismic surveys are typically of concern to commercial fisheries, PGS is trying to identify licence holders who have activities or interests in the proposed new Rollo operating areas and want to obtain more information. PGS contact details provided.	Fishery Licensee PGS Rollo Update – Fisheries Letter May 2018 - Mail	Provision of information. No response received.
Pilbara Line Fishery licence holders	Letter	11/9/2018	PLF 02	Letter and fact sent to four Pilbara Line Fishery titleholders for which emails were not available. Fact sheet provided details of the survey and generic controls. Letter provide more information on controls specific to the fishery.	PLF Licence Holder 1 PGS Rollo Update - Sept 2018.pdf PLF Licence Holder 2 PGS Rollo Update - Sept 2018.pdf PLF Licence Holder 3 PGS Rollo Update - Sept 2018.pdf PLF Licence Holder 4 PGS Rollo Update WESTERN WILD FISHERIES HOLDINGS PTY LTD - Sept 2018.pdf PGS Rollo MultiClient Marine Seismic Survey Fact Sheet Sept 2018.pdf	Provision of information including updated controls. No response received.

Stakeholder Name	Communication Type	Date	Record #	Description	Attachments Provided to NOPSEMA	PGS Repsonse
Pilbara Trap Managed Fishery licence holders	Letter	2/5/2018	PTMF 01	PGS letter sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. As seismic surveys are typically of concern to commercial fisheries, PGS is trying to identify licence holders who have activities or interests in the proposed new Rollo operating areas and want to obtain more information. PGS contact details provided.	Fishery Licensee PGS Rollo Update – Fisheries Letter May 2018 - Mail	Provision of information. No response received.
Pilbara Fish Trawl Interim Managed Fishery licence holders	Letter	2/5/2018	PFTIMF 01	PGS letter sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. As seismic surveys are typically of concern to commercial fisheries, PGS is trying to identify licence holders who have activities or interests in the proposed new Rollo operating areas and want to obtain more information. PGS contact details provided.	Fishery Licensee PGS Rollo Update – Fisheries Letter May 2018 - Mail	Provision of information. No response received.
Pilbara Fish Trawl Interim Managed Fishery licence holders	Letter	11/9/2018	PFTIMF 02	Letter and fact sent to four Pilbara Line Fishery titleholders for which emails were not available. Fact sheet provided details of the survey and generic controls. Letter provide more information on controls specific to the fishery.	PFTIMF Licence Holder 1 PGS Rollo Update - Sept 2018.pdf PGS Rollo MultiClient Marine Seismic Survey Fact Sheet Sept 2018.pdf	Provision of information including updated controls. No response received.
Raptis Fishing Licenses Pty Ltd	Letter	4/6/2018	RFL 01	PGS letter sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. As seismic surveys are typically of concern to commercial fisheries, PGS is trying to identify licence holders who have activities or interests in the proposed new Rollo operating areas and want to obtain more information. PGS contact details provided.	RFL01 PGS Rollo Seismic Survey Update - Fisheries Letter Raptis Fishing June 2018.pdf	Provision of information. No response received
Raptis Fishing Licenses Pty Ltd	Email	11/9/2018	RFL 02	PGS sent a letter to Raptis Fishing Licenses Pty Ltd in June 2018 in relation to its proposed seismic surveys within the Rollo operating areas. We did not receive a reply from you and wanted to confirm that the letter had been received as the AFMA website details that Raptis Fishing Licenses Pty Ltd are a licence holder in the North West Slope Trawl Fishery and Western Deepwater Trawl Fishery which the Rollo operating areas overlap. Attached is an updated fact sheet that provides some further details in regards to PGS proposed seismic surveys. If you could please let me know whether Raptis Fishing Licenses Pty Ltd does fish within the Rollo operating area, and if you would like any further information regarding PGS proposed seismic surveys. Alternatively, if you do not fish in the area and don't want to receive further information I would appreciate if you could let me know so we can remove you from our mailing list. Please don't hesitate to contact us if you have any questions on the above or would like more information on our activities.	RFL02 PGS Rollo Seismic Survey Update Raptis Fishing Licenses Pty Ltd - September 2018.pdf PGS Rollo MultiClient Marine Seismic Survey Fact Sheet Sept 2018.pdf	Provision of information.
Raptis Fishing Licenses Pty Ltd	Email	12/9/2018	RFL 03	Raptis response: Sorry for the lack of response regarding your email. Yes I had seen the attached previously, but as we at Raptis are currently not operating in this area I thought I should leave comments to those that are. PGS response: Thanks for getting back to me, it is always good to get feedback on whether you are or aren't active in an area, so we can make sure you are getting the right information. Please don't hesitate to be in touch if your area of operations do change in the future as we are always happy to provide an update.	RFL03 PGS Rollo Seismic Survey Update Raptis Fishing Licenses Pty Ltd - September 2018.pdf	No objections or claims. Raptis Fishing Licenses Pty Ltd included in ongoing consultation (Chapter 1 Table 2.4).
RNR Fisheries Pty Ltd	Email	23/01/2018	PLF RNR03	PGS email: Just thought I'd check as to whether you had any feedback to the email (Dated 28/8/2017).	PLF RNR03 PGS Rollo Update - PLF RNR Fisheries Email 23 Jan 2018.pdf; PLF RNR03 20170817_PGS_Rollo_Update-PLF_RNRFisheries.pdf PLF RNR03 Draft_PGS-CSIRO_Schools_Scattering_Layers_Proposal_V3.0.pdf	Follow-up on provision of information.
RNR Fisheries Pty Ltd	Email	6/04/2018	PLF RNR01	PGS email sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. Updated operating protocol to reflect changes to areas. Confirmation that controls and operating parameters previously committed to still apply.	PLF RNR01 PGS Rollo Update - PLF RNR Fisheries Email 6 April 2018.pdf PLF RNR01 PGS Rollo Update - PLF RNR Fisheries April 2018.pdf PLF RNR01 PGS Rollo Cooperation Protocol and Ongoing Consultation Plan - PLF RNR Fisheries April 2018.pdf	Provision of information.
RNR Fisheries Pty Ltd	Email	23/05/2018	PLF RNR02	Follow up on PLF RNR01. Just following up on my email dated 6.4.18 regarding the changes to the Rollo EP operating areas. Do you have any comments or require any further information prior to PGS resubmitting the Rollo Seismic Survey EP to NOPSEMA?	PLF RNR02 PGS Rollo Update - PLF RNR Fisheries Email 23 May 2018.pdf PLF RNR01 PGS Rollo Cooperation Protocol and Ongoing Consultation Plan - PLF RNR Fisheries April 2018.pdf	Follow-up on provision of information. No response. RNR Fisheries Pty Ltd included in ongoing consultation (Chapter 1 Table 2.4).

Stakeholder Name	Communication Type	Date	Record #	Description	Attachments Provided to NOPSEMA	PGS Repsonse
					PLF RNR01 PGS Rollo Update - PLF RNR Fisheries April 2018.pdf	
RNR Fisheries Pty Ltd	Email	11/9/2018	PLF RNR04	PGS email: Provision of Rollo MMSS Fact Sheet and updated Cooperation Protocol and Ongoing Consultation Plan with new controls. We are still working on the Rollo EP, and since our last email we have undertaken further consultation with the Department of Primary Industries and Regional Development (DPIRD) and WAFIC. From that consultation we have agreed to additional controls to manage impacts to commercial fisheries. These controls are: • A minimum of 8 weeks' notice will be provided to commercial fishers ahead of the commencement of any seismic survey under the Rollo EP that may impact fishing operations. This has been increased from two weeks. • No more than 25,000 km2 of 3D will be acquired within a 12-month period, for the five-year validity of the EP. This has decreased from 35,000 km2. • No discharge of the acoustic source outside of the NCB and Beagle OAs. • No more than two seismic surveys undertaken within the Rollo OAs at the same time, except for within a fishery where there has been catch effort. In this case only one survey will be undertaken at a time within the fishery area. • Seismic acquisition will not be undertaken within 40 km of another vessel that is also acquiring data. • Seismic acquisition will not be undertaken less than one year after a survey has been undertaken over the same area. This has been increased from one month. • Seismic surveys will only be undertaken within the Mackerel and Pilbara line, trap and trawl fisheries catch effort areas (as defined by the last five years of data from the DPIRD Fish Cube) during May, June and July which is outside of known spawning timing. • If new information becomes available through consultation or new publications regarding key locations for spawning and/or fishing locations within the operational area, PGS shall determine the feasibility of avoiding these periods/locations. The attached Cooperation Protocol and Ongoing Consultation Plan has been updated with these controls which will further reduce potential impacts to your activities. Please don't hesitate to contact us if you have any questions on the above our would like more information.	PLF RNR04 PGS Rollo Seismic Survey Update RNR Fisheries - September 2018.pdf PGS Rollo Cooperation Protocol and Ongoing Consultation Plan - PLF RNR Fisheries September 2018.pdf PGS Rollo MultiClient Marine Seismic Survey Fact Sheet Sept 2018.pdf	Follow-up on provision of information including updated controls. No response. RNR Fisheries Pty Ltd included in ongoing consultation (Chapter 1 Table 2.4).
Sabea Fishing Co Pty Ltd	Email	30/04/2018	SF 01	PGS email: Please find attached an update in regard to the PGS Rollo MultiClient Marine Seismic Survey. Since our last contact with you the Rollo survey area has been substantially reduced to two areas off the North West Shelf. The attached update provides information on the changes to the Rollo areas and information relevant to your interests. Please let me know if the new areas are within areas you fish. If not, we can remove you from our stakeholder list and reduce your email traffic. If you would like any further information in regard to the changes to the Rollo survey please let me know.	SF01 PGS Rollo Update - [redacted] Email 30 April 2018.pdf SF01 Rollo Ongoing Consultation Plan - [redacted] - Updated April 2018.pdf SF01 PGS Rollo Update - [redacted] April 2018.pdf	Provision of information
Sabea Fishing Co Pty Ltd	Email	23/05/2018	SF 02	PGS email: Follow up on SF01. Just following up on my email dated 30.4.18 regarding the changes to the Rollo EP operating areas. Do you have any comments or require any further information prior to PGS resubmitting the Rollo EP to NOPSEMA?	SF02 PGS Rollo Update - [redacted] Email 23 May 2018.pdf SF01 PGS Rollo Update - [redacted] April 2018.pdf	Follow-up on provision of information.
Sabea Fishing Co Pty Ltd	Email	28/05/2018	SF 03	Sabea email: Thanks for the update. Yes there are no issues with your planned Seismic surveys in either zone 3 of the mackerel fishery or Gascoyne DS. I haven't talked to [redacted] since our last meeting, but as we discussed at that meeting there have been quite severe cuts to the commercial snapper fishery and closed fishing zones implemented since that time. Any updates of proposed work in the GDSF is greatly appreciated given the very fragile state of Pink Snapper populations in the GDS and the WCDS fisheries. PGS email: Thanks for your response. We will keep you on our stakeholder list so that you receive updates of any surveys within the Rollo operating area.	SF03 PGS Rollo Update - [redacted] Email 25 May 2018.pdf SF03 PGS Rollo Update - [redacted] Email 28 May 2018.pdf	The Rollo OAs (NCB and Beagle) do not overlap the MMF Zone 3 or GDSF. Pink snapper is not an indicator species or a species of significant catch for the North Coast Demersal Fisheries which consist of the Pilbara Line, Trap and trawl fisheries. Sabea Fishing Co Pty Ltd included in ongoing consultation (Chapter 1 Table 2.4).
Samson Seafoods Pty Let	Letter	4/6/2018	SS01	PGS letter sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. As seismic surveys are typically of concern to commercial fisheries, PGS is trying to identify licence holders who have activities or interests in the proposed new Rollo operating areas and want to obtain more information. PGS contact details provided.	SS01 PGS Rollo Seismic Survey Update - Fisheries Letter Samson Seafoods June 2018.pdf	Provision of information. No response received.
Samson Seafoods Pty Ltd	Email	11/9/2018	SS02	PGS email: PGS sent a letter to Samsons Seafoods in June 2018 regarding its plan to undertake seismic surveys within the Rollo operating areas. We did not receive a reply from you and wanted to ensure that you had received the information as the AFMA	SS02 PGS Rollo Seismic Survey Update Samsons Seafoods - September 2018.pdf	No objections or claims. Samson Seafoods Pty Ltd included in ongoing consultation (Chapter 1 Table 2.4).

Stakeholder Name	Communication Type	Date	Record #	Description	Attachments Provided to NOPSEMA	PGS Repsonse
				website details that you are a licence holder in the North West Slope Trawl Fishery which the Rollo operating areas overlap. Attached is an updated fact sheet which provides information in regards to the Rollo MultiClient Seismic Survey. If you could please let me know whether Samsons Seafoods does fish within the Rollo operating area, and if you would like any further information regarding PGS proposed seismic surveys. Alternatively, if you do not fish in the area and don't want to receive further information I would appreciate if you could let me know so we can remove you from our mailing list. Please don't hesitate to contact us if you have any questions on the above or would like more information on our activities. Samson Seafood email: We will not be operating in the survey area anytime in the near future. PGS email: Thanks for getting back to me, the feedback is appreciated. Please do keep in touch if your fishing operations change in future and you think there may be overlap with our EP and you would like to discuss.	PGS Rollo MultiClient Marine Seismic Survey Fact Sheet Sept 2018.pdf	
Seafresh Holdings Pty Ltd	Letter	2/5/2018	SH01	PGS letter sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. As seismic surveys are typically of concern to commercial fisheries, PGS is trying to identify licence holders who have activities or interests in the proposed new Rollo operating areas and want to obtain more information. PGS contact details provided.	SH01 PGS Rollo Update - Fisheries Letter May 2018.pdf	Provision of information. No response received.
Seafresh Holdings Pty Ltd	Email	11/9/2018	SH02	PGS email: PGS sent a letter to Seafresh Holdings Pty Ltd in June 2018 in relation to its proposed seismic surveys within the Rollo operating areas. We did not receive a reply from you and wanted to check that the letter had been received as the Rollo operating area overlaps a number of fisheries that Seafresh Holdings Pty Ltd and Shark Bay Nominees Pty Ltd are a licence holder in (NWST, WDTF, PFTIMF, PTMF). Attached is an updated fact sheet that provides some further details in regards to PGS proposed seismic surveys. If you could please let me know whether Seafresh Holdings Pty Ltd or Shark Bay Nominees Pty Ltd do fish within the Rollo operating area, and if you would like any further information regarding PGS proposed seismic surveys. Alternatively, if you do not fish in the area and don't want to receive further information I would appreciate if you could let me know so we can remove you from our mailing list. Please don't hesitate to contact us if you have any questions on the above or would like more information on our activities.	SH02 PGS Rollo Seismic Survey Update Seafresh Holdings Pty Ltd Shark Bay Nominees Pty Ltd - September 2018.pdf PGS Rollo MultiClient Marine Seismic Survey Fact Sheet Sept 2018.pdf	Provision of information. No response received.
Uptop Fisheries Pty Ltd	Letter	5/6/2018	UF 01	PGS letter sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. As seismic surveys are typically of concern to commercial fisheries, PGS is trying to identify licence holders who have activities or interests in the proposed new Rollo operating areas and want to obtain more information. PGS contact details provided.	Fishery Licensee PGS Rollo Update – Fisheries Letter May 2018 - Mail	Provision of information. No response received.
WA DBCA - WA Department of Biodiversity, Conservation and Attractions	Email	24/04/2018	DBCA 01	PGS email: Please find attached an update in regard to the PGS Rollo MultiClient Marine Seismic Survey on behalf of PGS. Since PGS' last contact with you the Rollo survey area has been substantially reduced to two areas off the North West Shelf. The new operating areas do not overlap State waters, however there is a potential that if a vessel collision occurred within 30 km of Bedout Island, and resulted in a diesel spill, the spill could reach Bedout Island. If you would like any further information in regard to the Rollo Seismic Survey please contact me as per my details below.	PGS Rollo Update - DBCA-PaWS April 2018.pdf DBCA 01 PGS Rollo Update - DBCA-PaWS Email 24 April 2018.pdf	Provision of information
WA DBCA - WA Department of Biodiversity, Conservation and Attractions	Email	24/04/2018	DBCA 02	Automatic reply from DBCA that person is on leave. Original information in DBCA 01 resent to contact in email.	DBCA 02 PGS Rollo Update - DBCA-PaWS Email 24 April 2018.pdf DBCA 02 Automtic Reply PGS Rollo Update - DBCA-PaWS Email 24 April 2018.pdf	Provision of information
WA DBCA - WA Department of Biodiversity, Conservation and Attractions	Email	24/05/2018	DBCA 03	Follow up on DBCA 01 and DBCA 02. Just following up on my email dated 24.4.18 in regard to the changes to the Rollo EP operating areas. Do you have any comments or require any further information prior to PGS resubmitting the Rollo EP to NOPSEMA?	DBCA 03 PGS Rollo Update - DBCA-PaWS Email 24 May 2018.pdf PGS Rollo Update - DBCA-PaWS April 2018.pdf	Follow-up on provision of information.
WA DBCA - WA Department of Biodiversity,	Email	7/06/2018	DBCA 04	DBCA email: Thank you for the discussion last week regarding the PGS Rollo MultiClient Marine Seismic Survey updates. From the information provided and our discussion, the proposed survey appears to pose a low risk to lands and waters managed by the	DBCA 04 PGS Rollo Update - DBCA-PaWS Email 7 June 2018.pdf	EP Chapter 3 Section 3.8 Oil Pollution Emergency Plan details that for an oil spill that enters State waters or impacts State land the WA DoT becomes the Hazard

Stakeholder Name	Communication Type	Date	Record #	Description	Attachments Provided to NOPSEMA	PGS Repsonse
Conservation and Attractions				Department of Biodiversity, Conservation and Attractions (DBCA). DBCA has no comments to provide in relation to this update.		Management Agency which PGS would support. As the HMA the WA DoT would consult with state agencies such as WA DBCA.
WA DMIRS - WA Department of Mines, Industry Regulation and Safety	Email	26/04/2018	DMIRS 01	PGS email: Please find attached an update in regard to the PGS Rollo MultiClient Marine Seismic Survey on behalf of PGS. Since PGS' last contact with you the Rollo survey area has been substantially reduced to two areas off the North West Shelf. The new operating areas do not overlap State waters, however there is a potential that if a vessel collision occurred within 30 km of Bedout Island, and resulted in a diesel spill, the spill could reach Bedout Island. If you would like any further information in regard to the Rollo Seismic Survey please contact me as per my details below.	DMIRS 01 PGS Rollo Update - DMIRS April 2018.pdf DMIRS 01 PGS Rollo Update - Email 26 April 2018.pdf	Provision of information
WA DMIRS - WA Department of Mines, Industry Regulation and Safety	Email	15/05/2018	DMIRS 02	DMIRS email: DMIRS acknowledges receipt of the information sent by PGS on 26 April 2018 updating details of the Rollo MultiClient Marine Seismic Survey to be conducted in Commonwealth waters. DMIRS notes that the proposed activity will be assessed under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 and regulated by NOPSEMA. DMIRS notes the following: A reduction in scope:- no more than two PGS surveys will be undertaken at one time- no more than 35,000km2 of data acquired with 12 months. DMIRS has reviewed the notification and does not require any further information at this stage. Please provide pre-start notification confirming the start date of the proposed activity and a cessation notification to inform DMP upon completion of the activity to petroleum.environment@dmirs.wa.gov.au. Please see the Consultation Guidance Note for information pertaining to the reporting of incidents that could potentially impact on any land or water under State jurisdiction.	DMIRS 02 PGS Rollo Update - Email 15 May 2018.pdf	Pre-start notification confirming the start date of the proposed activity and a cessation notification to inform DMIRS included in ongoing consultation (Chapter 1 Table 2.4). Incident reporting requirements to DMIRS included in Chapter 3 Section 3.11.4 Incident Reporting. Response provided to DMIRS (DMIRS 03).
WA DMIRS - WA Department of Mines, Industry Regulation and Safety	Email	22/05/2018	DMIRS 03	PGS reply to DMIRS02: The Rollo EP covers the DMIRS activity pre-start and cessation notifications and incident reporting requirements which will be implemented for each survey undertaken under the EP.	DMIRS 03 PGS Rollo Update - Email 22 May 2018.pdf	Pre-start notification confirming the start date of the proposed activity and a cessation notification to inform DMIRS included in ongoing consultation (Chapter 1 Table 2.4). Incident reporting requirements to DMIRS included in Chapter 3 Section 3.11.4 Incident Reporting.
WA DoT - WA Department of Transport	Email	24/04/2018	WA DoT 01	PGS Email: update in regard to the PGS Rollo MultiClient Marine Seismic Survey. Since PGS' last contact with you the Rollo survey area has been substantially reduced to two areas off the North West Shelf. The attached update details the changes to the Rollo areas and provides information as per the DoT's Offshore Petroleum Industry Guidance Note, Marine Oil Pollution: Response and Consultation Arrangements Rev 3 Dec 2017. Could you confirm the arrangement are acceptable to DoT. If you would like any further information in regard to the Rollo Seismic Survey, please contact me as per my details below.	WA DoT 01 PGS Rollo Update - DoT April 2018.pdf; WA DoT 01 PGS Rollo Update - DoT Email 24 April 2018.pdf	Provision of information.
WA DoT - WA Department of Transport	Email	24/04/2018	WA DoT 02	WA DoT email: Thank you for your email to the Maritime Environmental Emergency Response (MEER) Unit, Department of Transport. Please note that this mailbox is monitored during normal business hours (0800 - 1600hrs) only and will be actioned as soon as possible by the relevant officer.	WA DoT 02 PGS Rollo Update - DoT Email 24 April 2018.pdf	
WA DoT - WA Department of Transport	Email	23/05/2018	WA DoT 03	PGS email: Follow up on WA DoT 01. Just following up on my email dated 24.4.18 regarding the changes to the Rollo EP operating areas and PGS' oil spill response arrangements. Do you have any comments or require any further information prior to PGS resubmitting the Rollo EP to NOPSEMA?	WA DoT 03 PGS Rollo Update - DoT Email 23 May 2018.pdf; WA DoT 01 PGS Rollo Update - DoT April 2018.pdf	Follow-up on provision of information.
WA DoT - WA Department of Transport	Email	31/5/2018	WA DoT 04	WA DoT email: Thank you for providing us with the updated Oil Spill Risk information in regard to the revised Rollo MultiClient Marine Seismic Survey. We do not have any further comments.	WA DoT 04 PGS Rollo Update - DoT Email 31 May 2018.pdf	Incident reporting requirements to WA DoT included in Chapter 3 Section 3.11.4 Incident Reporting.
WA DPIRD - Department of Primary Industries and Regional Development: Fisheries	Email	23/03/2018	DPIRD 001	PGS follow-up email after phone call to explain change to Rollo operating area. Provision of map of new areas. Request to access Fish cube to obtain catch effort data for State fisheries that the new operating areas overlap. Commitment that once information compiled would be good to meet to discuss the changes and any outstanding issues from the previous consultation with the Department.	DPIRD 001 PGS Rollo Seismic Survey - Email 23.3.18.pdf; PGS Rollo EP NCB and Beagle Operating Areas Mar 2018.pdf	Provision of information.
WA DPIRD - Department of Primary Industries and Regional	Email	28/03/2018	DPIRD 002	DPIRD email: Obtained information from DPIRD in relation to Fish Cube which can be used to identify fishing grounds within much broader licence areas.	DPIRD 0002 PGS Rollo Seismic Survey - Email 28.3.18.pdf	Provision of information.

Stakeholder Name	Communication Type	Date	Record #	Description	Attachments Provided to NOPSEMA	PGS Repsonse
Development: Fisheries						
WA DPIRD - Department of Primary Industries and Regional Development: Fisheries	Email	16/04/2018	DPIRD 03	DPIRD email: Fish cube data broken down by year / fishery. Please note 2017 data is not included as it has not been finalised for release. I have included maps of each fishery as worksheets. Please cross reference blocks with data, please note where data is listed as confidential the block will not be outputted on the corresponding Map. CAES Block shape files attached Please contact me if you require further assistance.	DPIRD 03 PGS Rollo Update - Email 16 May 2018.pdf	Fish Cube data used to determine areas of catch effort for WA fisheries and seasonality of fishing. EP Chapter 2 2.5.5.1 State Administered Fisheries updated with information from Fish Cube.
WA DPIRD - Department of Primary Industries and Regional Development: Fisheries	Email	24/04/2018	DPIRD 04	PGS email: We have received the information from Fish Cube in relation to WA State fisheries within the new Rollo EP NCB and Beagle Operating Areas. Attached is information regarding the proposed Rollo seismic survey new operating areas. The information provided consists of: Attachment 1: information regarding the changes to the Rollo EP areas, the commercial fisheries that the areas overlap and the ongoing stakeholder consultation process for commercial fishers. Attachment 2: response to your letter to PGS dated 14 Sept 2017. As detailed in the attachment we are currently updating the Rollo EP and would like to ensure we have the correct information from DPIRD in relation to the fisheries and aquatic resources to undertake the impact assessment on.	DPIRD 0004 PGS Rollo Seismic Survey - Email 24.4.18.pdf DPIRD 0004 PGS Rollo Update DPIRD - April 2018.pdf Miller & Cripps 2013.pdf	Provision of information regarding the reduced Rollo operating areas and the assessment of impacts as part of the revision of the EP. As part of ongoing engagement with DPIRD and obtaining Fish Cube data more detailed information was available as to the fisheries and resources within the NCB and Beagle OAs. This is detailed in DPIRD 008 and DPIRD 0012. In relation to the DPIRD letter: Impacts to resources - DOF Risk Assessment: For mobile invertebrates such as scampi which the NWST target in water depths > 200m the rating is moderate. This rating is based on Day et al. (2016). Noise modelling did not predict levels at the Day et al. (2016) level at the seafloor within the NWST fishery. For immobile invertebrates such as pearl oyster the risk rating is severe (50m), high (100m) and low (>250m). PGS has implemented the following control: No survey acquisition in the Pearl Oyster Fishery Zone 1 and 2 out to the 100 m contour pending research outcomes that are acceptable to the PPA. For demersal fish such as snapper and cod risk ratings range from High (50m, 100m) and moderate (.250 m). The impact assessment predicted less than 10% of the fishery area would be impacted and has implemented the following controls: There will be <5% annual overlap with PFTIMF Zone 2 areas actively fished which equates to no more than 1,155 km^2 acquisition per year. Based on the PFTIMF Zone 2 areas actively fished (Fish Cube 2012 -2016) is 23,108 km^2. There will be <5% overlap with PTMF Schedule 1 areas actively fished which equates to no more than 4,206 km^2 acquisition per year. Based on the PTMF Schedule 1 areas actively fished (Fish Cube 2012 -2016) is 84,112 km^2: No more than one PGS survey will be undertaken at one time within a fishery area where there is catch effort. Seismic acquisition will not be undertaken within 40 km of another vessel that is also acquiring data. Seismic acquisition will not be undertaken less than one year after a survey has been undertaken over the same area. For pelagic fish such as mackerel risks are negligible. Large project envelope and poorly defined survey activities PGS has reduced the size of the OA from 830,000 km^2 to 117,833 km^2 which is an 86% reduction in area. PGS has also reduced the maximum are of acquisition a year from 35,000 km^2 to 25,000 km^2. There are two defined areas and a control of No more than one PGS survey will be undertaken at one time within a fishery area where there is catch effort. In relation to impacts to spawning PGS has implemented the control of: Seismic surveys will only be undertaken within the Mackerel and Pilbara line, trap and trawl fisheries catch effort areas (as defined by the last five years of data from Fish Cube) during May, June and July which is outside of

Stakeholder Name	Communication Type	Date	Record #	Description	Attachments Provided to NOPSEMA	PGS Repsonse
						known spawning timing. This also reduces the period of time that seismic surveys are undertaken within fishing areas providing more certainty to licence holders. PGS acknowledges that the update Rollo area is of substantial size and allows for multiple seismic surveys within a year, however, because of this size PGS has been able to implement operational restrictions to reduce impacts to licence holders and their resource to reduce impacts to ALARP.
WA DPIRD - Department of Primary Industries and Regional Development: Fisheries	Email	3/05/2018	DPIRD 05	DPIRD-Fisheries email: Thanks for your email of April 24th with the updated information on the proposed seismic survey for PGS Rollo. Firstly the Department acknowledges and is supportive of the greatly reduced survey area. I write to seek further clarification of one issue at this stage, does PGS proposed to operate in the Pearl Exclusion Zone and Spawning Exclusion Area? The wording in Table 3 is not entirely clear to me. PGS Response: In relation to the information about pearling you are correct in that a part of the information is missing. It should read: PGS will not discharge the acoustic source: From September to December, during the identified peak spawning period for P. maxima, in water depths < 100 m, plus an additional 40 km either side of the POMF Zone 2 boundary adjacent to Eighty Mile Beach (Figure 12). From January to August, outside of pearl oyster spawning, in water depths less than 50 m. At all times, PGS will adhere to 100 m minimal operational depths within the defined POMF Zone 2 (Figure 12). Pending research outcomes that are acceptable to the PPA. PPA had previously agreed to these restrictions. I have sent an update but as yet have not heard back from them. Please let me know if you need anything further or would like to meet up to go through the information.	DPIRD 0005 PGS Rollo Seismic Survey - Email 3.5.18.pdf	PGS provided clarification regarding the exclusions for the POMF.
WA DPIRD - Department of Primary Industries and Regional Development: Fisheries	Email	22/05/2018	DPIRD 06	DPIRD-Fisheries email: A couple of things I want clarified relate to Table 3. How did you calculate the total area in any one year for the PLF, PTMF and PFTIMF? Also It looks like you are planning to undertake surveys in the Pearl Exclusion Zone and the Spawning Exclusion Area. The Department does not support surveys in these locations at any time of the year. From a brief conversation with PPA they are also opposed to surveys in the locations at any time of the year. I think you are under the impression that they supported the proposals providing there were adequate controls. PGS Response: Though we are catching up I thought it would be good to reply to your questions below so we can discuss on Thursday. In relation to the calculations: PLF calculation is based on the fishery covering 550,256 km2 thus a restriction of 35,000 km2 of acquisition is equivalent to 6.36% of the fishery. PTMF calculation is not as clear and I had presumed it was 5% of the Schedule 1 area of 112,091 km2 which equates to 5610 km2 and then it had been agreed to not exceed 5000 km2. PFTIMF calculation is based on the area of Schedule 2 is 50,614 km2 of which 5% equates to 2,531 km2. It would be good to confirm with you the area of each fishery. In relation to the POMF, acquisition (use of seismic source) will not be undertaken within the Pearl Exclusion Zone at any time of the year and within the Spawning Exclusion Area between 1 Sept to 31 Dec. Maybe it is not clear as the operating area is shown to overlap these exclusion areas. However, the operating area is where the vessel may turn around but without the seismic source operating. We can discuss how to show this so that it is clear to all parties.	DPIRD 0006 PGS Rollo Seismic Survey - Email 22.5.18.pdf	PGS provided clarification regarding the exclusions for the POMF and calculation of annual area of seismic acquisition for PLF, PTMF and PFTIMF.
WA DPIRD - Department of Primary Industries and Regional Development: Fisheries	Email	24/05/2018	DPIRD 07	DPIRD-Fisheries: Thanks for the clarification on my previous question. I have one more thing I would like clarified please- how did you calculate Table 2 - overlap with catch effort. PGS Response: Just following up on your email below. Table 2 maybe a bit confusion. I was trying to capture two things in the one column: 1. the area of overlap of the fishery which is shown as a percentage. This is based on the NCB OA being 89,816 km2 and Beagle OA being 28,017 km2. 2. If there has been catch effort in the OAs in the last five years. That is the yes/no and the subscript details where that data is from. I can go over it with you on Monday. It would be good to confirm on Monday if we have the correct Area of Fishery km2 correct and our assumptions in regard to catch effort in the area.	DPIRD 0007 PGS Rollo Seismic Survey - Email 24.5.18.pdf	PGS provided clarification in regard to information provided.

Stakeholder Name	Communication Type	Date	Record #	Description	Attachments Provided to NOPSEMA	PGS Repsonse
WA DPIRD - Department of Primary Industries and Regional Development: Fisheries	Email	31/05/2018	DPIRD 08 Part 1	PGS email following up on meeting held on 28 May 2018. Summary is: 1. Area of fisheries being used in EP need to ensure align with fisheries and excludes closures. 2. Catch effort data being obtained from Fish Cube. 3. Pearl Oyster Fishery - DPIRD-Fisheries stated that they and PPA would not support seismic surveys within Zone 1 and 2 in water depths up to 100m to protect broodstock. This was their position until the research currently being undertaken via the AIMS North West Shoals to Shore program was completed. PGS agreed that they would not undertake acquisition (seismic source would not be activated) within water depths to 100 m within POMF Zone 1 and Zone 2 pending research outcomes that are acceptable to the PPA. DPIRD-Fisheries asked that this area be removed from the Rollo OA, however, PGS explained that they wanted to retain the area within the EP and instead commit to exclusion based on research outcomes. The reason for this is that if the research showed that the area to 100 m was not a source of broodstock and consultation with PPA and DPIRD-Fisheries showed impacts where ALARP and acceptable PGS may not be required to resubmit the EP to NOPSEMA saving PGS time and money. DPIRD-Fisheries asked how PGS could guarantee that the seismic source would not be operated in the exclusion area. The following controls would be undertaken: As part of the planning process for individual seismic surveys within the operating areas PGS will initiate consultation with the PPA and DPIRD-Fisheries a minimum of 2 months prior to the commencement of the survey. As part of this consultation PGS will supply the survey track lines showing where the source will be activate and not active. PGS will supply the exclusion zones to the seismic vessel and these will be included in their mapping system so they know the areas they can and cannot access or activate the seismic source. PGS will track the seismic vessel and shot point locations as live data similar to how fisheries track vessels via AIS. PGS will retain records of the seismic vessel tracks and shot points, these can be inspected by NOPSEMA and made available to PPA and DPIRD-Fisheries if requested.	DPIRD 0008 PGS Rollo Seismic Survey - Email 31.5.18.pdf; DPIRD 0008 Geomorphic Features.pdf	Points 1 and 2: EP Chapter 2 2.5.5.1 State Administered Fisheries details the area of fisheries and fishery effort based on Fish Cube data for 2012 – 2016 as 2017 data is not yet available. Final areas communicated to DPIRD in DPIRD 0012. Areas of closure for Pilbara Trawl Fishery agreed with DPIRD in DPIRD 0010. Point 3: EP Section 3.3.2.25 details performance objectives, standards and measurement criteria for pearl oysters and fishery: Performance objectives: • Undertake seismic acquisition in a manner that prevents: • long term or population impacts pearl oyster stocks • impacts to pearl oyster fisheries. Performance standards: • No survey acquisition in the Pearl Oyster Fishery Zone 1 and 2 out to the 100 m contour pending research outcomes that are acceptable to the PPA. • No survey acquisition within 10 km of a pearl lease Measurement criteria: • Vessel track logs • Shot point records • Exclusion zones available in seismic vessel mapping system The requirement for engagement with PPA and DPIRD 8 weeks prior to the commencement of a survey and to provide survey track lines showing where the source will be activated and not activated is in Chapter 1 Table 2.4 which details the ongoing consultation requirements. Chapter 1 Section 2.3 Pre-survey Consultation details the requirement to provide access to a web based near real time acquisition map along with a 72 hour forward plan.
WA DPIRD - Department of Primary Industries and Regional Development: Fisheries	Email	31/05/2018	DPIRD 08 Part 2	PGS email following up on meeting held on 28 May 2018. Summary is: 4. Assessment of demersal fishery (PLF, PTMF, PFTIMF) stock and spawning areas - Table 3 of the information provide to the DPIRD-Fisheries assessed whether the aquatic resource type per fishery area would be present based on habitat preference. DPIRD-Fisheries noted that demersal finfish should also include bluespotted emperor as this was one of the main fish species that the demersal fisheries caught. This is also an indicator species for the fishery along with red emperor and Rankin cod. The EP will be updated to include information on these indicator species. A discussion was undertaken about how to identify areas where spawning may occur. DPIRD-Fisheries said there were no identified areas and to presume that spawning occurred in the areas which were fished as fishing occurred within spawning areas. 5. Habitat areas - PGS commented that habitat areas for snapper and emperor such as offshore reefs, pinnacles and other features that had drop offs had not been identified within the Beagle and NCB OAs. DPIRD-Fisheries asked how this had been determined as habitat mapping had not been undertaken in the area. PGS explained this had been done using geomorphic features mapping as per attached. 6. DPIRD-Fisheries asked how the following restrictions were determined: PTMF - there will be <5% overlap between any single seismic survey and the PTMF i.e. the maximum survey area for a single survey within the Pilbara Trap Fishery will be <5,000 km2 per year. PFTIMF - there will be <5% overlap between any single seismic survey and Zone 2 of the fishery. The area of Zone 2 equates to 50,614 km2 thus the maximum seismic survey area for a single survey within the PFTIMF will be <2,531 km2 per year. PGS stated the 5% overlap was committed to through stakeholder engagement with fishers. As discussed it was not clear to PGS what area these calculations where done on. As noted as a previous action DPIRD-Fisheries was going to obtain the fisheries areas for PGS. 7. Individual seismic survey consultation - Currently the commitment to fishers and	DPIRD 0008 PGS Rollo Seismic Survey - Email 31.5.18.pdf; DPIRD 0008 Geomorphic Features.pdf	Point 4: EP Chapter 2 Sections 2.5.5.1.2 PTIMF, 2.5.5.1.3 PTMF and 2.5.5.1.4 PLF updated to: Major species taken by the Pilbara demersal fishery in 2015 were goldband snapper, bluespotted emperor, and crimson snapper. Assessment of impacts to commercial fish spawn has considered that spawning occurs where there is fish effort. PGS has committed to the following control to reduce impacts to commercial fish spawning species: Seismic surveys will only be undertaken within the Mackerel and Pilbara line, trap and trawl fisheries catch effort areas (as defined by the last five years of data from Fish Cube) during May, June and July which is outside of known spawning timing. Point 6: Updated information has been provided to DPIRD in relation to operational restrictions and how calculated (see DPIRD 0012 Part 3). Point 7: The requirement for engagement with commercial fishery licence holders 8 weeks prior to the commencement of a survey is detailed in Chapter 1 Table 2.4 which details the ongoing consultation requirements.

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				within the Rollo EP is that for each seismic survey stakeholder will be notified a minimum of 2 - 4 weeks prior to the survey commencing. Both PGS and DPIRD-Fisheries agreed this was not sufficient time to undertake consultation and that this should be 8 weeks (2 months) prior to a survey commencing.		
WA DPIRD - Department of Primary Industries and Regional Development: Fisheries	Email	18/06/2018	DPIRD 09	DPIRD reply to DPIRD 008 Meeting notes: 1. Area of fisheries The Department has developed some useful links to information relating to different fisheries data and resources which were forwarded. For Pilbara Trawl Fishery - Fishing does not currently occur in Zone 1, or in Areas 3 & 6 for Zone 2. Licensees are permitted to operate in Areas 1, 2, 3 and 5. When calculating the operational area of the fishery I would use Areas 1, 2, 3 and 5. 2. Catch effort data - Agreed the fisheries active in the area are as listed - POMF, PLF, PTMF and PFTIMF. 3. Pearl Oyster Fishery - The Department retains the position that the Beagle Survey area EP should not extend to depths less than 100m due to the severe risk rating to immobile invertebrates i.e. pearls (Departmental Seismic ERA). Whilst the Department appreciates that PGS would like include this area within the EP and lists controls to control operations, the Department has several concerns: It is difficult to reverse an EP approval unless there is a very significant reason. New research is likely to become available in the next few years, which will identify the importance waters <100m for pearl brood stock. The Department would like to retain this position until the science is published, peer reviewed and available. 4. Assessment of demersal fishery (PLF, PTMF, PFTIMF) stock and spawning areas. The spawning grounds for most species occurs throughout their distribution. Fishers typically target areas of higher fish densities, which may include spawning individuals, and/or spawning aggregations. As it is difficult to identify spawning areas one way to undertake seismic surveys during time periods when there is the least overlap with spawning periods. Based on the current Departmental Seismic Guidance Statement the period of least overlap is June and July. 5. Habitat areas - The Department currently uses the IMCRA mapping provided by the Department of Environment and Energy, which has several scales, the lowest being geomorphic units. I note this map is similar to the one you provided. 6. DPIRD-Fisheries asked how the following restrictions were determined: Please see GIS information links and information provided in the following email for any updates. 7. Individual seismic survey consultation. The greater time period for notification is noted and appreciated.	DPIRD 0009 PGS Rollo Seismic Survey - Email 18.6.18.pdf	Point 1: See DPIRD 010 as DPIRD confirm Pilbara Trawl Fishery areas for Zone 2 are 1,2,4,5. Point 2: See DPIRD 009 as this is incorrect as Mackerel Managed Fishery also has catch effort within the operating areas. Point 3: PGS • No survey acquisition in the Pearl Oyster Fishery Zone 1 and 2 out to the 100 m contour pending research outcomes that are acceptable to the PPA. • No survey acquisition within 10 km of a pearl lease PGS believe this is reasonable to retain the exclusion area within the EP and that sufficient controls have been committed to in the EP to ensure no seismic acquisitions takes place in the exclusion area unless research outcomes are acceptable to the PPA. The PGS response in DPIRD 0008 Part 1 details the controls committed to in the Rollo EP. Point 4: A review of the current Departmental Seismic Guidance Statement shows the period of least overlap is May, June and July for the key species for the MMF and Pilbara line, trap and trawl fisheries. Clarification was requested from DPIRD (0014). PGS has committed to the following control to reduce impacts to commercial fish spawning species: Seismic surveys will only be undertaken within the Mackerel and Pilbara line, trap and trawl fisheries catch effort areas (as defined by the last five years of data from Fish Cube) during May, June and July which is outside of known spawning timing. Point 5: The IMCRA geomorphic units are the same as the same as the geomorphic units used in the EP Chapter 2 Section 3.3.7 Geomorphic Features. Point 6: Updated information has been provided to DPIRD in relation to operational restrictions and how calculated (see DPIRD 0012 Part 3). Point 7: The requirement for engagement with commercial fishery licence holders 8 weeks prior to the commencement of a survey is detailed in Chapter 1 Table 2.4 which details the ongoing consultation requirements.
WA DPIRD - Department of Primary Industries and Regional Development: Fisheries	Email	26/06/2018	DPIRD 10	PGS email: Would you be able to check the advice for the Pilbara Trawl Fishery Zone 2. The first part says that fishing does not occur within Areas 3 & 6 for Zone 2 then it advises to use Areas 1, 2, 3 and 5 to calculate the area. The attached map of the Fish Cube catch data for 2012 to 2016 shows that there is fishing effort in Zone 2 Areas 1, 2, 4 and 5 which comes to 23,108 km2. Could you please confirm the areas. Also when we looked at the Fish Cube data we identified that there has been some catch effort for 2012 - 2016 for the Mackerel Managed Fishery see attached map. Please note that this map only shows the 10 x 10 fish cube catch effort data for those blocks within or adjacent to the survey areas. DPIRD email: I confirm there is an error below. Fishers in the trawl fishery are not permitted in operate in Zone 1, or in Area 3 in Zone 2. There has been no trawl effort in Area 6 since 1998. Therefore, the fishing area for trawl should include Areas 1, 2, 4 and 5.	DPIRD 0010 PGS Rollo Seismic Survey - Email 26.6.18.pdf DPIRD 0010 N17169-001_SF_001b_Pilbara Fish Trawl Fish Cube A4_180618.pdf DPIRD 0010 N17169-001_SF_003b_Mackerel Managed Fishery FishCubeA4_10x10_180619.pdf	DPIRD confirm that the areas open for fishing by the Pilbara Trawl Fishery for Zone 2 are 1,2,4,5.
WA DPIRD - Department of Primary Industries and Regional	Email	26/06/2018	DPIRD 11	DPIRD email: Here is that table with a list of links to fisheries. The GIS section has put together some useful links for all of fisheries which includes information on the status of fisheries and shape files. The table below is the full list of fisheries. The Pilbara trap and trawl fisheries are located in the Consolidated Management Plans group. The Pilbara line fishery is managed by prohibition in the Consolidated Notices and Orders group.	DPIRD 0011 PGS Rollo Seismic Survey - Email 26.6.18 Data Links.pdf	Provision of information that was used to determine the area of catch effort and closed and open areas of the fisheries as detailed in EP Chapter 2 Section 2.5.5.1 State Administered Fisheries. Updated information on the areas

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Development: Fisheries						of catch effort for the fisheries that the NCB and Beagle OAs overlap were provided to DPIRD 0011.
WA DPIRD - Department of Primary Industries and Regional Development: Fisheries	Mail	9/07/2018	DPIRD 12 Part 1	PGS email: An update on our meeting actions and information in relation to the Rollo Environment Plan is included below. Attached are the updated maps and area of overlap calculations. These have been updated based on the information provided by DPIRD-Fisheries from Fish Cube. As part of the impact assessment PGS has taken into account feedback from DPIRD-Fisheries and individual fishers and have implemented substantial controls to ensure all parties can undertake their activities without negatively impacting each other. Please let me know if you would like any further information. 1. Area of fisheries PGS update: Pilbara Trawl Fishery where they are allowed to fish in Zone 2 are Areas 1, 2, 4, 5. 2. The area of overlap with the State fisheries have been updated and calculated based on the area of fishery effort from Fish Cube data 2012 -2016. 2017 data is not yet available. This results in a smaller area for the fishery than using the whole area of the fishery. For example, the MMF area is 505,073 km2 while the area of catch effort is 31,977 km2 based on Fish Cube date. This provides a more conservative assessment of impact. 3. Pearl Oyster Fishery PGS update: The EP details the following performance standards in relation to the POMF: No survey acquisition in the Pearl Oyster Fishery Zone 1 and 2 out to the 100 m contour pending research outcomes that are acceptable to the PPA. No survey acquisition within 10 km of a pearl lease. This information has been provided to PPA as per the email you where cced into. In relation to ensuring PGS meet these standards, assessment will be conducted by NOPSEMA via inspections, incident reporting if PGS breach this standard, and annual reports to NOPSEMA detailing compliance with this standard. As discussed, PGS are willing to share the vessel track records with both PPA and DPIRD-Fisheries if they require further assurance that seismic acquisition has not taken place in the agreed exclusion area.	DPIRD 0012 PGS Rollo Seismic Survey - Email 9.7.18 July 2018 Update.pdf; DPIRD 0012 PGS Rollo EP State Fisheries Areas - July 2018 Update.pdf	Point 1: See DPIRD 010 as DPIRD confirm Pilbara Trawl Fishery areas for Zone 2 are 1,2,4,5. Point 2: Assessment of area of overlap with the State fisheries has been based on areas where there is fishery effort from Fish Cube data. This provides a more realistic assessment of impacts as is based on where the licence holders fish rather than the whole fishery area. Point 3: PGS believe it is reasonable to retain the POMF exclusion area within the EP and that sufficient controls have been committed to in the EP to ensure no seismic acquisitions takes place in the exclusion area unless research outcomes are acceptable to the PPA. The PGS response in DPIRD 0008 Part 1 details the controls committed to in the Rollo EP.
WA DPIRD - Department of Primary Industries and Regional Development: Fisheries	Mail	9/07/2018	DPIRD 12 Part 2	PGS email: 4. Assessment of demersal fishery (PLF, PTMF, PFTIMF) stock and spawning areas PGS update: In regards to spawning PGS will implement the following controls to prevent long term or population impacts on commercial fishery stocks: Seismic surveys will only be undertaken within the Mackerel and Pilbara line, trap and trawl fisheries catch effort areas (as defined by the last five years of data from Fish Cube) during May, June and July which is outside of known spawning timing. If new information becomes available through consultation or new publications regarding key locations for spawning and/or fishing locations within the operational area, PGS shall determine the feasibility of avoiding these periods/locations. The month of May is included as per the Departmental Seismic Guidance Statement (DoF 2013) which shows the period of May, June and July for the North Coast is the least are of overlap. In regard to key demersal species, stock status and area of overlap, these parameters have been included in the impact assessment and based on the controls detailed above in regard to spawning and below to reduce the area of overlap impacts can be managed to an acceptable level. 5. Habitat areas - no further updates.	DPIRD 0012 PGS Rollo Seismic Survey - Email 9.7.18 July 2018 Update.pdf; DPIRD 0012 PGS Rollo EP State Fisheries Areas - July 2018 Update.pdf	Point 4: A review of the current Departmental Seismic Guidance Statement shows the period of least overlap is May, June and July for the key species for the MMF and Pilbara line, trap and trawl fisheries. Clarification was requested from DPIRD (0014).
WA DPIRD - Department of Primary Industries and Regional Development: Fisheries	Mail	9/07/2018	DPIRD 12 Part 3	PGS email: 6. DPIRD-Fisheries asked how the following restrictions were determined: PGS update: In relation to determining the area of overlap per year these calculations have been updated and based on the Fishery area of effort from Fish Cube as shown in the attached document. Based on this PGS will implement the following controls: There will be <5% annual overlap with PFTIMF Zone 2 areas actively fished which equates to no more than 1,155 km2 acquisition per year. Based on the PFTIMF Zone 2 areas actively fished (Fish Cube 2012 -2016) is 23,108 km2. There will be <5% overlap with PTMF Schedule 1 areas actively fished which equates to no more than 4,206 km2 acquisition per year. Based on the PTMF Schedule 1 areas actively fished (Fish Cube 2012 -2016) is 84,112 km2. Other controls PGS will implement to further reduce impacts to commercial fishers and	DPIRD 0012 PGS Rollo Seismic Survey - Email 9.7.18 July 2018 Update.pdf; DPIRD 0012 PGS Rollo EP State Fisheries Areas - July 2018 Update.pdf	Point 6: The operational restrictions and other controls to minimise impact to commercial fisheries are detailed in EP Section 3.3.2.25 as performance standards.

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				their stock are: No more than one PGS survey will be undertaken at one time within a fishery area where there is catch effort. Seismic acquisition will not be undertaken within 40 km of another vessel that is also acquiring data. Seismic acquisition will not be undertaken less than one year after a survey has been undertaken over the same area. 7. Individual seismic survey consultation - no further updates.		
WA DPIRD - Department of Primary Industries and Regional Development: Fisheries	Mail	11/07/2018	DPIRD 13	PGS Email: This was the email to PPA that DPIRD was cced into. The control we have committed to in the EP to minimise impacts to POMF are: No survey acquisition in the Pearl Oyster Fishery Zone 1 and 2 out to the 100 m contour pending research outcomes that are acceptable to the PPA. No survey acquisition within 10 km of a pearl lease. DPIRD had requested that this area be removed from the EP and PGS have wanted to retain. The reason being that if research outcomes that are acceptable to the PPA became available PGS can undertake surveys in this area. PGS believe this is reasonable.	DPIRD 0013 PGS Rollo Seismic Survey - Email 11.7.18 July 2018 Update.pdf	PGS believe it is reasonable to retain the POMF exclusion area within the EP and that sufficient controls have been committed to in the EP to ensure no seismic acquisitions takes place in the exclusion area unless research outcomes are acceptable to the PPA. The PGS response in DPIRD 0008 Part 1 details the controls committed to in the Rollo EP.
WA DPIRD - Department of Primary Industries and Regional Development: Fisheries	Mail	11/07/2018	DPIRD 14	PGS email: I have a clarification in relation to spawning. Under the Section 1. Assessment of demersal fishery (PLF, PTMF, PFTIMF) stock and spawning areas in the email from DPIRD it says as it is difficult to identify spawning areas one way to undertake seismic surveys during time periods when there is the least overlap with spawning periods. Based on the current Departmental Seismic Guidance Statement the period of least overlap is June and July. However, the guidance shows May, June, July as least time of overlap for Pilbara trap, trawl or line fishery and mackerel fishery. Pink snapper is not an indicator species of major or iconic species for the Pilbara trap, trawl or line fishery and this is also in June/July. PGS has presume May/June/July are the least period of overlap and have committed to the following in the EP. Seismic surveys will only be undertaken within the Mackerel and Pilbara line, trap and trawl fisheries catch effort areas (as defined by the last five years of data from Fish Cube) during May, June and July which is outside of known spawning timing. Could you confirm that May, June and July are the months of least overlap.	DPIRD 0014 PGS Rollo Seismic Survey - Email 11.7.18 July 2018 Update.pdf	Point 4: A review of the current Departmental Seismic Guidance Statement shows the period of least overlap is May, June and July for the key species for the MMF and Pilbara line, trap and trawl fisheries. Clarification was requested from DPIRD (0014).
WA DPIRD - Department of Primary Industries and Regional Development: Fisheries	Mail	15/07/18	DPIRD 15	Thanks for confirming the period of least overlap for spawning is May, June and July. In the EP PGS have detailed that consultation will be undertaken for individual surveys with fishers who operate in the area with the aim to confirm fishing activity and agreed operational restrictions and timings.	DPIRD 0015 PGS Rollo Seismic Survey - Email 15.7.18 July.pdf	DPIRD confirmed that the period of least overlap for spawning is May, June and July. Thus, the following control is appropriate for minimising impacts to MMF and Pilbara line, trap and trawl fisheries resource spawning: Seismic surveys will only be undertaken within the Mackerel and Pilbara line, trap and trawl fisheries catch effort areas (as defined by the last five years of data from Fish Cube) during May, June and July which is outside of known spawning timing.
WA DPIRD - Department of Primary Industries and Regional Development: Fisheries	Mail	15/07/18	DPIRD 16	DPIRD email: Thank you for providing me with an update on the proposed Rollo EP. The Department of Primary Industries and Regional Development (DPIRD) supports previous comments made by our agency with regards to the request that the Pearling grounds that PGS has committed to not operate in (exclusion zone in the attached map) be removed from the EP. DPIRD is aware there is research currently being undertaken by AIMS and once the outcomes of these studies are finalised, published and peer reviewed, DPIRD will then be in a position to review the science, until that time DPIRD will not support the proposed survey acquisition/operational area for Beagle. I refer to the Risk Assessment of the potential impacts of seismic air gun surveys on marine finfish and invertebrates in Western Australia http://www.fish.wa.gov.au/Documents/research_reports/frr288.pdf We understand that this may not be the preferred position of PGS and as such if the operational area for Beagle is not modified as per our request above, then DPIRD request the following: • at least 6 months' notice of a proposal that may come within the 100m contour of the pearling grounds in Zone 1 and Zone 2; • sufficient information from PGS on the proposal;	DPIRD 0016 PGS Rollo Seismic Survey - Email 15.7.18 July.pdf	As PGS would like to retain the exclusion area in the EP the DPIRD requirements have been included in the EP. Chapter 1 Table 2-4 Ongoing Stakeholder Engagement has been updated to include: For proposed surveys within the 100m contour of the POMF Zone 1 and Zone 2 the following is required: ○ at least 6 months' notice to DPIRD and PPA; ○ provision of sufficient information of the proposed survey; ○ published and peer reviewed outcomes of the AIMS project be publicly available as part of this assessment. Any grey literature or draft results will not be considered as new science for this proposal. ○ Any other new science that is published and peer reviewed and relevant to this area. ○ PGS have undertaken extensive consultation with PPA and that any proposed survey is acceptable by PPA. Chapter 2 Section 3.3.2.25 Summary of Environmental performance has been updated to:

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				• published and peer reviewed outcomes of the AIMS project be publicly available as part of this assessment. Any grey literature or draft results will not be consider as new science for this proposal. • Any other new science that is published and peer reviewed and relevant to this area. • PGS have undertaken extensive consultation with PPA and that any proposed survey is acceptable by PPA. PGS email: Thanks for getting back to us on this. As PGS would like to retain the exclusion area in the EP we agree to your requests and will update the EP to reflect these requirements.		• No survey acquisition in the Pearl Oyster Managed Fishery Zone 1 or 2 out to the 100 m depth contour pending research outcomes that are acceptable to the PPA. • At least 6 months notice to PPA and DPIRD -Fisheries of a proposed survey within the 100 m depth contour of the Pearl Oyster Managed Fishery Zone 1 or 2.
WAFIC - Western Australian Fishing Industry Council	Email	20/04/2018	WAFIC 01	PGS email after phone call: Rollo Seismic EP area has been reduced to two operating areas called North Carnarvon Basin (NCB) and Beagle - see attached. The areas have been defined and significantly reduced. Trying to identify the fisheries, effort and licence holders within these two areas to recommence consultation. We have confirmed with AFMA that the two areas overlap the following Commonwealth fisheries that are active: WTBF, NWST, WDTF. Thanks for your insights into these fisheries: That the WDTF had recommenced in 2018 undertaking a trial for 6 weeks. WTBF had one licensee in the area - Uptop Fisheries. I have received the current licensee list from AFMA for these fisheries (see attached spreadsheet Cth Tab). I was going to send them a different Fact Sheet specific to their fisheries and will work on that next. In regard to the State fisheries we have identified the following that the operating areas overlap and are active in the area. Pilbara Fish Trawl Interim Managed Fishery, Pilbara Line Fishery, Pilbara Trap Managed Fishery. The following also overlap but based on data received from DPIRD don't seem to be active in the area: Mackerel Managed Fishery Area 2 and 3, West Coast Deep Sea Crustacean Managed Fishery, North Coast Shark Fishery (though currently not operating you thought they were looking at restarting in the next year), Nickol Bay Prawn (fish in nearshore waters), Onslow Prawn (fish in nearshore waters). I have obtained the licensee contacts from DPIRD for these fisheries (see attached spreadsheet State Tab). I was planning to send the attached fact sheet to these licensees with the exception of those that I have noted that we have already sent specific information to as PGS had received feedback from them via previous consultation. As requested I have attached the draft fact sheet that I was going to send the licensees of these fisheries for you to review. It contains maps of the operating areas and fisheries overlaps. Any insights would be good so we are not sending out the right level of information and also to licensees that are not relevant. Let me know if you need anything else at this stage and I can come into WAFIC if easier to go through the information.	WAFIC 01 PGS PGS Rollo EP Update - Fact Sheet for Review 20 April 2018.pdf WAFIC 01 PGS Rollo EP New Operating Areas.pdf WAFIC 01 PGS PGS Rollo EP Update - Fact Sheet for Review Email 20 April 2018.pdf WAFIC 01 PGS Rollo Update Fact Sheet 4 - State Fisheries Draft.pdf	Provision of information as WAFIC had asked to review information to be sent to fishery licensees.
WAFIC - Western Australian Fishing Industry Council	Email	27/04/2018	WAFIC 02 Part 1	WAFIC email: Note the following plus comments in green within the text of your email in the trail below: 18 pages (8 pages plus maps) plus a covering email is completely unacceptable, it is this type of consultation which exacerbates stakeholder fatigue, stakeholder fatigue has been due largely to the multiple emails / letters sent from seismic proponents such as PGS, TGS etc. with no exaggeration some proposals have been re-done and re-sent more than 5 times plus, plus. Page 11 Mackerel Manger Fisher (should be Managed Fishery) Operational Restrictions - this is not clear and to me it downplays impacts to fishers. Proposing no more than 2 surveys at any one time? Not within 40kms of each other? Can repeat in the same area only after one month? The above need to be highlighted and bold - the potential effect of this is huge, it distorts what the true impact is. Fishers don't know where and when these surveys are going to take place and on top of that, PGS is proposing parallel surveys and the potential for surveys in the same area after just one month??? How can fishers respond to that? The new operating area map is not clear, I would make the lines in a colour which stands out (red?) not blue and slate grey on blue. Good to have the original map fishers will then recall this (because it was so huge / so ugly etc) and can tie this consultation in with the past emails/letter (s). To give it context, I would have the new lines on this monster map in red. Note the water depth for Beagle is as shallow as 33 metres. How much seismic activity is in waters less than 100 metres and less than 50 metres. If there is going to be seismic	WAFIC 02 PGS Rollo EP Update - Fact Sheet for Review Email 27 April 2018.pdf	Response provided in WAFIC 03. Via ongoing consultation the following controls where included in the Rollo EP to reduce impacts to commercial fishers and were communicated to WAFIC in WAFIC 06: Reduced annual area of seismic acquisition from 35,000 km2 to 25,000 km2 of acquisition within a 12-month period, for the five-year lifespan of the EP. Increased time between acquisition over the same area from 1 month to one year. Though a maximum of two surveys can occur within the operating areas, only one survey will occur within a fishery area at a time No seismic acquisition during June and July which DPIRD-Fisheries has advised is the period of least overlap with commercial fish spawning.

Stakeholder Name	Communication Type	Date	Record #	Description	Attachments Provided to NOPSEMA	PGS Repsonse
				activity in these areas (prime fishing water depths) you need to address the issue of increased impact of seismic activities in shallower waters.		
WAFIC - Western Australian Fishing Industry Council	Email	27/04/2018	WAFIC 02 Part 2	WAFIC email: Potential impact to commercial fisheries. Zero information on impacts to the resource. Zero information on impacts to spawning fish and fish spawn. Zero information on impacts due to plankton death. Recent research says plankton die, if plankton dies quite likely so will fish spawn. These points are raised all the time in seismic consultation you need to let fishers know how you plan to work around impacts to the resource. WDTF - Looking at these maps, I'm not sure if this overlaps, hard to tell, goes to the tip of Exmouth Gulf. You need to include Southern Bluefin Tuna not for licence holders but absolutely for the resource spawning areas and migratory route. MMF Area 2 and 3 - it is in the water depths for this fishery, especially Beagle. If you're doing your own engagement you need to confirm agreed engagement with LHs. West Coast Deep Sea Crustacean Managed Fishery - Agree they don't fish this far north, however, seismic impact on the resource is very important and needs to be addressed - potential future use. North Coast Shark Fishery - This is the state fishery, it is closed. However, you need to address the resource and protect the resource (breeding stock area). The joint authority fishery is further north, they are looking at fishing again (currently getting WTO approval). Nickol Bay Prawn - Beagle shallow waters may be an issue - check State of the Fisheries, they show trawl activities for these prawn fisheries Onslow Prawn - very little fishing due to Wheatstone, a couple back in the water this year but not out to the edge of the fishery as per your overlay maps	WAFIC 02 PGS Rollo EP Update - Fact Sheet for Review Email 27 April 2018.pdf	As detailed in response to WAFIC (WAFIC 03) this letter was to fishery licence holders that had either not been previously engaged with for the broader Rollo EP or had not responded to consultation to information supplied regarding the broader Rollo EP. The aim of this letter was to make initial contact to then proceed with provision of more detailed information. Thus, these stakeholders had not raised any issues or concerns. Where stakeholders have raised issues or concerns in regard to impacts on the resource, impacts to spawning fish and fish spawn or impacts due to plankton information has been provided.
WAFIC - Western Australian Fishing Industry Council	Email	9/05/2018	WAFIC 03	Thanks for your feedback both below and on the phone. Agree that the letter and fact sheet is too long. The letter is to notify licensees, who have not responded to date to information sent regarding the Rollo EP, about the changes and to try to get a response as to if the areas are of interest to them. So on your advice have slashed the letter back to a 2 pager to notify of the changes and request that they let us know if potentially impacted so we can then engage with them. As recommended by you have added a comment (in bold) that if we don't hear from them we will remove from the stakeholder list. I have added some comments to your comments below. Page 11 Mackerel Manger Fisher (should be Managed Fishery) PGS - changed. Operational Restrictions - PGS - these restrictions have come about from engagement with the licensees that have responded to previous contact. I will relook at though as part of the update I am doing to the impact assessment. Operating area map is not clear - PGS - am getting maps updated so can see areas better. Note the water depth for Beagle is as shallow as 33 metres. The 33 - 50m is 0.1% of the Beagle Area. However, I should have included that there is an agreed restriction with PPA that the seismic source will not be discharged within the 100m isobath off 80 Mile Beach (map attached). So technically the shallowest water depth will be ~65 m. Potential impact to commercial fisheries - PGS - I am updating the impact assessment and will ensure that it covers these impacts so we can let fishers know the extent of impacts. PGS - WDTF - updates have been sent to licensees. Southern Bluefin Tuna - updates have been sent to ASBTIA.MMF - updates have been sent to licensees. West Coast Deep Sea Crustacean Managed Fishery - updates have been sent to licensees. Shark fisheries - PGS - updates have been sent to NCSF licensees. JA fishery is much further north than the new areas. Nickol Bay Prawn - PGS - updates have been sent to licensees. Onslow Prawn - PGS - updates have been sent to licensees.	WAFIC 03 PGS Rollo EP Update - Fact Sheet for Review Email 9 May 2018.pdf WAFIC 03 N17169-001_SF_006a_Pearl Oyster Exclusion A4_180405.pdf	Update to WAFIC as to how their comments on the fishery and information to be provided to them have been addressed. Information on operational restrictions is provided in WAFIC 06. Shallowest water depth is 40 – 50m which is still 1% of the OAs.
WAFIC - Western Australian Fishing Industry Council	Email	15/06/2018	WAFIC 04	WAFIC email 14.6.18: What's happening with this please? Keen to receive a Rollo update. PGS email 15.6.18: The EP submission date has been delayed until the 16th July 2018 to allow a longer period for stakeholder engagement. No issues but when we did our mail out a couple of Commonwealth fisheries were accidentally missed. Hence different mail out dates. State Fisheries -On the 4 May letters were sent to all licences in the following State fisheries: Mackerel Managed Fishery, North Coast Shark, Nickol Bay Prawn, Onslow Prawn, Pilbara Trap, Pilbara Line, Pilbara Trawl, West Coast Deep Sea Crustacean. We	WAFIC 04 PGS Rollo EP Update - Update 15 June 2018.pdf	PGS supplied an updated as to the fisheries that have been sent a letter to initiate engagement regarding the update Rollo areas. As no response has been received from the letter sent. PGS was trying to obtain contact details for those stakeholders who had not previously received information as part of the consultation for the broader Rollo EP.

Stakeholder Name	Communication Type	Date	Record #	Description	Attachments Provided to NOPSEMA	PGS Repsonse
				have only had response from a couple of licensees saying they have no concerns. Commonwealth Fisheries - On the 5 June letters were sent to all licences in the following Commonwealth fisheries: North West Slope Fishery, Western Deep Water Trawl Fishery, UPTOP FISHERIES PTY LTD. To date we have had no response from the Commonwealth Fisheries. Would you have any contact details for the following licensees that you could share? RAPTIS FISHING LICENCES PTY LTD, SAMSON SEAFOODS PTY LTD, SEAFRESH HOLDINGS PTY LTD, W.A. FISHING DEVELOPMENTS PTY. LTD, UPTOP FISHERIES PTY LTD. We have also meet with the Fiona Webster at the DPIRD-Fisheries and gone through her feedback.		
WAFIC - Western Australian Fishing Industry Council	Email	27/06/2018	WAFIC 05	WAFIC email: Unfortunately, not in position to give out contact information, this is WAFIC IP plus it is licence holder information, will not release without their permission. Keen to receive a formal written update, only information I have received of late was the draft information to go to licence holders and the update below. Seek more than a telephone update please. WAFIC is keen to also make comment as a stakeholder for this updated EP, look forward to receiving: Copy of the corro sent to fishers. Overall update on the EP.	WAFIC 05 PGS Rollo EP Update - WAFIC Reply 27 June 2018.pdf	WAFIC cannot supply licence holder information. There are four licence holders who have only been contacted once as there is no other contact information available for them. A copy of the correspondence sent to all licence holders and an update on the EP is provided in WAFIC 06.
WAFIC - Western Australian Fishing Industry Council	Email	29/06/2018	WAFIC 06	PGS email: Stakeholder Engagement: Attached is the letter that was sent to the following State fisheries (sent 4 May) and Commonwealth Fisheries (sent 5 June). The aim of this letter was to provide licensees some general information in regard to the Rollo seismic survey operational areas so that they could determine if they wanted any detailed information or raise any concerns. To date we have had no replies to this mail out. Mackerel Managed Fishery, North Coast Shark, Nickol Bay Prawn, Onslow Prawn, Pilbara Trap, Pilbara Line, Pilbara Trawl, West Coast Deep Sea Crustacean, North West Slope Fishery, Western Deep Water Trawl Fishery, Uptop Fisheries Pty Ltd. Of these fisheries, four licensees that operate within the updated Rollo areas have not had any previous correspondence in regard to the Rollo Seismic Surveys. These are Bardsely Fisheries Pty Ltd (MMF), [redacted] (Pilbara Line), Samson Seafoods Pty Ltd and Uptop Fisheries Pty Ltd. We have googled these licensees and cannot find an alternative contact. From the mail out we did to stakeholders that had previously engaged on the broader Rollo EP, we have had no issues or concerns raised from those that have replied back to PGS. Operational Restrictions: There has been a number of changes to the operational restrictions to reduce the impact on fisheries: Reduced annual area of seismic acquisition from 35,000 km2 to 25,000 km2 of acquisition within a 12-month period, for the five-year lifespan of the EP. Increased time between acquisition over the same area from 1 month to one year. Though a maximum of two surveys can occur within the operating areas, only one survey will occur within a fishery area at a time No seismic acquisition during June and July which DPIRD-Fisheries has advised is the period of least overlap with commercial fish spawning. Survey Consultation: For each survey we have increased the timing to contact fishers that may be affected from 4 weeks to 8 weeks to provide more time for consultation and to be able to coordinate each party's activities to minimise restrictions on either party.	WAFIC 06 PGS Rollo Update - Update 29 June 2018.pdf; WAFIC 06 PGS Rollo Update - Fisheries Letter May 2018 - Mail.pdf	A copy of the correspondence sent to all licence holders and an update on the EP is provided. The operational restrictions are detailed as performance standards in the EP. The requirement for engagement with commercial fishery licence holders 8 weeks prior to the commencement of a survey is detailed in Chapter 1 Table 2.4 which details the ongoing consultation requirements.
WAFIC - Western Australian Fishing Industry Council	Email	2/07/2018	WAFIC 07 Part 1	WAFIC email: Thank you for the WAFIC Rollo update below of 29th June 2018 and the copy of a letter sent to state commercial fishers of 2nd May 2018 and to commonwealth commercial fishers of 5th June 2018. I would have expected that WAFIC, as a key stakeholder, would have received the Rollo update at the same time as our commercial fishers, however better late than never! Note the following: There is nowhere in this correspondence clearly stating that this EP is being worked for potential seismic surveys and that PGS would only be proceeding with any surveys if your tender is successful (competing I believe with possibly four to five other companies)? This unfortunately creates the incorrect impression there are multiple seismic surveys occurring by multiple parties. Does PGS have any idea when the tender process will open for the areas you are seeking EP approval for? Including this information in your correspondence with stakeholders would provide a far clearer picture and be a far more transparent process. Not including it and therefore fishers having no idea when these surveys may take place does not	WAFIC 07 PGS Rollo Update - 2 July 2018.pdf	Response is provided in WAFIC 08. PGS has throughout the Rollo EP process undertaken extensive consultation, and where stakeholders have responded to information provided, actively engaged to try to minimise impacts on stakeholders. Consultation/engagement cannot occur if a party does not engage. PGS has provided information to affected fishery licensees with PGS contact details available, they have undertaken consultation with fishery industry groups and information of the EP is available on the NOPSEMA website. For individual surveys consultation will again be undertaken providing affect stakeholders another opportunity to comment and raise any objections or concerns.

Stakeholder Name	Communication Type	Date	Record #	Description	Attachments Provided to NOPSEMA	PGS Repsonse
				encourage any responses. Your opening paragraph assumes that stakeholders are aware of the Rollo history and that this is an up-date letter only, especially targeting stakeholders who have not previously replied. I have (multiple) correspondence regarding Rollo going back more than two years, in that two year period, as Rollo has evolved, I have also received many emails from many seismic and other oil and gas proponents (or companies representing seismic proponents, these companies sometimes representing multiple seismic companies), many with similar names (PGS, TGS, RPS, CGG, ERM etc). Accordingly, a better opening paragraph and some back information would have been helpful (note the maps are good) to clearly note a) who you are b) what PGS had planned to do and then c) your revised proposal etc. I would also be very, very surprised if commercial fishers kept a file for each operator (and each activity) in the oil and gas industry - this is a full-time job, hence the importance of a better introduction.		
WAFIC - Western Australian Fishing Industry Council	Email	2/07/2018	WAFIC 07 Part 2	WAFIC email: As an update, I would have expected you to note concerns previously raised and that these concerns have been taken into account at these two revised sites, such as not conducting surveys during peak catching periods, not conducting surveys during spawning periods of key indicator species etc (see my comments in the email trail below from April). As it stands now, we know the area but don't have any update how PGS will mitigate impacts on commercial fishers and the commercial fishing resource. By informing upfront how you have recognised, identified and mitigated these concerns would have been very good information for commercial fishers. As it stands now, you have sent revised site information and then saying contact PGS if you want further information, not very helpful and not a good use of fisher time. The update also does not indicate how many times you may / may not be conducting surveys in and over the same area and over how many year time frame. It is my understanding that [redacted] met directly with commercial fishers, have you managed to meet with or have a telephone contact with these key stakeholders? I appreciate it is a fine line between engaging with stakeholders and then "presuming" a no-reply equates to a lack of ongoing interest. The lack of interest is an unfortunate result of extremely poor consultation from a range of seismic proponents since the inception of NOPSEMA. A no-reply does not necessarily equate to zero interest and in many cases is a representation of fed-up fishers who believe they are not being heard and that you will be "coming through ready or not" regardless of commercial fishing activity and regardless of environmental and spawning conditions for key indicator species. Hence as per my comment above and below from April, if you had included mitigation information in this update fishers may then have reason to have some small confidence that perhaps their concerns have been recognised and it would alleviate the need for them to contact you one by one. I look forward to hearing from you regarding an approximate time-frame for the Rollo submission. Once the EP is submitted and "assuming" with modifications etc this EP may potentially be approved, thereafter, knowing proponents proposed survey timings what is the approximate timeframe for the next update to commercial fishers with clarity around actual survey activity, why these survey dates are being considered and demonstrating to commercial fishers how all concerns have been addressed and mitigated in relation to the proposed survey dates.	WAFIC 07 PGS Rollo Update - 2 July 2018.pdf	
WAFIC - Western Australian Fishing Industry Council	Email	5/07/2018	WAFIC 08	PGS email: Thanks for your reply and feedback. It is good to get your perspective in regard to information being sent to fishers, especially in relation to this broader EP for which consultation has been ongoing for a period of time. PGS has had limited feedback from fishers contacted by mail and email. Those that have responded have typically responded that the area is not an area of concern for them. In relation to individual surveys, there is currently one tender process open within the Rollo EP area but this is in deeper water away from main fishing areas. If PGS is successful with the tender and can obtain EP approval, we would look at undertaking the survey in December 2018. As part of the ongoing consultation process however, we would engage with any affected fishers and at that stage provide more detailed information. As to ongoing consultation for surveys within the Rollo EP area (presuming it is accepted by NOPSEMA) we would be keen to work with you to minimise the ongoing burden on	WAFIC 08 PGS Rollo Update - 5 July 2018.pdf	Response to WAFIC 07. PGS has throughout the Rollo EP process undertaken extensive consultation, and where stakeholders have responded to information provided, actively engaged to try to minimise impacts on stakeholders. Consultation/engagement cannot occur if a party does not engage. PGS has provided information to affected fishery licensees with PGS contact details available, they have undertaken consultation with fishery industry groups and information of the EP is available on the NOPSEMA website. For individual surveys consultation will again be undertaken providing affect stakeholders another

Stakeholder Name	Communication Type	Date	Record #	Description	Attachments Provided to NOPSEMA	PGS Repsonse
				stakeholders and be able to engage more effectively to ensure both parties can undertake their activities without negatively impacting each other. We believe that throughout the Rollo EP consultation where we have been able to engage with fishers, PGS has taken onboard their concerns and come up with controls or measures to minimise impacts. The Rollo EP is required to be submitted to NOPSEMA by the 16th July and we will endeavour to keep you more up to date with its progress and associated consultation.		opportunity to comment and raise any objections or concerns.
WAFIC - Western Australian Fishing Industry Council	Email	11/7/2018	WAFIC 09	I do not believe your response has acknowledged the concerns I raised on behalf of the commercial fishing sector namely: • Have you only emailed / sent a letter to commercial fishers or did you succeed in telephone followed-up conversations noting the direct contact [redacted] had with fishers? Email / letter is not enough. A "no reply" does not indicate no interest / no concerns. • You note below that you believe that throughout the Rollo EP consultation where you have been able to engage with fishers, PGS has taken onboard fisher concerns and come up with controls or measures to minimise impacts. This information should have been part of your update to fishers – ie this is what fishers have raised under previous consultations and these are PGS mitigation measures. All you have done with this engagement is note (again) a change in EP boundaries. Are you acknowledging and mitigating against concerns raised previously by commercial fishers? • Thank you for noting that at this point you are expecting one tender in deeper water away from main fishing areas and if your tender is successful, the proposed survey schedule is December 2018 – long distance from the coast and very deep waters are usually not areas of concern for actual fishing activity, there may be concerns if these areas have been identified as key spawning areas at that time of the year (it is my understanding DPIRD (Fisheries) provides this information to proponents). Even though this proposed survey date is not 100% confirmed, this should have been included in the update noting this consultation 100% revolves around (if) your tender is successful and at this point, this is what we expect to potentially happen (as per your email to me below). Transparency allays a lot of fear and distrust.	WAFIC 09 PGS Rollo Update - 11 July 2018.pdf	PGS response WAFIC 10. As detailed in Section 2.2 Phase 1 Preparatory stakeholder engagement – NCB and Beagle. Stakeholder updates regarding the reduced operating area were provided based on: • If they had responded to previous information/engagement for the broader Rollo EP an update with information specific to their activities and an updated Cooperation Protocol and Ongoing Consultation Plan, if previously developed, was provided. • If they had not responded to previous information/engagement for the broader Rollo EP a generic letter providing information on the new Rollo operating areas was provided. The aim of this letter was to initiate contact and identify those stakeholders who were active in the area and/or wanted to receive more specific information regarding the Rollo seismic program.
WAFIC - Western Australian Fishing Industry Council	Email	13/7/2018	WAFIC 10	WAFIC: Have you only emailed / sent a letter to commercial fishers or did you succeed in telephone followed-up conversations noting the direct contact [redacted] had with fishers? Email / letter is not enough. A "no reply" does not indicate no interest / no concerns. PGS: You are correct in that we have only emailed/mailed the EP update information this time around. We believe that the main concerns have been discussed and controls/agreements for ongoing operations detailed in the individual protocols developed during the contact effort driven by [redacted] Thus for these stakeholders that we have contact details for, the update contains no significant changes to our EP (we have only reduced the area that may be impacted). We will attempt more direct contact once any potential surveys become likely or are awarded. For the other stakeholders who received the two page letter this was sent via mail as we only have that method of contact. WAFIC: You note below that you believe that throughout the Rollo EP consultation where you have been able to engage with fishers, PGS has taken onboard fisher concerns and come up with controls or measures to minimise impacts. This information should have been part of your update to fishers – i.e. this is what fishers have raised under previous consultations and these are PGS mitigation measures. All you have done with this engagement is note (again) a change in EP boundaries. Are you acknowledging and mitigating against concerns raised previously by commercial fishers? PGS: Information on operational restrictions, cooperation protocol and ongoing consultation was included in the update correspondence to affected parties who had raised concerns. The aim of the two page letter was to identify any stakeholders that may be affected by the change in the operating area to then be able to provide further information specific to their impacts or concerns. WAFIC: Thank you for noting that at this point you are expecting one tender in deeper water away from main fishing areas and if your tender is successful, the proposed survey schedule is December 2018 – long distance from the coast and very deep waters are usually not areas of concern for actual fishing activity, there may be concerns if these areas have been identified as key spawning areas at that time of the year (it is my understanding DPIRD (Fisheries) provides this information to proponents). Even though this proposed survey date is not 100% confirmed, this should have been included in the	WAFIC 10 PGS Rollo Update - 13 July 2018.pdf	Response to WAFIC 09.

Stakeholder Name	Communication Type	Date	Record #	Description	Attachments Provided to NOPSEMA	PGS Repsonse
				update noting this consultation 100% revolves around (if) your tender is successful and at this point, this is what we expect to potentially happen (as per your email to me below). Transparency allays a lot of fear and distrust. PGS: Noted and we agree that transparency is key, however as there are multiple companies being considered to undertake this tendered project we would not want to fatigue stakeholders by having multiple companies contact them about the same activity and potentially misrepresent that there would be more than one activity undertaken in that area. We expect this tender to be awarded by late July- early August and will keep you informed should PGS be the successful recipient of this project.		
West Coast Deep Sea Crustacean Managed Fishery licence holder	Letter	2/5/2018	WCDSMF 01	PGS letter sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. As seismic surveys are typically of concern to commercial fisheries, PGS is trying to identify licence holders who have activities or interests in the proposed new Rollo operating areas and want to obtain more information. PGS contact details provided.	Fishery Licensee PGS Rollo Update – Fisheries Letter May 2018 - Mail	Provision of information. No response received.
Western Deep Water Trawl Fishery licence holders	Letter	5/6/2018	WDWT 01	PGS letter sent detailing update to Rollo Seismic Survey Area to NCB and Beagle operating areas. As seismic surveys are typically of concern to commercial fisheries, PGS is trying to identify licence holders who have activities or interests in the proposed new Rollo operating areas and want to obtain more information. PGS contact details provided.	Fishery Licensee PGS Rollo Update – Fisheries Letter May 2018 - Mail	Provision of information. No response received.

ROLLO MULTICLIENT
MARINE SEISMIC SURVEYS
ENVIRONMENT PLAN SUMMARY

CHAPTER 2
Northwest Bioregion; Environmental Standards for Seismic Operations

PGS Australia Pty Ltd
October 2018

Contents

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1. INTRODUCTION

The geophysical company PGS Australia Pty Ltd (PGS) proposes to acquire multi-client (MC) three-dimensional marine seismic surveys (MC3D MSS) within two operational areas (OAs), North Carnarvon Basin (NCB) and Beagle, in the North-west Marine Region (NWMR) offshore from Western Australia (WA; Figure 1-1).

This Environment Plan (EP) for activities within the proposed OAs has the objective of covering multi-client 3D seismic surveys over specific petroleum titles and adjacent vacant acreage over a period of five years, from the date of acceptance of the EP. The actual timing of individual surveys is not yet defined and will be acquired dependent on client requirements, vessel availability and environmental considerations.

1.1 DOCUMENTATION

Chapter 1 – details stakeholder submissions, meeting summaries, assessments of merit and ongoing consultation requirements. Stakeholder input was considered in developing additional Performance Outcomes, Standards and Measurement Criteria detailed in Chapters 2 and 3.

Chapter 2 (this document) – comprises a review of the Bioregion within which the proposed OAs are located, the North-west Marine Region (NWMR; as defined by the Commonwealth). The outcome of the Bioregion risk evaluation resulted in various temporal and/or spatial exclusion zones being implemented. This Chapter assesses the known potential impacts or risks to stakeholders' activities or interests from the activity. No direct stakeholder feedback / submissions received regarding the Rollo EP are incorporated into this Chapter.

Chapter 3 – deals with many elements that are relatively constant by nature, such as titleholder information, legislative requirements, assessment process, the nature and management of the operating vessels, environmental risk evaluation (including methodology), and implementation strategy.

PGS is confident that the structure defined above will, over time, allow stakeholders to become more familiar with Chapters 2 and 3, and as such not require constant review in their entirety, but rather reviewed as required when considering details contained within the project specific Chapter 1. Revisions or amendments to Chapters 2 and 3 because of the stakeholder engagement process will be highlighted so that the entire contents need not be re-read. The revised version of the Rollo EP will then be submitted to NOPSEMA for acceptance under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS [E] Regs; as amended January 2015).

Both the interim versions of the Environment Plan and the versions submitted to NOPSEMA will be posted on a specific website designed for that purpose. Details of how to access the three chapters of the EP will be contained within the initial stakeholder letters. For stakeholder confidentiality purposes, no direct stakeholder correspondence will be disclosed on the EP website. However, summaries of key points raised will be posted in the interest of transparency, so each individual respondent can verify that respective submissions were accurately captured.

The EP is a large and complex document and may contain errors. Where such errors are noted, and the intent is clear to a reasonable person given the context and general discussion contained within the EP, they shall be amended under Management of Change (MoC) procedures in such a manner that the intended outcome is attained.

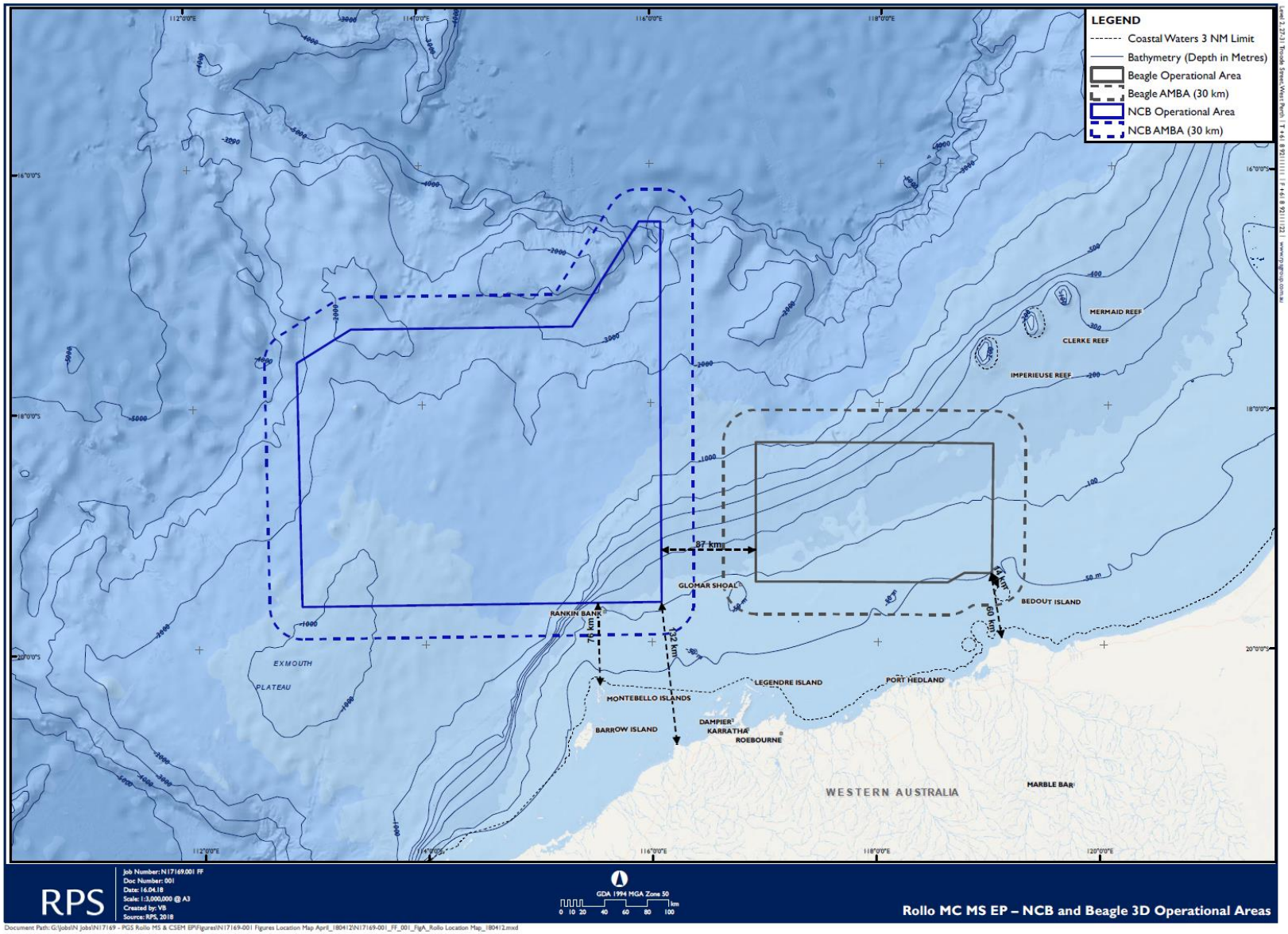


Figure 1-1 - Location map - proposed NCB and Beagle OAs

1.2 SEISMIC PROGRAMME

1.2.1 Survey Parameters

The 3D seismic surveys to be undertaken within the Rollo OAs are conventional 3D surveys like most others conducted in Australian waters in terms of technical methods and procedures. No unique or unusual equipment or operations are proposed. Surveys will be conducted using a purpose built seismic vessel that will traverse a series of pre-determined sail lines within the OA at a speed of ~ 8-9 km/hr. As the vessels travel along the sail lines a series of sound pulses (~every 10 seconds) will be directed down through the water column and seabed. The sound is attenuated and reflected at geological boundaries and the reflected signals are detected using sensitive pressure and velocity sensors arranged along cables (known as streamers) towed behind the survey vessel. The reflected sound is then processed to provide information about the structure and composition of geological formations below the seabed to identify potential hydrocarbon reservoirs.

Within the Rollo OAs a maximum of two surveys may be undertaken at the same time greater than 40 km apart.

Given the seabed geology and OAs water depths, it is considered that to achieve the survey objectives the most suitable operating pressure of the seismic energy source will be ~2,000 pounds per square inch (psi) with the source deployed in two arrays firing alternately, each with a maximum, intended volume of 3,260 cubic inch (in^3).

Table 1-1 - Rollo OA acquisition parameters

Parameter	Value
	3D MSS
NCB Operating Area	89,816 km^2
Beagle Operating Area	28,017 km^2
Total Operating Area	117,833 km^2
No. of streamers	10-16 (solid)
Streamer length	8,000 m
Streamer spacing	50-150 m
Streamer depth	~8-26 m
Seismic acquisition lines (sail lines)	600 m
Vessel speed	~ 8 – 9 km/hr
Size of acoustic source array	3,260 in^3 (max. per array)
Operating pressure	2,000 psi
Minimum Source interval	16.67 m
Sound pulse interval	~ 10 sec
Source depth	8 m
Peak near field sound pressure level (SPL)	Max 249.3 dB re 1 µPa @ 1 m as per acoustic modelling (horizontal)[1]
Dominant frequency range	1-500 Hz

[1] Refers to the source level specifications in horizontal plane as per JASCO acoustic modelling (Wood and McPherson 2018).

1.2.2 Acoustic Source Array

PGS designed the acoustic source array to meet several criteria regarding operational stability, predictable behaviour, and fit-for-purpose subsurface seismic imaging (i.e. vertical focus). The size of the source volume is dependent on the depth below the seabed that the geological targets occur. However, it is important to note that the energy produced is not directly proportional to total array volume. Several years of careful numerical modelling and acoustic source description have culminated in a configuration that can be accurately modelled and described across all frequencies of interest, from the perspective of both exploration requirements and for transparent environmental management. The acoustic output is predictable, it is measurably accurate, and therefore the operational towing depths and sub-array separation can be robustly customized for the relevant objectives of any survey location.

From the exploration perspective, the total array volume is optimized for the depth ranges of all likely hydrocarbon targets. In contrast to some historically much larger arrays, a 3,260 in^3 array uses only two sub-arrays to yield acoustic output that is close to being azimuthally symmetric (directionally-focused effects can be neglected), minimizes bubble energy, and minimizes in-sea maintenance and handling risks.

1.3 VESSELS

1.3.1 Seismic Survey Vessels

PGS proposes to conduct the activity using purpose-built seismic survey vessel(s) from the PGS fleet. The MV *Ramform Titan*, which is owned and operated by PGS, is one of the largest in the fleet and is typical of the survey vessels that will be used to acquire data within the OA (Figure 1-2).

The vessel(s) will travel within the NCB and Beagle OAs at an average speed of 4.5 knots (~8.3 km per hour). The use of helicopters may be required for the transfer of personnel to and from the survey vessel.

Figure 1-2 - Seismic survey vessel MV *Ramform Titan*

1.3.1.1 Refuelling

Depending on the duration of individual surveys, the survey vessel(s) may need to be refuelled at sea using the support vessel either within or immediately adjacent to the specified survey area.

1.3.2 Support Vessels

One or more support vessels will accompany the seismic survey vessel(s) to maintain a safe distance between the survey array and other vessels, and to manage interactions with shipping and fishing activities, if required. The support vessel(s), which have a crew of 5-15 personnel, will also re-supply the survey vessel(s) with fuel and other logistical supplies depending on the duration and location of the specified survey.

2. DESCRIPTION OF THE ENVIRONMENT

This section describes the physical, biological, cultural and socio-economic environment and identifies any relevant values and sensitivities of the environment that may be affected by the activity (EMBA). The EMBA is within the area that may be affected (AMBA). The AMBA for the survey has been developed by combining of two different aspect exposures; noise emissions from the seismic array and a diesel spill resulting from a vessel collision. The reason for using two different aspects is that exposures from a hydrocarbon spill are limited to a 30 km radius around the Operational Areas (OAs), whilst some modelled noise emissions were identified to exceed hydrocarbon impact exposures. Figure 2-1 shows the AMBA for the survey. For more information on the aspect exposures for noise and spills, see Section 3.3.2 and 3.4.3 respectively.

Using PGS' and publicly available information and the results from the Protected Matters Search a review of biological, cultural and socio-economic environment was undertaken to identify the environmental values and / or sensitivities that can reasonably be expected to occur within the AMBA. Table 2-1 provides a summary of these values and sensitivities.

Table 2-1 - Environmental Values and/or Sensitivities with the Potential to Occur within the AMBA

Environment Receptor	Summary
Benthic	Most of the seabed within the AMBAs is largely devoid of hard substrate, with only sparse benthic communities of bryozoans, molluscs and echinoids on the predominantly sandy substrate. Hard seafloor areas such as limestone pavements on the North West Shelf, and submerged cliffs are said to support a high diversity of benthic filter-feeders and producers. However, significant areas of coral reefs within the NWMR are all located outside of the NCB and Beagle AMBA. Features such as shoals provide topographic structure and habitat for demersal fish and sessile megabenthos, including hard and soft corals, filter feeders, seagrass and macroalgae. Shoals identified within the AMBA are: Rankin Bank ~ 7 km south of the NCB OA and > 100 km from the Beagle OA. Glomar Shoal ~ 11 km from the Beagle OA and ~ 50 km from the NCB OA. Glomar Shoal is listed as a Key Ecological Feature (KEF).
Plankton	Phytoplankton (alga) and zooplankton (fauna including larvae) are likely to be present. However, given the oligotrophic nature of the North Marine Region waters, production in the AMBA is expected to be sparse and patchy. No known spawning areas were identified within the AMBAs.
Fish	Commercial demersal and pelagic fish species targeted within the NCB and Beagle AMBA include demersal species; Carangidae (snapper species), Lutjanidae (Trevallies and Jacks) and pelagic species: Scombridae (mackerel species). Habitat associated with site attached fish and Syngnathid species are present at Rankin Bank and Glomar Shoal within the AMBA. The NCB AMBA overlaps the Continental slope demersal fish communities KEF.
Sharks	The NCB and Beagle AMBAs overlap the whale shark foraging BIA. Those species identified as having the potential to transit through the AMBA include: White shark, grey nurse shark, whale shark, shortfin and longfin mako.
Rays	No feeding, breeding or aggregation areas were identified for rays within the NCB and Beagle AMBAs and consequently if present would only be transient. Those species identified as having the potential to transit through the AMBA include: Reef manta ray and giant manta ray.
Turtles	Five species of marine turtles have the potential to transit through the NCB and Beagle AMBAs. In addition to this there is: Flatback turtle internesting BIA within the Beagle AMBA but not within the Beagle OA.

Environment Receptor	Summary
	Flatback turtle, green turtle, hawksbill turtle and loggerhead turtle foraging BIA within the Beagle AMBA but not within the Beagle OA.
Marine Birds	The following marine bird BIAs are located within either the NCB or Beagle AMBAs: Brown Booby Lesser crested tern Lesser Frigatebird Roseate tern Wedge-tailed shearwater White-tailed tropicbird
Cetaceans	The Beagle AMBA and OA overlaps the humpback whale BIA for migration – north and south. The Beagle and NCB AMBA and OA overlaps the pygmy blue Whale BIA for distribution and migration. No other cetacean BIAs are located within the NCB and Beagle AMBAs
Commercial fishing	Fisheries that operate (have catch effort) in the NCB or Beagle AMBAs are: WA State Fisheries Pilbara Fish Trawl Interim Managed Fishery (PFTIMF) Pilbara Trap Managed Fishery (PTMF) Pilbara Line Fishery (PLF) Mackerel Managed Fishery (MMF) Commonwealth Fisheries North West Slope Trawl Fishery (NWSTF)
Recreational activities	Recreational fishing and diving may be conducted within the NCB and Beagle AMBA around Rankin Bank, Glomar Shoal and Bedout Island.
Petroleum Activities	Production facilities are located within the NCB and Beagle AMBAs including Floating Production Storage Offshore (FPSO) facilities, manned and unmanned monopods, and larger production platforms. Gas pipelines extending from offshore areas to land based production facilities are within the NCB AMBA.
Shipping	Major shipping channels and fairways are located within the NCB and Beagle AMBAs.
Defence	The NCB AMBA overlaps the North West Exercise Area (NWXA).
Commonwealth Protected Areas	No Commonwealth protected areas are within the NCB AMBA. The Eighty Mile Beach Marine Park Multiple Use Zone IUCN VI is within the Beagle AMBA.
Key Ecological Features	NCB AMBA: Ancient coastline at 125 m depth contour Continental slope demersal fish communities Exmouth Plateau Beagle AMBA: Ancient coastline at 125 m depth contour Glomar Shoal

2.1 REGIONAL SETTING

The NCB and Beagle "Area that May Be Affected" (AMBA) lies within Commonwealth marine waters of the North-west Marine Region (NWMR) and the North West Shelf Mesoscale Bioregion (Figure 2-1). The Marine Bioregional Plan for the Northwest Marine Region (DSEWPaC, 2012) has been used in conjunction with other relevant management plans and studies to inform this description of the environment.

The NWMR extends from offshore of Kalbarri in Western Australia (WA) to the WA/Northern Territory (NT) border. The NWMR includes waters three nautical miles (nm) from the territorial baseline to the 200 nm Exclusive Economic Zone (EEZ) boundary (DEWHA, 2007; DEWHA, 2008a). The NWMR covers approximately 1.07 million km^2 of sub-tropical and tropical waters in the Indian Ocean and Timor Sea. Although the region is bounded inshore by the outer limit of the WA State waters boundary, the baseline extends across the openings of bays and rivers and around some coastal islands. The region is adjacent to, but does not cover, the State waters of WA. The Australian EEZ, which is generally 200 nm from the Low Water Mark (LWM) represents the offshore boundary of the NWMR (DEWHA, 2008a).

2.1.1 IMCRA Regions

The physical, biological and social environments within the proposed OA are discussed (where relevant) with reference to the Integrated Marine and Coastal Regionalisation of Australia Version 4.0 Provincial Bioregions (IMCRA v. 4.0). The IMCRA bioregions are based on fish, benthic habitat and oceanographic data, and the proposed AMBAs overlap three of these bioregions (Commonwealth of Australia [CoA], 2006; Figure 2-2):

Features and areas of ecological importance in the Northwest Province, Northwest Shelf Province and Northwest Transition are detailed in Table 2-4, Table 2-5 and Table 2-6.

NCB OA:

- Northwest Province
- Northwest Shelf Province
- Northwest Transition

1. Beagle OA:
   - Northwest Shelf Province
   - Northwest Transition

Table 2-2 - IMCRA Regions within the NCB AMBA and Operational Area

IMCRA Region	Occurrence		~% AMBA overlap with IMCRA Region	~% OA overlap with IMCRA Region
	AMBA	Operational Area		
Northwest Province	✓	✓	49.66%	39.10%
Northwest Shelf Province	✓	✓	2.28%	0.44%
Northwest Transition	✓	✓	16.20%	9.40%

Table 2-3 - IMCRA Regions within the Beagle AMBA and Operational Area

IMCRA Region	Occurrence		~% AMBA overlap with IMCRA Regio	~% OA overlap with IMCRA Regio
	AMBA	Operational Area		
Northwest Shelf Province	✓	✓	8.37%	14.25%
Northwest Transition	✓	✓	4.32%	9.39%

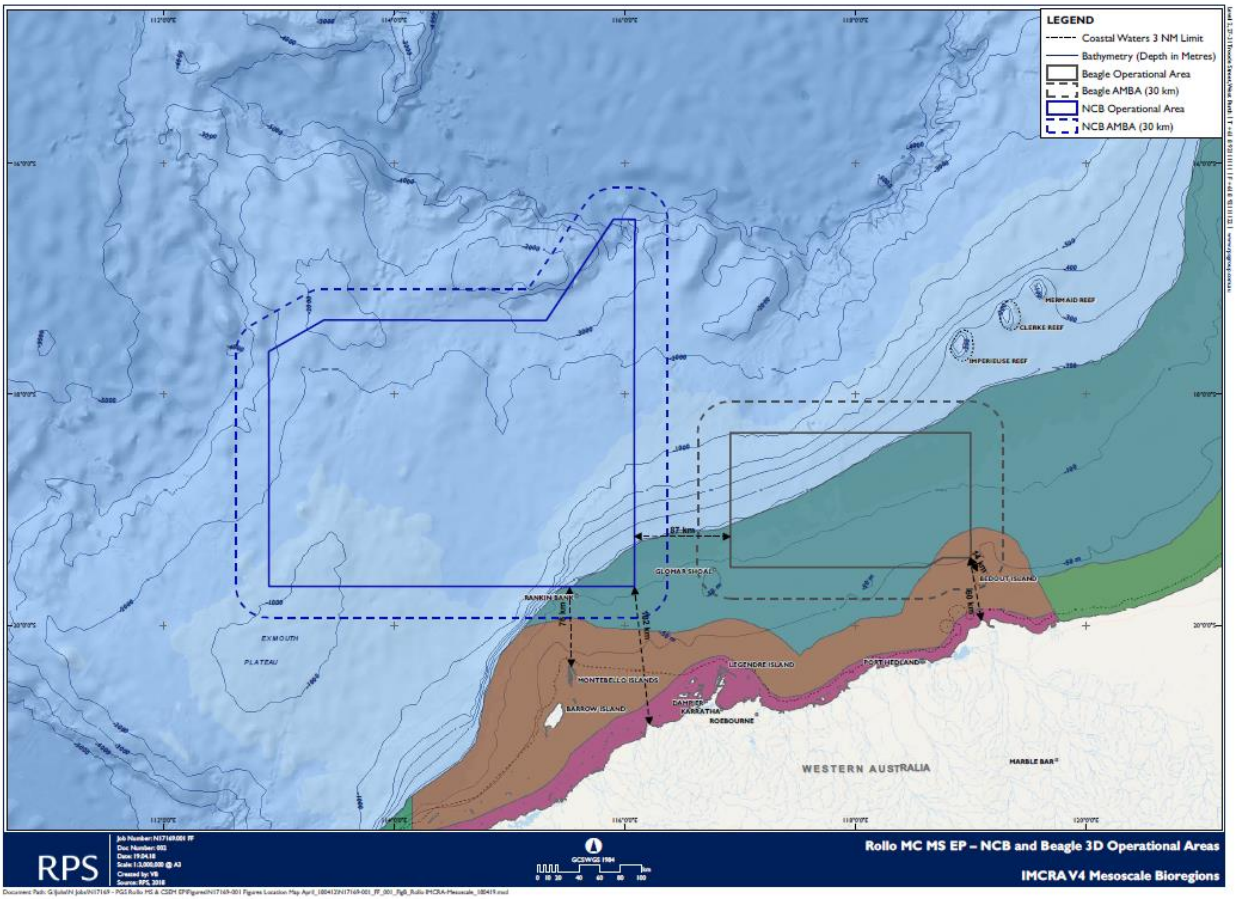
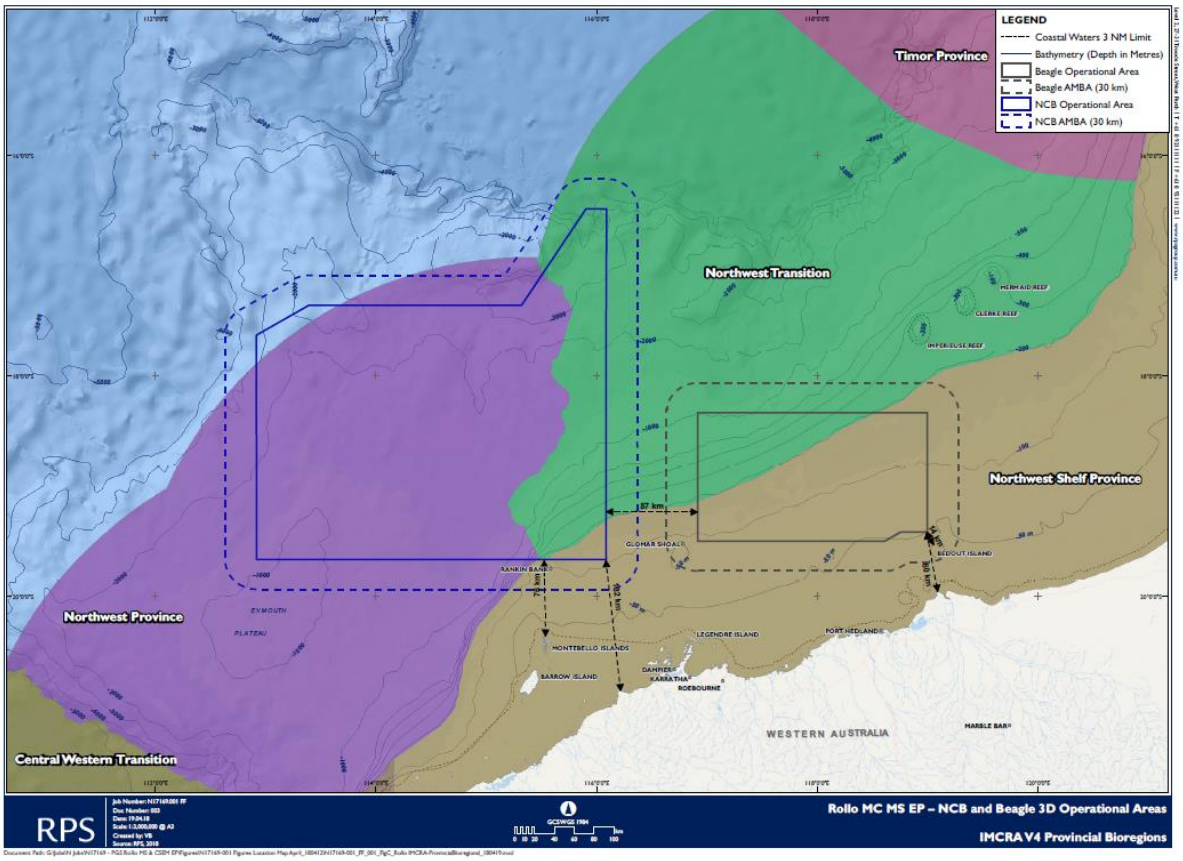


Figure 2-1 - Mesoscale Bioregions overlapped by the NCB and Beagle AMBAs



Source: modified from CoA (2006).

Figure 2-2 – Provincial bioregions IMCRA V4 overlapped by the NCB and Beagle AMBAs

Table 2-4 - Features and areas of ecological importance in the Northwest Province relevant to the NCB AMBA

Feature or area	Rationale
Exmouth Plateau	The Exmouth Plateau is an area of enhanced localised biological productivity. This productivity is seasonal and occurs in sporadic bursts. It is driven by the interaction of regional oceanography and topographic features. The plateau is a topographic obstacle that forces the upwelling of deeper, more oxygen and nutrient-rich waters up into the photic zone where primary productivity can occur. The Exmouth Plateau also receives detritus and other matter from the pelagic environment, which supports an important suite of demersal species. Enhanced productivity on the Exmouth Plateau is likely to support a number of marine species and be the site of distinct marine ecosystems.
Demersal fish communities associated with the slope	The upper and middle parts of the continental slope in this bioregion have important demersal fish communities, which display a high degree of endemism compared with other areas of slope in the Australian EEZ. The continental slope between North West Cape and the Montebello Trough supports, over 508 fish species of which 76 are endemic. This is believed to be associated with areas of enhanced biological productivity because of the interaction between seasonal currents and seafloor topography.

Source: modified from DSEWPaC (2012).

Table 2-5 - Features and areas of ecological importance in the Northwest Shelf Province relevant to the NCB and Beagle AMBAs

Feature or area	Rationale
Ancient coastline at 125 m depth contour	The ancient coastline along the 125 m depth contour in Commonwealth waters is thought to be an important seafloor feature that acts as a migratory pathway for cetaceans and other pelagic marine species such as whale sharks, as they move north and south between feeding and breeding grounds. The topographic variation created by the ancient coastline is also thought to aid minor upwelling, as a result of internal wave activity. These upwellings may initiate seasonal bursts in biological productivity that provide food for migrating marine species.
Glomar Shoal	Glomar Shoal is an important seafloor feature, as they are a raised feature on a relatively featureless continental shelf. They are characterised as a high energy environment because of current action, resulting in local enhancements in productivity. Enhanced biological productivity supports significant populations of commercially important fish species such as Rankin cod, brownstripe snapper, red emperor, crimson snapper and frypan bream.

Source: modified from DSEWPaC (2012).

Table 2-6 - Features and areas of ecological importance in the Northwest Transition relevant to the NCB and Beagle AMBAs

Feature or area	Rationale
Fish communities associated with the slope	The upper and mid-slope areas of the continental slope of this bioregion and the neighbouring Timor Province support rich and diverse demersal fish communities with a high level of endemism (64 species). There are two distinct demersal community types associated with the upper slope (water depths of 225–500 m) and the mid-slope (water depths of 750–1000 m).

Source: modified from DSEWPaC (2012).

2.2 EPBC MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Two searches of the online EPBC Act Protected Matters Database were undertaken on 21 March 2018 for the Beagle and NCB AMBAs (OAs plus 30 km buffers). The results are summarised in Table 2-7.

Table 2-7 - Summary of relevant MNES and other features within the NCB and Beagle AMBA

MNES	NCB AMBA	Beagle AMBA
World Heritage Properties	None	None
National Heritage Places	None	None
Wetlands of International Importance	None	None
Great Barrier Reef Marine Park	None	None
Commonwealth Marine Area	2	1
Listed Threatened Ecological Communities	None	None
Listed Threatened Species	18	22
Listed Migratory Species	33	44
Other Matters		
Commonwealth Land	None	None
Commonwealth Heritage Places	None	None
Listed Marine Species	59	88
Whales and Other Cetaceans	28	26
Critical Habitats	None	None
Commonwealth Reserves Terrestrial	None	None
Commonwealth Reserves Marine	None	1
Extra Information		
State and Territory Reserves	None	2
Regional Forest Agreements	None	None
Invasive Species	None	None
Nationally Important Wetlands	None	None
Key Ecological Features (KEF)	3	2

2.2.1 World Heritage Properties

There are no World Heritage Properties (WHP) within the NCB or Beagle AMBAs. The nearest WHP to the proposed OA is the Ningaloo Coast World Heritage Property (Place ID 106208, Place File No 5/14/192/0013), which is located > 211 km from the NCB OA (Figure 2-3).

2.2.2 National Heritage Places and Commonwealth Heritage Places

There are no places listed on the National Heritage List or Commonwealth Heritage Places within the NCB or Beagle AMBAs.

2.2.3 Declared Ramsar Wetlands

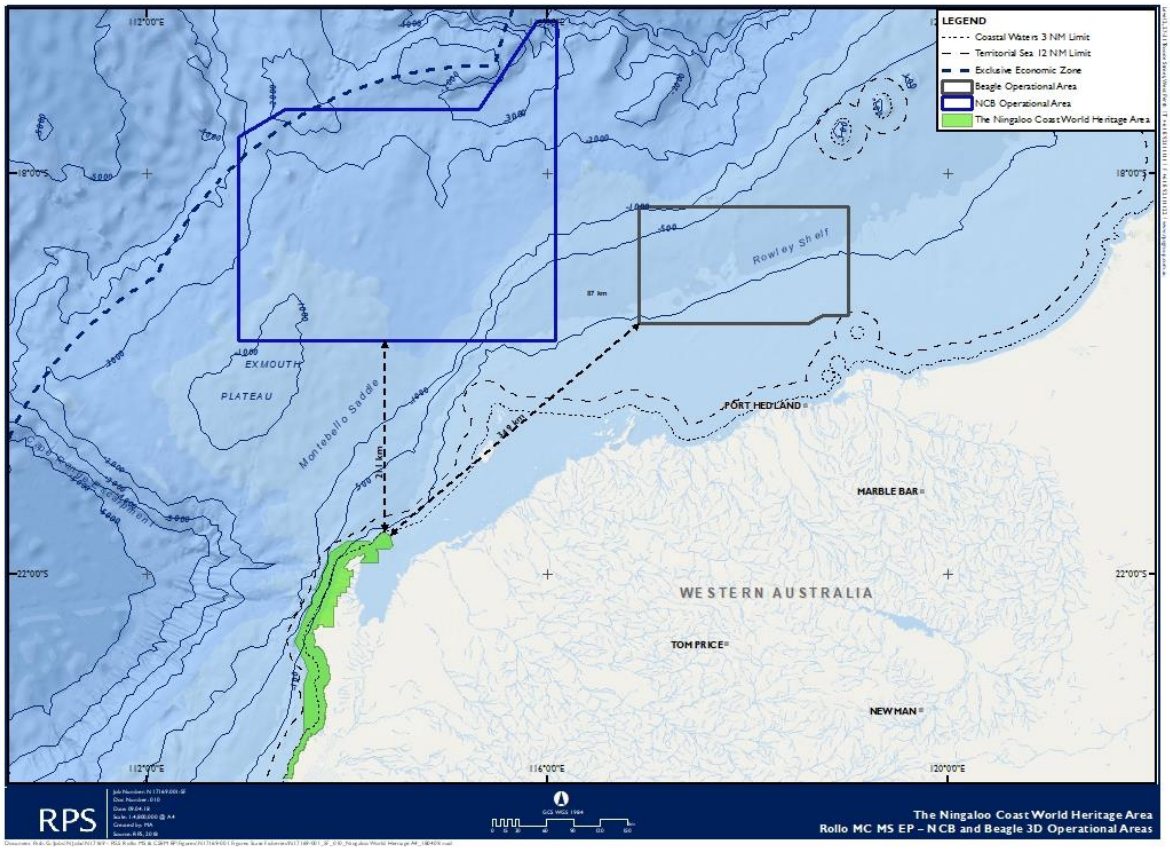
There are no Wetlands of International Importance under the Ramsar Convention within the NCB or Beagle AMBAs.

2.2.4 Commonwealth Marine Area

The NCB PMST search area overlaps the EEZ and territorial sea.

The Beagle PMST search area overlaps the the following Commonwealth Marine Areas:

- the exclusive economic zone (EEZ) and territorial sea
- extended continental shelf.



Source: modified from DoE (2016d).

Figure 2-3 - Location map – World Heritage Properties adjacent to the proposed NCB and Beagle OAs

2.2.5 EPBC listed critical habitat or threatened ecological communities

No critical habitats or threatened ecological communities, as listed under the EPBC Act, are known to occur within the NCB or Beagle AMBA, as indicated by the EPBC Act PMST.

2.2.6 Threatened and migratory species

The EPBC Act Protected Matters database searches identified threatened and migratory species occurring within 30 km of the proposed OAs. Note that the 30 km buffer used for the Beagle search resulted in some terrestrial species being included (e.g. ghost bat, barn swallow, grey flagtail, yellow flagtail). These are listed in Table 2-8 but as it is considered that there is no credible pathway for these to be impacted, they are not considered in the impact assessments.

Table 2-8 - EPBC Act threatened and listed migratory marine species potentially occurring within the NCB and Beagle AMBA

Scientific name	Common name	Threatened	Migratory	NCB	Beagle
Mammals					
Balaenoptera bonaerensis	Antarctic Minke Whale	-	Migratory	Y	
Balaenoptera borealis	Sei Whale	Vulnerable	Migratory	Y	Y
Balaenoptera edeni	Bryde's Whale	-	Migratory	Y	Y
Balaenoptera musculus	Blue Whale	Endangered	Migratory	Y	Y
Balaenoptera physalus	Fin Whale	Vulnerable	Migratory	Y	Y
Delphinus delphis	Common Dolphin	-	-	Y	Y
Feresa attenuata	Pygmy Killer Whale	-	-	Y	Y
Globicephala macrorhynchus	Short-finned Pilot Whale	-	-	Y	Y
Grampus griseus	Risso's Dolphin	-	-	Y	Y
Indopacetus pacificus	Longman's Beaked Whale	-	-	Y	
Kogia breviceps	Pygmy Sperm Whale	-	-	Y	Y
Kogia simus	Dwarf Sperm Whale	-	-	Y	Y
Lagenodelphis hosei	Fraser's Dolphin	-	-	Y	Y
Macroderma gigas	Ghost Bat	Vulnerable	-		Y
Megaptera novaeangliae	Humpback Whale	Vulnerable	Migratory	Y	Y
Mesoplodon densirostris	Blainville's Beaked Whale	-	-	Y	Y
Mesoplodon ginkgodens	Ginko-toothed Beaked Whale	-	-	Y	
Orcinus orca	Killer Whale	-	Migratory	Y	Y
Peponocephala electra	Melon-headed Whale	-	-	Y	Y
Physeter macrocephalus	Sperm Whale	-	Migratory	Y	Y
Pseudorca crassidens	False Killer Whale	-	-	Y	Y
Sousa chinensis	Indo-Pacific Humpback Dolphin	-	Migratory		Y
Stenella attenuata	Spotted Dolphin	-	-	Y	Y
Stenella coeruleoalba	Striped Dolphin	-	-	Y	Y
Stenella longirostris	Long-snouted Spinner Dolphin	-	-	Y	Y
Steno bredanensis	Rough-toothed Dolphin	-	-	Y	Y
Tursiops aduncus	Indian Ocean Bottlenose Dolphin	-	-	Y	Y
Tursiops aduncus	Spotted Bottlenose dolphin (Arafura / Timor Sea populations)	-	Migratory	Y	Y
Tursiops truncatus s. str.	Bottlenose Dolphin	-	-	Y	Y
Ziphius cavirostris	Cuvier's Beaked Whale	-	-	Y	Y
Marine Reptiles					
Acalyptophis peronii	Horned Sea Snake	-	-	Y	Y
Aipysurus apraefrontalis	Short-nosed Sea Snake	Critically Endangered	-	Y	Y
Aipysurus duboisii	Dubois' Sea Snake	-	-	Y	Y
Aipysurus eydouxii	Spine-tailed Sea Snake	-	-	Y	Y
Aipysurus laevis	Olive Sea Snake	-	-	Y	Y
Aipysurus tenuis	Brown-lined Sea Snake	-	-	Y	Y

Scientific name	Common name	Threatened	Migratory	NCB	Beagle
Astrotia stokesii	Stokes' Sea Snake	-	-	Y	Y
Caretta caretta	Loggerhead Turtle	Endangered	Migratory	Y	Y
Chelonia mydas	Green Turtle	Vulnerable	Migratory	Y	Y
Dermochelys coriacea	Leatherback Turtle	Endangered	Migratory	Y	Y
Disteira kingie	Spectacled Sea Snake	-	-	Y	Y
Disteira major	Olive-headed Sea Snake	-	-	Y	Y
Emydocephalus annulatus	Turtle-headed Sea Snake	-	-		Y
Ephalophis greyi	North-western Mangrove Sea Snake	-	-	Y	Y
Eretmochelys imbricata	Hawksbill Turtle	Vulnerable	Migratory	Y	Y
Hydrelaps darwiniensis	Black-ringed Sea Snake	-	-		Y
Hydrophis czeblukovi	Fine-spined Sea Snake	-	-		Y
Hydrophis elegans	Elegant Sea Snake	-	-	Y	Y
Hydrophis mcdowelli	null	-	-	Y	Y
Hydrophis ornatus	Spotted Sea Snake	-	-	Y	Y
Natator depressus	Flatback Turtle	Vulnerable	Migratory	Y	Y
Pelamis platurus	Yellow-bellied Sea Snake	-	-	Y	Y
Ray-finned Fishes					
Acentronura larsonae	Helen's Pygmy Pipehorse	-	-		Y
Bhanotia fasciolata	Corrugated Pipefish	-	-		Y
Bulbonaricus brauni	Braun's Pughead Pipefish, Pug-headed Pipefush	-	-		Y
Campichthys tricarinatus	Three-keel Pipefish	-	-	Y	Y
Choeroichthys brachysoma	Pacific Short-bodied Pipefish	-	-	Y	Y
Choeroichthys latispinosus	Muiron Island Pipefish	-	-		Y
Choeroichthys suillus	Pig-snouted Pipefish	-	-	Y	Y
Corythoichthys amplexus	Fijian Banded Pipefish	-	-		Y
Corythoichthys flavofasciatus	Reticulate Pipefish	-	-	Y	Y
Corythoichthys intestinalis	Australian Messmate Pipefish	-	-		Y
Corythoichthys schultzi	Schultz's Pipefish	-	-		Y
Cosmocampus banneri	Roughridge Pipefish	-	-	Y	Y
Doryrhamphus dactyliophorus	Banded Pipefish	-	-	Y	Y
Doryrhamphus excisus	Bluestripe Pipefish	-	-	Y	Y
Doryrhamphus janssi	Cleaner Pipefish	-	-	Y	Y
Doryrhamphus negrosensis	Flagtail Pipefish	-	-		Y
Festucalesx scalaris	Ladder Pipefish	-	-		Y
Filicampus tigris	Tiger Pipefish	-	-	Y	Y
Halicampus brocki	Brock's Pipefish	-	-	Y	Y
Halicampus dunckeri	Red-hair Pipefish	-	-		Y
Halicampus grayi	Mud Pipefish	-	-	Y	Y
Halicampus nitidus	Glittering Pipefish	-	-		Y
Halicampus spinirostris	Spiny-snout Pipefish	-	-	Y	Y
Haliichthys taeniophorus	Ribboned Seadragon	-	-	Y	Y

Scientific name	Common name	Threatened	Migratory	NCB	Beagle
Hippichthys penicillus	Beady Pipefish	-	-	Y	Y
Hippocampus angustus	Western Spiny Seahorse	-	-	Y	Y
Hippocampus histrix	Spiny Seahorse	-	-	Y	Y
Hippocampus kuda	Spotted Seahorse	-	-	Y	Y
Hippocampus planifrons	Flat-face Seahorse	-	-	Y	Y
Hippocampus spinosissimus	Hedgehog Seahorse	-	-	Y	Y
Hippocampus trimaculatus	Three-spot Seahorse	-	-		Y
Micrognathus micronotopterus	Tidepool Pipefish	-	-	Y	Y
Phoxocampus belcheri	Black Rock Pipefish	-	-		Y
Solegnathus hardwickii	Pallid Pipehorse	-	-	Y	Y
Solegnathus lettiensis	Gunther's Pipefish	-	-	Y	Y
Solenostomus cyanopterus	Robust Ghost Pipefish	-	-	Y	Y
Solenostomus paegnius	Rough-snout Ghost Pipefish	-	-	Y	Y
Syngnathoides biaculeatus	Double-end Pipehorse	-	-	Y	Y
Trachyrhamphus bicoarctatus	Bentstick Pipefish	-	-	Y	Y
Trachyrhamphus longirostris	Straightstick Pipefish; Long-nosed Pipefish	-	-	Y	Y
Sharks & Rays					
Anoxypristis cuspidata	Narrow Sawfish	-	Migratory	Y	Y
Carcharias taurus (west coast population	Grey Nurse Shark	Vulnerable	-	Y	Y
Carcharodon carcharias	White Shark	Vulnerable	Migratory	Y	Y
Isurus oxyrinchus	Shortfin Mako	-	Migratory	Y	Y
Isurus paucus	Longfin Mako	-	Migratory	Y	Y
Manta alfredi	Reef Manta Ray	-	Migratory	Y	Y
Manta birostris	Giant Manta Ray	-	Migratory	Y	Y
Pristis clavata	Dwarf Sawfish	Vulnerable	-		Y
Pristis pristis	Largetooth Sawfish	Vulnerable	-		Y
Pristis zijsron	Green Sawfish	Vulnerable	-	Y	Y
Rhincodon typus	Whale Shark	Vulnerable	Migratory	Y	Y
Sirenian					
Dugong dugon	Dugong	-	Migratory		Y
Birds					
Actitis hypoleucos	Common Sandpiper	-	Migratory Wetland Species	Y	Y
Anous stolidus	Common Noddy	-	Migratory	Y	Y
Calidris acuminata	Sharp-tailed Sandpiper	-	Migratory Wetland species	Y	Y
Calidris canutus	Red Knot	Endangered	Migratory Wetland species	Y	Y
Calidris ferruginea	Curlew Sandpiper	Critically Endangered	Migratory Wetland species	Y	Y
Calidris melanotos	Pectoral Sandpiper	-	Migratory Wetland species	Y	Y

Scientific name	Common name	Threatened	Migratory	NCB	Beagle
Calonectris leucomelas	Streaked Shearwater	-	Migratory	Y	Y
Fregata ariel	Lesser Frigatebird	-	Migratory	Y	Y
Fregata minor	Great Frigatebird	-	Migratory	Y	Y
Haliaeetus leucogaster	White-bellied Sea Eagle	-	-		Y
Hirundo rustica	Barn Swallow	-	Migratory Terrestrial Species		Y
Larus novaehollandiae	Silver Gull	-	-		Y
Motacilla cinerea	Grey Wagtail	-	Migratory Terrestrial Species		Y
Motacilla flava	Yellow Wagtail	-	Migratory Terrestrial Species		Y
Numenius madagascariensis	Eastern Curlew	Critically Endangered	Migratory Wetland Species	Y	Y
Pandion haliaetus	Osprey	-	Migratory Wetland species	Y	Y
Papasula abbotti	Abbott's Booby	Endangered	-	Y	Y
Phaethon lepturus	White-tailed Tropicbird	-	Migratory		Y
Rostratula australis	Australian Painted Snipe	Endangered	-		Y
Sterna bengalensis	Lesser Crested Tern	-	-		Y
Sterna bergii	Crested Tern	-	-		Y
Sterna dougallii	Roseate tern	-	Migratory		Y
Sula dactylatra	Masked Booby	-	Migratory		Y
Sula leucogaster	Brown Booby	-	Migratory		Y
Thalasseus bergii	Crested Tern	-	Migratory Wetland Species		Y

2.2.7 Biologically Important Areas

A review of the National Conservation Values Atlas (NCVA) determined that there are biologically important areas (BIA) for 13 species located within 30 km of the proposed OAs (Table 2-9).

Table 2-9 - BIA with ranges located within the NCB and Beagle AMBA

Species Group	Common Name	Behaviour
Cetaceans	Humpback Whale	Migration – north and south
	Pygmy Blue Whale	Distribution, Migration
Marine Turtles	Flatback Turtle	Foraging (Beagle OA only), Internesting buffer (both OAs)
	Loggerhead Turtle	Foraging (Beagle OA only)
	Green Turtle	Foraging (Beagle OA only)
	Hawksbill Turtle	Foraging (Beagle OA only)
Sharks and Rays	Whale Shark	Foraging
Birds	Brown Booby	Nesting, Foraging (Beagle OA only)
	Lesser Crested Tern	Breeding, Foraging (Beagle OA only)
	Lesser Frigatebird	Breeding, Foraging (Beagle OA only)
	Roseate Tern	Breeding, Foraging (Beagle OA only)
	Wedge-tailed Shearwater*	Foraging
	White-tailed Tropicbird	Foraging (Beagle OA only)

2.2.8 Listed threatened species recovery plans

Recovery plans are enacted under the EPBC Act and remain in force until the species is removed from the threatened list. Conservation advice provides guidance on immediate recovery and threat abatement activities that can be undertaken to facilitate the conservation of a listed species or ecological community.

Table 2-10 outlines those plans/advices relevant to those species identified as potentially occurring within, or adjacent to, the proposed OA (Table 2-8) and summarises the key threats (as described in relevant recovery plans and conservation advices) to those species.

Table 2-10 - Summary of EPBC recovery plans relevant to the proposed OA

Species	Recovery plan/conservation advice (date adopted)	Key threats identified in the recovery plan and / or conservation advices	EP risk assessment section
Cetaceans			
Blue whale	Blue Whale Conservation Management Plan (October 2015).	Noise interference	3.2.2 & 3.2.3
		Vessel disturbance (i.e. vessel presence or collision)	3.3.1
		Whaling	n/a[2]
		Climate Variability and Change	
		Habitat Modification	
		Overharvesting of prey	
Humpback whale	The recovery plan that was made for this species on 18/05/2005 ceased to be in effect from 1/10/2015. Conservation advice (October 2015)	Noise interference	3.2.2 & 3.2.3
		Vessel disturbance and strike	3.3.1
		Entanglement (fishing)	n/a
		Whaling	
		Climate and oceanographic variability and change	
		Overharvesting of prey	
		Habitat degradation including coastal development and port expansion	
Sei whale	The recovery plan that was made for this species on 18/05/2005 ceased to be in effect from 1/10/2015. Conservation advice (October 2015)	Anthropogenic noise and acoustic disturbance	3.2.2 & 3.2.3
		Pollution (persistent toxic pollutants)	3.3.2
		Vessel strike	3.3.1
		Climate and oceanographic variability and change	n/a

[2] Key threats are outside the scope of this EP.

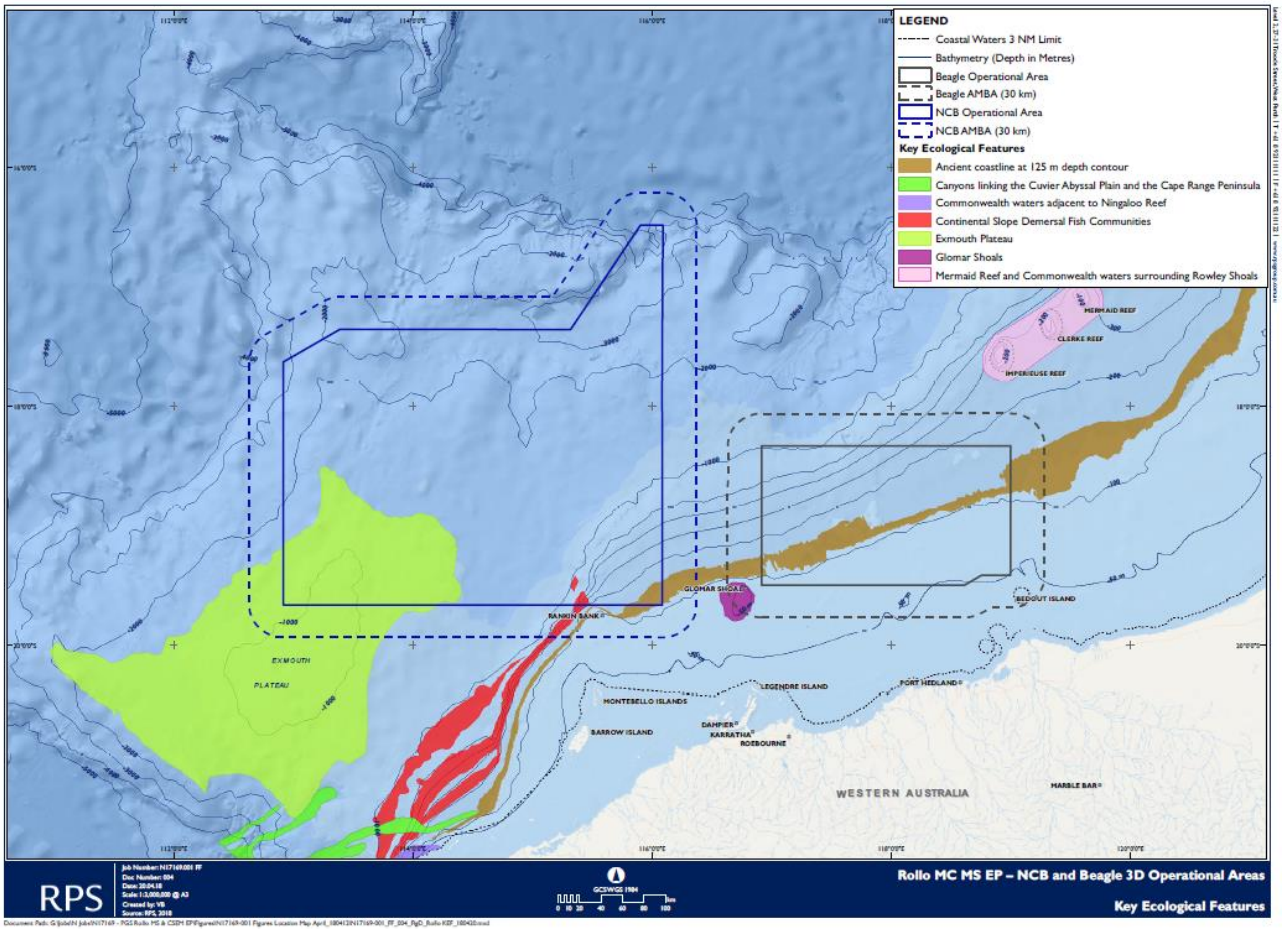
Species	Recovery plan/conservation advice (date adopted)	Key threats identified in the recovery plan and / or conservation advices	EP risk assessment section
		Habitat degradation including pollution (increasing port expansion and coastal development)	
		Prey depletion due to fisheries (potential threat)	
		Resumption of commercial whaling (potential threat)	
Fin whale	The recovery plan that was made for this species on 18/05/2005 ceased to be in effect from 1/10/2015. Conservation advice (October 2015).	Anthropogenic noise and acoustic disturbance	3.2.2 & 3.2.3
		Pollution (persistent toxic pollutants)	3.3.2
		Vessel strike	3.3.1
		Climate and oceanographic variability and change	n/a
		Habitat degradation including coastal development, port expansion and aquaculture	
		Fisheries catch, entanglement and bycatch	
		Resource depletion due to fisheries (potential threat)	
		Resumption of commercial whaling (potential threat)	
Turtles			
Flatback turtle Green turtle Hawksbill turtle Leatherback turtle Loggerhead turtle Olive ridley turtle	Recovery Plan for Marine Turtles in Australia (2017-2027)	Marine Debris	Chapter 3 - Section 3
		Chemical and terrestrial discharge	Chapter 3 - Section 3
		Light Pollution	Chapter 3 - Section 3
		Vessel disturbance	Chapter 3 - Section 3
		Noise interference	3.2.2
		Climate change and variability	n/a
		International take	
		Terrestrial predation	
		Fisheries bycatch	
		Habitat modification	
		Indigenous take	

Species	Recovery plan/conservation advice (date adopted)	Key threats identified in the recovery plan and / or conservation advices	EP risk assessment section
		Recreational activities	
		Disease and pathogens	
Leatherback turtle	Conservation advice (December 2008)	Boat strike	3.3.1
		Incidental capture in commercial fisheries	n/a
		Harvest of eggs and meat	
		Ingestion of marine debris	
		Predation on eggs by wild dogs, pigs and monitor lizards	
		Degradation of foraging areas	
		Changes to breeding sites	
Sea snakes			
Short-nosed sea snake	Conservation Advice (December 2010).	Habitat Loss, Disturbance and Modification	3.2.2
		Incidental catch and death in commercial prawn trawling fisheries	n/a
		Unsustainable and illegal fishing practices	
Sharks and Rays			
White shark	Recovery Plan for the White Shark (*Carcharodon carcharias*; August 2013)	Ecosystem effects — habitat modification and climate change	n/a
		Incidental (accidental bycatch and/or illegal) capture by commercial and recreational fishers	
		Shark control activities- beach meshing or drum lining	
		Ecotourism (including cage diving)	
		Trade in white shark products	
Grey nurse shark	Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*; 2014)	Pollution and disease	Section 3.3.2 and Chapter 3 - Section 3
		Ecosystem effects - habitat modification and climate change	n/a
		Incidental (accidental bycatch and/or illegal) capture by commercial and recreational fishers	
		Shark control activities- beach meshing or drum lining	

Species	Recovery plan/conservation advice (date adopted)	Key threats identified in the recovery plan and / or conservation advices	EP risk assessment section
		Ecotourism	
		Aquarium trade	
Dwarf sawfish Largetooth sawfish Green sawfish	Sawfish and River Sharks Multispecies Recovery Plan (2015). Conservation Advice (April 2014). Conservation Advice (October 2009). Conservation Advice (April 2014). Conservation Advice (2008).	Marine debris	Chapter 3 - Section 3
		Habitat degradation and modification	n/a
		Bycatch (accidental bycatch and/or illegal) capture by commercial and recreational fishers; Indigenous fishing; and illegal, unreported and unregulated fishing	
		Recreational fishing	
		Indigenous fishing	
		Illegal, unreported and unregulated fishing (IUU)	
		Collection for public aquaria	
Whale shark	The recovery plan (DEH 2005) that was made for this species on 28/04/2005 ceased to be in effect from 1/10/2015. Conservation advice (October, 2015)	Direct disturbance or interference (i.e. vessel presence or collision)	3.3.1
		Marine debris	Chapter 3 - Section 3
		Intentional/unintentional mortality from fishing outside of Australian waters	n/a
		Climate change	
Birds			
Eastern curlew	Recovery Plan not required, for this species as the approved conservation advice for the species provides sufficient direction to implement priority actions and mitigate against key threats. Conservation Advice (May, 2015).	Degradation from pollution	Section 3.3.2
		Habitat Loss, coastal development, leading to changes to the water regime and stabilisation of water levels	n/a
		Human disturbance	
		Invasive plants	

2.2.9 Key Ecological Features

Four key ecological features (KEFs) were identified as being within the NCB and Beagle AMBAs (Figure 2-4). Table 2-11 provides an overview of the values of these KEFs.



Source: modified from DoE (2016b).

Figure 2-4 - KEF within, and adjacent to, the proposed OAs

KEF	NCB				Beagle			
	AMBA	OA	% overlap OA with KEF	Distance OA to KEF	AMBA	OA	% overlap OA with KEF	Distance OA to KEF
Ancient coastline at 125 m depth contour	✓	✓	2.13 %	Overlaps	✓	✓	17.51%	Overlaps
Continental slope demersal fish communities	✓	✓	0.48 %	Overlaps	-	-	-	152 km
Exmouth Plateau	✓	✓	26.66 %	Overlaps	-	-	-	>100 km
Glomar Shoal	-	-	-	50 km	✓	-	-	11 km

Table 2-11 - KEF within, or adjacent to, the proposed OA

Feature	Values	Description
Ancient coastline at 125 m depth contour	Unique seafloor feature with ecological properties of regional significance	The ancient coastline is recognised for its biodiversity values, which apply to both the benthic and pelagic habitats within the feature (DSEWPaC, 2012). The continental shelf of the NWMR contains several terraces and steps which reflect changes in sea level that occurred over the last 100,000 years. The most prominent of these features occurs as an escarpment along the NWS and Sahul Shelf at a depth of 125 m. Where the ancient submerged coastline provides areas of hard substrate it may contribute to higher diversity and enhanced species richness relative to soft sediment habitat. These include sponges, corals, crinoids, molluscs, echinoderms and other benthic invertebrate representative of hard substrate fauna in the bioregion. The escarpment may also facilitate increased availability of nutrients off the Pilbara by interacting with internal waves or regional mixing associated with seasonal changes in currents and winds creating small localised upwellings and enhancing vertical mixing of water layers. This enhanced productivity may attract larger marine life such as whale sharks and large pelagic fish (DEWHA, 2007) and humpback whales appear to migrate along the ancient coastline (DNP, 2013). The Marine Bioregional Plan (MBP) for the NWMR does not identify any potential pressures on this KEF as being "of concern". However, there are several potential pressures on this KEF identified as being "of potential concern": ocean acidification; extraction of living resources; oil pollution; invasive species. The potential pressure of noise pollution on this KEF is "of less concern" (DSEWPaC, 2012).
Continental slope demersal fish communities	High levels of endemism	The continental slope demersal fish communities are a rich assemblage of some 500 fish species, 76 of which are endemic to the bioregion. The demersal fish species occupy two distinct demersal community types (biomes) associated with the upper slope, in water depths of 225-500 m and the mid-slope, in water depths of 750-1,000 m. Although the reasons for the high levels of endemism are not fully understood, the presence of such a diversity of fish and high numbers of endemic species suggests there are important interactions occurring between the physical processes and trophic structures (DNP, 2013). The MBP for the NWMR does not identify any potential pressures on this KEF as being "of concern". However, there are several potential pressures on this KEF identified as being "of potential concern": changes in sea temperatures; ocean acidification; physical habitat modification and bycatch. The potential pressure of noise pollution on this KEF is "not of concern" (DSEWPaC, 2012).
Exmouth Plateau	Unique seafloor feature with ecological properties of regional significance	The Exmouth Plateau is a unique tropical deep sea plateau which covers an area of ~49,300 km^2 with water depths ranging from ~800 - 4,000 m (Figure 2-4). It modifies the flow of deep waters that generate internal tides by acting as a large topographic barrier which in turn causes the upwelling of deeper-water nutrients. These internal tides are strongest during January - March. The northern margin of the Plateau is steep and intersected by large canyons, for example the Montebello and Swan canyons, while the southern margin is gently sloping with few, if any canyons. The Plateau's surface is rough and undulating at 900 - 1,000 m depth (Falkner *et al.,* 2009). The enhanced productivity along the northern and southern boundaries and along the shelf edge suggests the Plateau is a significant contributor to the productivity of the region (Brewer *et al.,* 2007). Although the Plateau is considered an area of low habitat heterogeneity, it is likely to be an important area for biodiversity as it provides an extended area offshore for communities adapted to water depths of ~1,000 m. The sediments support populations of benthic filter

Feature	Values	Description
		feeds, scavengers and epifauna while the pelagic waters above are likely to have assemblages of small pelagic species. Historic whaling records indicate sperm whales may have been abundant in the area (Bannister *et al.,* 1996). The deeper waters of the inner edge of Exmouth Plateau, around the Montebello Trough, are believed to be an important feeding site for sperm whales, indicating an area of high biological productivity. However, little specific information is available on the biological communities of the Exmouth Plateau and associated slope (DSEWPaC, 2012). The MBP for the NWMR does not identify any potential pressures on this KEF as being "of concern". One potential pressure on this KEF is identified as being "of potential concern": ocean acidification. The potential pressure of noise pollution on this KEF is "not of concern" (DSEWPaC, 2012).
Glomar Shoal	High productivity and aggregations of marine life	Glomar Shoal is a submerged feature located ~100 km north of Dampier on the Rowley Shelf in a high energy environment subject to strong currents (Figure 2-4). It lies at a depth of 33-77 m and consists of a high percentage of marine derived sediments with high carbonate content including gravels of weathered coralline algae and shells (Falkner *et al.,* 2009; McLaughlin and Young, 1985). Glomar Shoal is regionally imported for its high biological diversity and high localised productivity. It is an important habitat for commercial and recreational pelagic fish species such as Rankin cod, brown striped snapper, red emperor, crimson snapper, bream and yellow-spotted triggerfish (Falkner *et al.,* 2009). The MBP for the NWMR does not identify any potential pressures on this KEF as being "of concern". However, there are several potential pressures on this KEF identified as being "of potential concern": changes in sea temperatures; ocean acidification; extraction of living resources and invasive species. The potential pressure of noise pollution on this KEF is "not of concern" (DSEWPaC, 2012).

Source: modified from DSEWPaC (2011) and DoE (2016b).

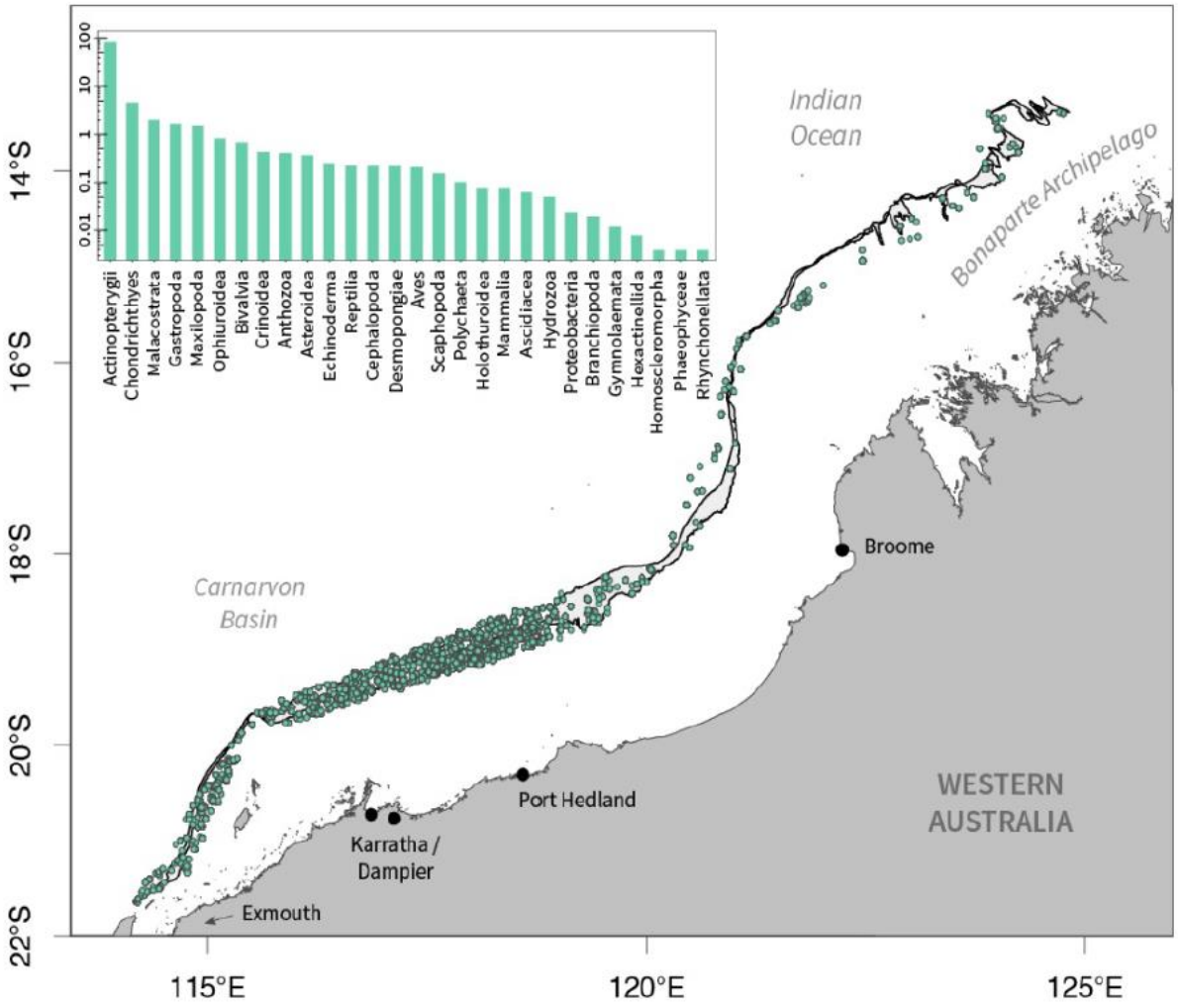


Figure 2-5 - Spatially valid (non-duplicated) occurrence records from the Atlas of Living Australia. The inset illustrates the distribution of percentage contributions (on the log scale) from each taxonomic group. (Miller et al. 2016)

2.3 PHYSICAL ENVIRONMENT

2.3.1 Bathymetry

Water depths within the NCB and Beagle OAs range from approximately 110 to 5,600 m and 40 to 1,100 m, respectively. The shelf gradually slopes from the coast to the shelf break and displays several sea floor features such as banks/shoals and holes/valleys. The shelf contains several terraces and steps that extend into adjacent bioregions and reflect ancient coastlines from when the sea level in the Region was lower than it is today.

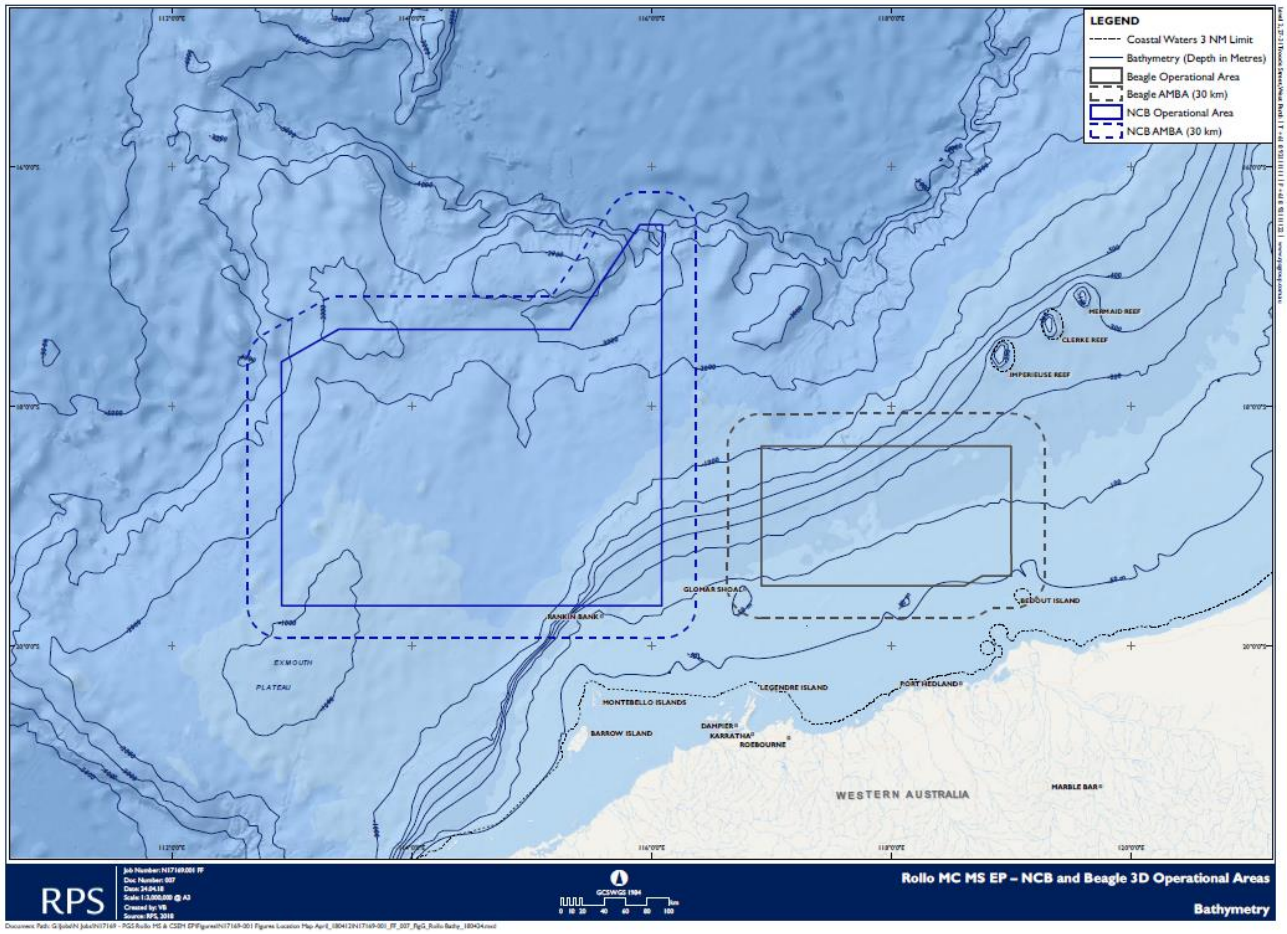


Figure 2-6 – Water Depths within the NCB and Beagle AMBAs

Table 2-12 - Water Depths within the NCB and Beagle Operational Area

NCB OA		
Depth Range (m)	**Km²**	**% overlap**
110-200	1,425	1.59%
200-500	2,917	3.25%
500-1000	3,646	4.06%
1000-2000	61,329	68.37%
2000-5000	20,216	22.54%
5600	164	0.18%
Beagle OA		
Depth Range (m)	**Km²**	**% overlap**
40-50	36	0.13%
50-100	9237	32.96%
100-200	11191	39.93%
200-500	6071	21.66%
500-1000	1432	5.11%
1100	61	0.22%

2.3.2 Currents

During the southeast trade winds (April to September), the predominant direction of the ocean current is west-southwest. In the monsoon season (December to March), winds come from the northwest or west, and the direction of the ocean current reverses, becoming east-northeast. The mean rate of ocean currents throughout the year is usually less than 0.5 knots (Skewes *et al.,* 1999).

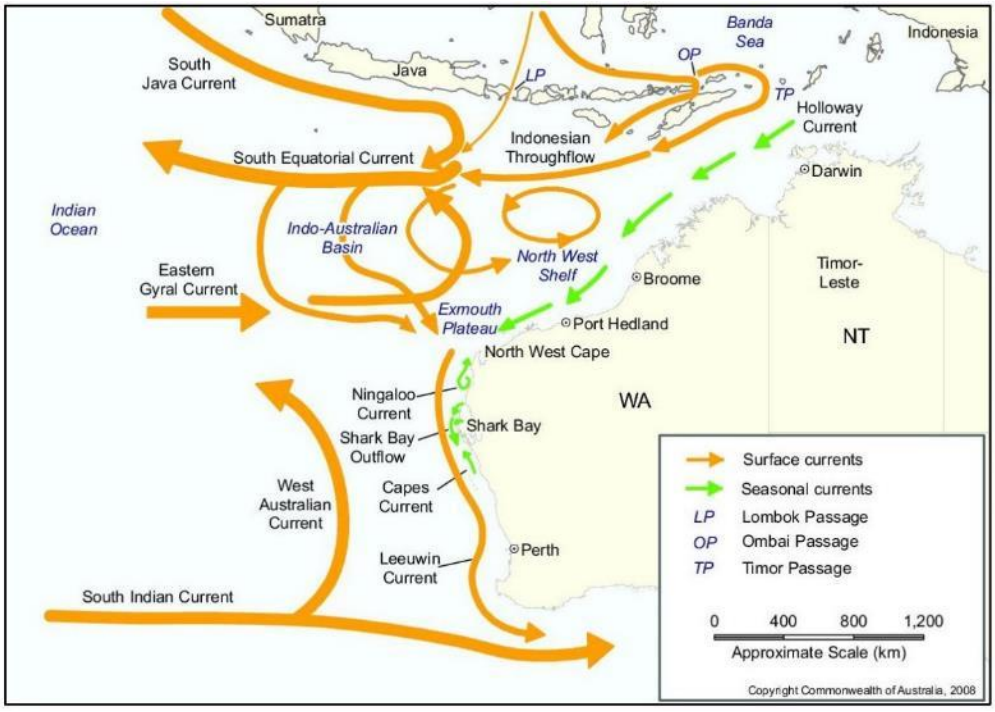
Overall, a key characteristic of the regional oceanography of the NWMR is the poleward flow of the main surface currents. The significant difference in steric height between the Pacific and Indian Oceans drives Pacific waters through the Indonesian archipelago via ITF into the Indian Ocean. A portion of these waters eventually travel poleward via a strong alongshore pressure gradient. This pressure gradient is not present along the eastern edge of other major oceans and makes the Western Australian system unique globally (DEWHA, 2007).

The NWMR's large scale surface currents are subject to strong seasonal variations, largely due to annual variation in the alongshore pressure gradient that is the main driver of the Region's surface currents. The South Equatorial Current and Eastern Gyral Current intensify during July-September (DEWHA, 2007). Similarly, the Leeuwin Current is strongest in autumn, and diminishes during the Northwest Monsoon (December-March). This complex system of ocean currents changes between seasons and between years, generally resulting in the surface waters being warm, nutrient poor and of low salinity (DEWHA, 2008a).

2.3.3 Tides

Astronomical tides on the NWMR are semi-diurnal and generally quite large; with tidal ranges increasing in amplitude from north to south, corresponding with the increasing width of the shelf and range from ~2 m at Exmouth to ~10 m near Broome. Tides and wind strongly influence water flow in the coastal zone and over the inner to mid-shelf influencing the dispersal of bottom sediments.

Tidal amplitude from south to north is most marked north of the Montebello Islands, where the width of the continental shelf increases significantly (Heyward *et al.,* 2000). Tides and wind strongly influence water flow in the coastal zone and over the inner to mid-shelf influencing the dispersal of bottom sediments. The dominant tidal current flows in the NWMR in summer are east-northeast and west-southwest, with speeds generally ranging from 0.1 to 0.3 m/s (Pearce *et al.,* 2003).



Source: modified from DEWHA (2007).

Figure 2-7 - Regional oceanography and surface currents

2.3.4 Waves

The NWMR typically receives a persistent swell of around 2 m, generated by low-pressure systems in southern latitudes during winter; strong easterly winds can also generate 2 m seas. Both swell and seas tend to be smaller during summer (Pearce *et al.,* 2003). Tropical cyclones generate waves propagating out in a radial direction from the storm centre, and generate swells from any direction, with wave heights between 0.5 and 9.0 m.

2.3.5 Wind

Southeast trade winds are prevalent from April to September. From May to August the winds average 11 to 30 km/h; however, winds stronger than 31 km/h are not uncommon. The trade winds are usually associated with fine dry weather. They produce a large swell that impacts on the southern side of most reefs in the area, producing consolidated crustose coralline algae and limestone substrates on the reef slope to depths characteristic of outer reefs or oceanic atolls (Skewes *et al.,* 1999).

2.3.6 Geology and Sedimentology

In terms of physical features, the NWMR is composed primarily of continental slope and continental shelf. The region also contains abyssal plains and a small area of continental rise. Other features such as canyons, plateau, terraces, ridges, reefs, banks and shoals occupy less space in the region but have relatively high importance for productivity and biodiversity. The slope is relatively flat but includes a number of large canyon heads that were probably excavated during and after continental break-up by sediment and water movements (DEWHA, 2007). Sediment transport on the shelf is largely influenced by tidal currents while on the slope and abyssal plains sediment transport is mostly influenced by large ocean currents and slope processes (Baker *et al.,* 2008). The deepest areas of the abyssal plain/deep ocean are thought to be muddy, and any potential particulate carbonate content would have been removed through dissolution as it sank beneath the carbonate compensation depth (DEWHA, 2007).

Sediments in the North West Shelf Province are relatively homogenous and dominated by sands, with a small proportion of gravels. Mud increases slightly within 100 km of the coast and within 100 km of the shelf break but is mostly absent from areas in between (Baker *et al.,* 2008). Sediment distribution is strongly influenced by cyclonic storms, long-period swells and large internal tides, which resuspend sediments and/or move across the shelf (DEWHA 2008a).

Overall, the region is relatively shallow, with water depths of less than 200 m over more than 40% of its area. More than 50% of the region has a depth of less than 500 m, reflecting the region's large areas of continental shelf and slope (Baker *et al.,* 2008). Extensive carbonate banks and coral reefs are important focal points for biodiversity in the region. Reefs of the inner shelf, including those in WA State waters, are dominated by hard corals and include Ningaloo Reef and the reefs of the Dampier Archipelago (Baker *et al.,* 2008).

The Australian Institute of Marine Science (AIMS, 2014) sampled sediments around the base of Glomar Shoal and Rankin Bank in November 2013 in water depths ranging from 50 to 80 m. Sediments were dominated by sand and to a lesser extent by gravel. Significant muds were only present at the deeper or more protected sites to the north-west, north-east and south-east of Glomar Shoal. Only one site was categorised as predominantly gravel (AIMS, 2014).

2.3.7 Geomorphic Features

An understanding of the seabed bathymetry and the type of seabed forms (geomorphic features) can be an important determinant of the diversity and dynamics of marine biological communities, especially in areas where there are limited biological studies. Geoscience Australia utilised bathymetry and published geological studies to identify and classify geomorphic features of the seabed (Harris *et al.,* 2005). The geomorphic features from this study are shown in Figure 2-8.

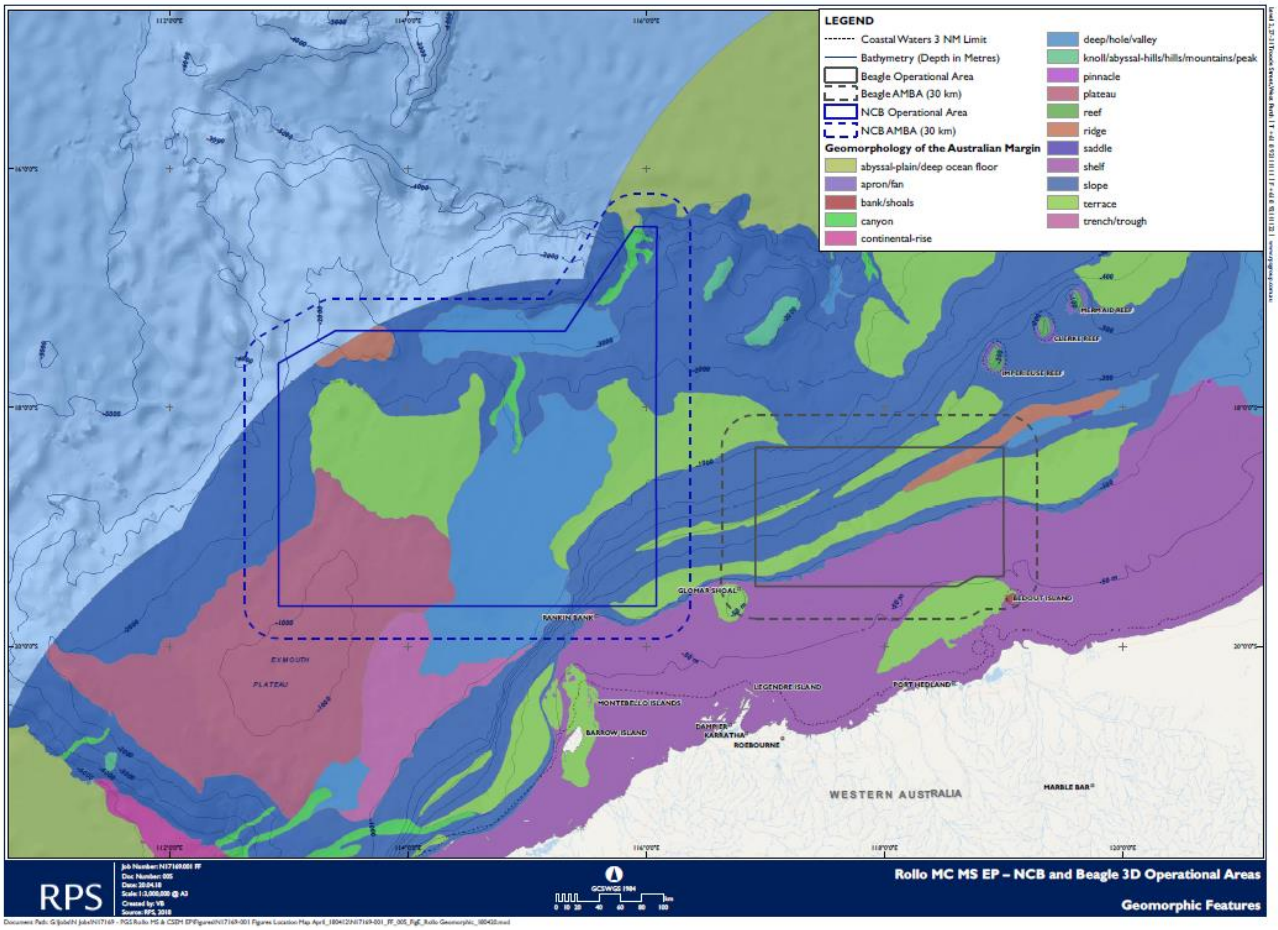


Figure 2-8 - Geomorphic Features of the NCB and Beagle AMBA

Based on this information the following geomorphic features are identified to be present within the NCB and Beagle AMBA (Harris *et al.,* 2005):

- Abyssal-plain / Deep ocean floor - Extensive, flat, gently sloping or nearly level region at abyssal depths.
- Canyon - A relatively narrow, deep depression with steep sides, the bottom of which generally has a continuous slope, developed characteristically on some continental slopes.
- Deep / hole/ valley - In oceanography, an obsolete term which was generally restricted to depths greater than 6,000 m. Hole: Local depression, often steep sided, of the sea floor. Valley: Relatively shallow, wide depression, the bottom of which usually has a continuous gradient. This term is generally not used for features that have canyon-like characteristics for a significant portion of their extent.
- Plateau - Flat or nearly flat area of considerable extent, dropping off abruptly on one or more sides.
- Ridge - (a) Long, narrow elevation with steep sides. (b) Long, narrow elevation often separating ocean basins. (c) Linked major mid-oceanic mountain systems of global extent.
- Slope - Slope seaward from the shelf edge to the upper edge of a continental rise or the point where there is a general reduction in slope.
- Terrace - Relatively flat horizontal or gently inclined surface, sometimes long and narrow, which is bounded by a steeper ascending slope on one side and by a steeper descending slope on the opposite side.

Table 2-13 lists the major geological features within the NWMR and relevant to the NCB and Beagle AMBA (Figure 2-9).

Table 2-13 - Major emergent geological features within the NWMR within the NCB and Beagle AMBA

Name	Features	Distance to OA
Bedout Island	• Seabird foraging and breeding sites; turtle nesting/foraging site.	>14 km from Beagle OA to WA State waters surrounding Bedout Island
Glomar Shoal	• Submerged feature located ~100 km north of Dampier on the Rowley Shelf in a high energy environment subject to strong currents. • Single plateau at 40 m water depth. • Potential important site for pelagic fish species.	~11 km to Beagle OA and 50 km to NCB OA
Rankin Bank	• Series of three major banks ~75 km north of Barrow Island. Relatively pristine but non-unique habitats of macroalgae, hard and soft coral, sand and rubble that support a diversity of fish species. • Water depths range from 20 – 120 m. • Significant for their isolation and relatively shallow depth.	~7 km from NCB OA

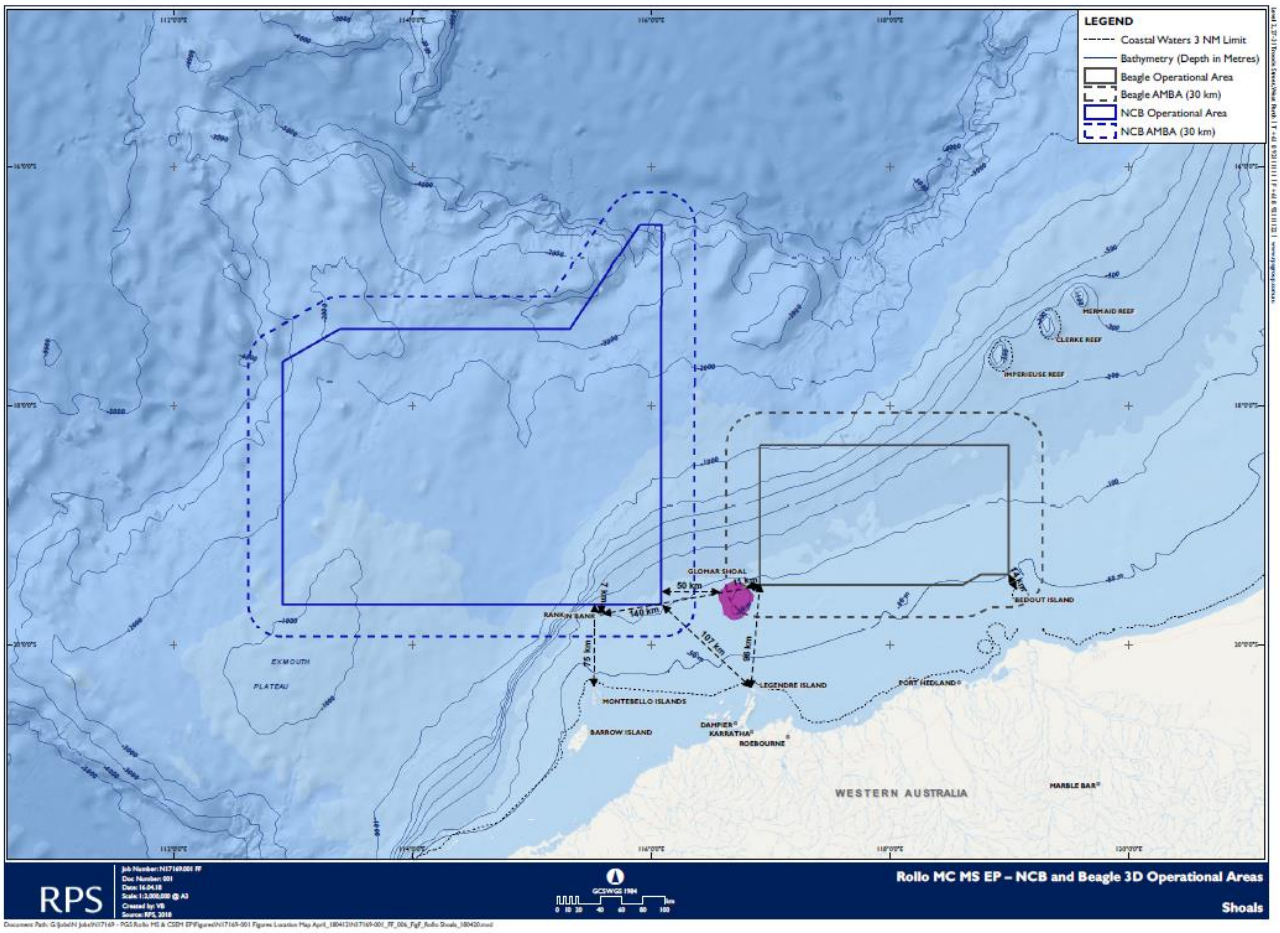


Figure 2-9 - Proximity of Shoals to the NCB and Beagle AMBA

2.4 BIOLOGICAL ENVIRONMENT

2.4.1 Benthic Environment

Much of the NWMR's outer mid-shelf is covered by a relatively featureless, sandy-mud seabed with a sparse covering of sessile organisms dominated by filter-feeding heterotrophs such as gorgonians, sponges, soft corals, and detritus-feeding crabs and echinoderms. This is especially true of the non-trawled areas in the deeper water, and the soft-bottomed rises (Heyward *et al.,* 1997). However, the many limestone banks have a harder substrate and are likely to support 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 fauna. Although these waters may be relatively oligotrophic for part of the year, these communities probably rely on primary productivity from phytoplankton and commensal zooxanthellae within hard corals (Brewer *et al.,* 2007).

2.4.1.1 Soft Substrate Communities

Most of the seabed within the AMBAs is largely devoid of hard substrate, with only sparse benthic communities of bryozoans, molluscs and echinoids on the predominantly sandy substrate (DEWHA, 2008a). The soft substrates are thought to support low density benthic communities of bryozoans, molluscs and echinoids. Sponge diversity between reefs is not uncommon in the NWMR; sponges have larvae that do not move very far, and settle out of the water column quickly, resulting in minimal larval exchange and high population differentiation (DEWHA, 2007; DEWHA, 2008a). Many are negatively buoyant or phototaxic, and there is a tendency for them to settle close to the parent populations (DEWHA, 2007). Occasional epibenthic fauna (feather stars, gorgonians, bryozoans, sea urchins, hydroids and sponges) have been recorded in areas where rocky substrate or outcrops are present (URS, 2010a).
Much of the outer mid-shelf is covered by a relatively featureless, sandy-mud seabed with a sparse covering of sessile organisms dominated by filter-feeding heterotrophs such as gorgonians, sponges, soft corals, echinoderms and detritus-feeding crabs and echinoderms. This is especially true of the non-trawled areas in the deeper waters, and the soft-bottomed rises (Heyward *et al.,* 1997).

2.4.1.2 Filter-feeder Communities

Sessile invertebrate filter feeders (e.g. sponges, bryozoans and hydroids) are heterotrophic, extracting their food from the surrounding waters. Filter feeders that dominate in the deep water, light-limited habitats as they don't rely on light to produce energy, instead filtering plankton from the water column (Heyward *et al.,* 1997).

Hard seafloor areas such as limestone pavements on the North West Shelf, and submerged cliffs are said to support a high diversity of benthic filter-feeders and producers. Whereas, soft-bottom substrates include areas of abiotic sandy seafloor support patchy and sparse distribution of sessile organisms such as filter-feeding and deposit-feeding species and mobile epibenthos, such as sea cucumbers, ophiuroids, echinoderms, polychaetes and sea-pens (DEWHA, 2008).

2.4.1.3 Coral communities

The reefs of the NWMR are areas of especially high species diversity, and there is a distinct zonation in reef types. Coral communities, including patch or fringing reefs occur in shallow water, sub-tidal environments of the NWMR, as well as around intertidal areas adjacent to islands and other emergent features (DEWHA, 2007). Coral diversity reduces with increasing depth, and corals are uncommon at depths greater than 40 m in the Pilbara region (Waples and Hollander, 2008). Coral distribution near the mainland is restricted by lack of light due to natural turbidity. Corals may exist as sparse coral colonies in some locations, rather than extensive coral communities.

Significant areas of coral reefs within the NWMR are all located outside of the NCB and Beagle AMBA, these include Ningaloo Reef(>100 km), Dampier Archipelago (>96 km), the Montebello and Lowendal Island groups (>75 km).

2.4.1.3.1 Coral Spawning

Corals have three possible reproductive modes; asexual, brooding and broadcast spawning. Asexual and brooding reproductive modes involve budding/fragmentation and internal fertilisation, respectively, with larval settlement from brooding occurring within hours of release. Broadcast spawning involves the discharge of sperm and eggs into the surrounding water column where egg fertilisation and planulae development occurs within a planktonic stage on or near the water surface (Underwood *et al.,* 2009). The process of fertilisation and embryo development after spawning occurs rapidly in most corals in the region. One study recorded cell division (after fertilisation) in approximately 30% eggs sampled within two hours of spawning (AIMS, 2004). After 15 hours, between 60% and 90% of the samples had developed into free swimming planulae, and after 48-72 hours after spawning, planulae were generally competent to settle on the substrate (AIMS, 2004).

Multi-specific, synchronous spawning (mass spawning) of scleractinian corals has been recorded in the Dampier Archipelago (in State waters adjacent to the Region), and is also believed to occur at other reefs in the region. Mass spawning occurs on neap, nocturnal ebb tides in March and April each year. This coincides with the annual intensification of the Leeuwin Current and ITF (DEWHA, 2008a). The major spawning period around Dampier is in autumn, however recent studies have also identified a second coral spawning event around Dampier (smaller in proportion to autumn) and two species of *Acropora* have been identified as spawning in spring and autumn.

The timing of mass spawning events explains the connectivity and genetic links between tropical and temperate coral reefs on the WA coast. Research into such genetic exchange has identified connectivity between the reefs of the Northwest Shelf Province; i.e. Montebello and Barrow islands and Ningaloo Reef.

2.4.1.4 Shoals of the NWMR

Features such as shoals provide topographic structure and habitat for sessile megabenthos, including hard and soft corals, filter feeders, seagrass and macroalgae. These shoals all have the potential to support photosynthetic organisms and primary production due to water clarity and adequate light penetration at the depths of the shoal plateaus (Heyward *et al.,* 2011a). Such habitats provide shelter and food for a diverse range of primary and secondary consumers, such as schooling fish (e.g. herring and damsel fish), parrot fish etc., which then support higher order consumers such as trevally, dolphin fish and emperors etc. (Brewer *et al.,* 2007). Although these waters may be relatively oligotrophic for part of the year, these communities probably rely on primary productivity from phytoplankton and commensal zooxanthellae (within hard corals; Brewer *et al.,* 2007). Although typical shoal biota includes algae, corals and seagrass, there can be significant diversity within and between shoal ecologies (Heyward *et al.,* 2011a).

Rankin Bank is approximately 7 km from southern NCB boundary. Rankin rises steeply from 120 m depth along its north-eastern side and rises from 80 m depth on all other sides, forming several rugose peaks and plateaus 20–40 m from the surface (Abdul Wahab et al 2017). AIMS concluded that despite Rankin Bank not being recognised as, or part of, a KEF or protected area (and not mentioned in the North-west marine bioregional plan), it is an important area in terms of diversity (AIMS 2014).

Glomar Shoal (approximately 11 km to the Beagle and 50 km to the NCB OAs) is listed as a Key Ecological Feature (KEF) (Section 2.2.9). Glomar rises gently on the south-west side of the reef from 80 m depth to a single plateau at 40 m depth (Abdul Wahab et al 2017). At the 60 m depth contour Glomar Shoal covers an area of 14,700 hectares, which is approximately 8.5 times larger than Rankin Bank which covers an area of 1,720 hectares (Abdul Wahab et al 2017).

Benthic communities at Glomar Shoal and Rankin Bank were like those seen on other shoals on the NWS (Heyward *et al.,* 2011, 2013). However, the total cover of fauna (such as soft coral cover and sponges) was much lower at Glomar Shoal and Rankin Bank than any other shoal in the area (Table 2-14; AIMS 2014).

Overall Glomar Shoal is characterised by a high proportion of sand/silt (approximately 41%) and consolidated reef[3] (approximately 44%). It is also characterised by a relatively low cover of epibenthic organisms (approximately 53%), which were dominated by algae (with only 4.5% represented by marine fauna). Hard coral cover was very low (<1%) when compared to other shoals in the region (> 10%). Due to the absence of coral reef (characterised as >10% coral cover) on Glomar Shoal, there is a low likelihood of the presence of site-attached fish (AIMS 2014).

In comparison to Glomar Shoal, Rankin Bank has much lower coverage of sand/silt, with a higher cover of epibenthic organisms (64%, of which 16.9% was represented by animals). Hard coral cover at Rankin Bank was high (13.6%), and at the upper end of the range seen at other shoals on the NWS (Table 2-14; AIMS 2014). Rankin Bank hard coral communities were also more diverse than those of Glomar Shoal and generally highest on consolidated reef and plateau areas in <40 m water depth (AIMS 2014). The deepest transects from Rankin Bank (>100 m depth) were more similar to benthic communities from Glomar Shoal overall and the shallowest transects from Glomar Shoal (<30 m depth) were similar to those from Rankin Bank, most likely reflecting the sand-dominated communities at Glomar compared with the coral-dominated ones at Rankin Bank (AIMS 2014).

Table 2-14 - Summary of Average Percent Cover of Key Benthic Communities on Glomar Shoal, Rankin Bank and Other Submerged Shoals of the NWS (Source: Heyward *et al.*, 2011 in AIMS 2014)

Shoal	Hard Coral	Soft Coral	Sponge	Other Fauna	Total
Glomar Shoal	0.4	1.3	1.8	1.1	4.5
Rankin Bank	13.6	0.9	1.4	1.0	16.9
Goeree	12.6	2.5	5.9	5.4	26.4
Wave Governor Bank	9.4	0.6	7.7	4.7	22.4
Barracouta West	6.1	2.6	2.8	1.1	12.6
Echuca	9.9	2.7	12.1	4.6	29.3
Eugene McDermott	17.7	7.5	11.2	3.9	40.3
Heywood	9.6	1.1	7.2	2.4	20.3
Shoal 25	14.1	3.2	4.5	3.8	25.6
Vulcan	7.8	2.2	8.1	7.3	25.4
Barracouta East	11.9	9.0	8.0	2.2	31.1

Towed camera surveys across Glomar Shoal revealed that benthic biotic cover was higher in shallow water (<40 m; with an approximate coverage of 44% of the seabed) and declined with increasing depth (Figure 2-10) (AIMS 2014). There was also a transition from a consolidated reef habitat in shallow water (<40 m) to a higher relative proportion of sand/silt in deeper water, (>40 m, unconsolidated reef category (sand/silt) accounts for around two thirds of the seabed surveyed). This trend was particularly observed on the exposed south-west side of the shoal. Consolidated reef cover represented around half the coverage of benthic categories in water depths greater than 60 m. Algal cover was dominant at depths of < 40 m, with decreasing contribution to biotic cover with increased depth (to >80 m) (AIMS 2014).

[3]AIMS (2014) define Consolidated Reef as comprising "consolidated substrate, reefal substrate, turf and crustose coralline algae (algal turf community), and filamentous algae".

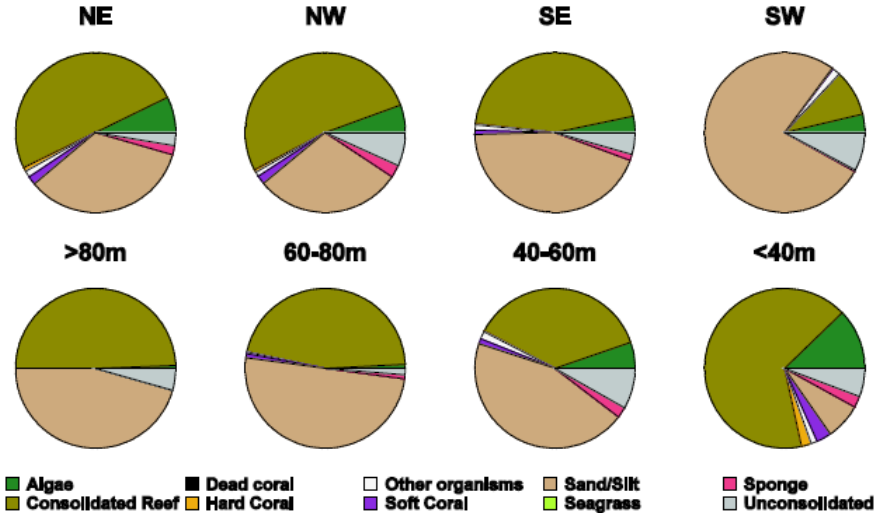


Figure 2-10 - Benthic Biotic Cover on Glomar Shoal Grouped by Exposed and Depth (AIMS 2014)

Towed video transects from Rankin Bank revealed that there was a gradual increase in the proportion of sand/silt with depth (Figure 2-11). Areas deeper than 80 m depth were dominated by sand/silt substrates with <1% hard coral cover. Soft coral was uncommon in shallow water (<40 m) and relatively more abundant at depths of more than 60 m. Sponges appear to be ubiquitous, with similar cover across all aspects and depths at Rankin Bank. Algal cover was high at depths of 60 m or less, but was still well represented at depths of 60 to 80 m (in comparison to Glomar Shoal). Algae contributed the fourth highest level of biotic cover at depths of >80 m (AIMS 2014). Only minor differences were observed in the relative proportion of benthic categories across the four quadrants of Rankin Bank. However, more unconsolidated reef was recorded in the SE quadrant, and less hard coral recorded on the eastern side compared with the western side of the reef (AIMS 2014).

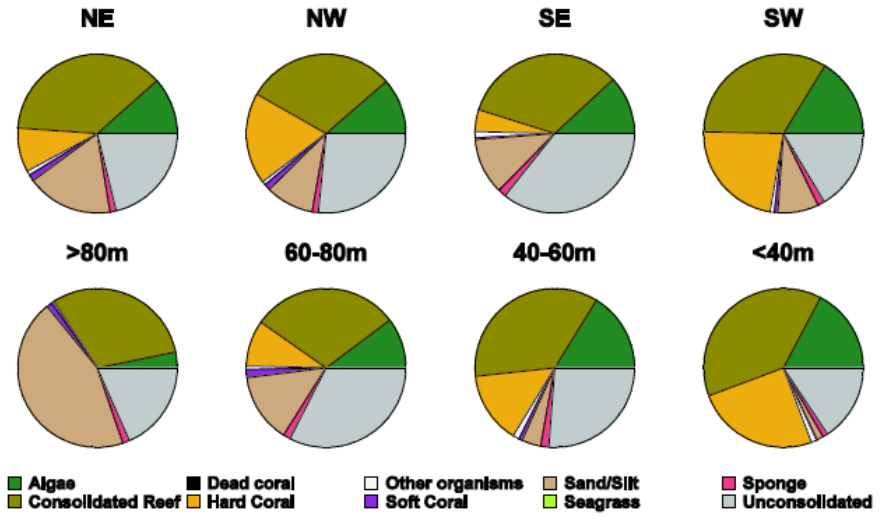


Figure 2-11 - Benthic Biotic Cover on Rankin Bank Grouped by Exposed and Depth (AIMS 2014)

2.4.1.4.1 Fish Communities and Shoals

Glomar Shoal and Rankin Bank are located in high-energy environments where localised upwelling has resulted in enhanced productivity, supporting significant populations of commercially and recreationally important fish species, including Rankin cod, brown-striped snapper, red emperor, crimson snapper, bream and yellow-spotted triggerfish. These taxa are highly mobile and the KEF is not recognised for site-attached reef fish. Productivity of commercially and recreationally important fish is specifically considered a defining value of the Glomar Shoal KEF (Director of National Parks 2013a).

Fish surveys conducted over Glomar Shoal in the period 1967 to 1982 recorded 280 species in the general shoal area (Falkner *et al.,* 2009). Of these species, the majority are demersal species and fish assemblages were not considered significantly different from those of the surrounding areas (Falkner *et al.,* 2009). This indicates that the whole of the shoal is important for fish and indicates that the reef crest does not support any higher conservation value fish assemblage than any other area.

AIMS conducted Stereo Baited Remote Underwater Visual Stations (SBRUVS) surveys at Glomar Shoal and Rankin Bank in 2013, with 96 stereo baited remote underwater video stations (SBRUVS) deployed at the larger Glomar Shoal in 31 to 78 m of water, and 46 at Rankin Bank in 19 to 90 m water depth (**Figure 2-12**; AIMS 2014). In this context AIMS used the term 'site-attached' to describe those fish which are unlikely to move between the shoals, or are restricted to the shoal. The study described site-attached fish species as the entire fish fauna recorded on the baited underwater cameras, and also included highly mobile species (such as snapper, bream and emperor).

Both Glomar Shoal and Rankin Bank were similar in terms of patterns of total fish abundance and species richness (diversity). Both abundance and diversity increased with decreasing depth (<40 m), and with an increase in habitat rugosity (particularly in association with hard coral environments). However, a comparison between the two areas showed that Rankin Bank contained higher fish species richness than Glomar Shoal, a pattern also mirrored in levels of abundance (AIMS 2014). AIMS concluded that demersal fish communities were comparable with other regional reefs and shoals on the NWS in terms of species richness and abundance, with a total of 275 species recorded during the surveys at Glomar Shoal and Rankin Bank combined (AIMS 2014).

AIMS characterised fish assemblages at Glomar Shoal by 'bare ground' or "sand-associated" fish genera based on the large expanse of sand/silt habitats in deeper parts of the shoal (> 40 m), such as threadfin breams (*Nemipterus*) and triggerfish (*Abalistes*), as well as the Carangidae (jacks, trevallys), Lethrinidae (emperors) and Labridae (wrasse) families. Of these families, the most common species were the threadfin bream (388 individuals), a species of wrasse (290 individuals) and coastal trevally (178 individuals). Conversely, AIMS characterised Rankin Bank by "reef-associated" fish genera (e.g. *Acanthurus* and *Naso* surgeonfishes, *Lethrinus* emperors and *Variola* coronation trout). None of these are known to be truly restricted to small home-ranges and isolated habitat patches and are widespread on bare, sandy seabeds in the region (AIMS 2014). The differences between the two locations were attributed to the differences in benthic habitats (AIMS 2014).

The AIMS study used statistical modelling and predictive mapping to develop objective and robust, quantitative maps of the areas on Glomar Shoal and Rankin Bank supporting the highest fish species richness and abundance (Figure 2-13 and Figure 2-14, respectively). Overall, depth was the shared variable that most influenced the richness and abundance of the fish community across both locations, with shallower areas (<40 m) supporting the most species. Fish abundance was highest in the 20 to 30 m depth range and declined quickly from 30 m. The decline of fish abundance in depths of >30 m was evident with declining levels of epibenthic cover (AIMS 2014). The degree of hard coral cover and rugosity, (seabed roughness), were the next most influential variables on fish species richness and abundance.

Fish abundance and species richness on Glomar Shoal was highest in the shallow and high rugosity reef ridge line running from the north-east through to the south-east of the site (Figure 2-13; AIMS 2014). On Rankin Bank the highest fish abundance and diversity were found in several sections of shallow water high relief reef area in the northern quadrant of the site and one high relief reef area in the south-western quadrant, both in <40 m water depth (Figure 2-14; AIMS 2014). Shallow water habitats were dominated by small to mid-sized fishes and few larger individuals were present. This indicates the larger individuals of commercial and recreational fisheries importance are not restricted to the shallower parts of the shoals. On Glomar Shoal, the area that is less than 30 m deep comprises much less than 10% of the area of the KEF.

While any sampling technique and survey (short of a full destructive census) will be subject to sampling bias and under-sampling, the SBRUVS survey method, used to quantify fish assemblages on Glomar Shoal and Rankin Bank, provides reliable estimates of relative fish abundance, diversity, species identify, size and biomass (AIMS 2014). Sampling that relies on a stationary platform (e.g. baited-video) to provide a visual observation dataset has been shown to allow time for species that are hiding amongst the crevices or canopy-forming macroalgae to be observed (Watson *et al.,* 2005). A study by Harvey *et al.,* (2007) indicated that bait attracted greater numbers of predatory and scavenging species without decreasing the abundances of herbivorous or omnivorous fishes, and concluded that the use of bait provides better statistical power to detect spatial and temporal changes in the structure of fish assemblages and the relative abundances of individual species within them (Harvey *et al.,* 2007).

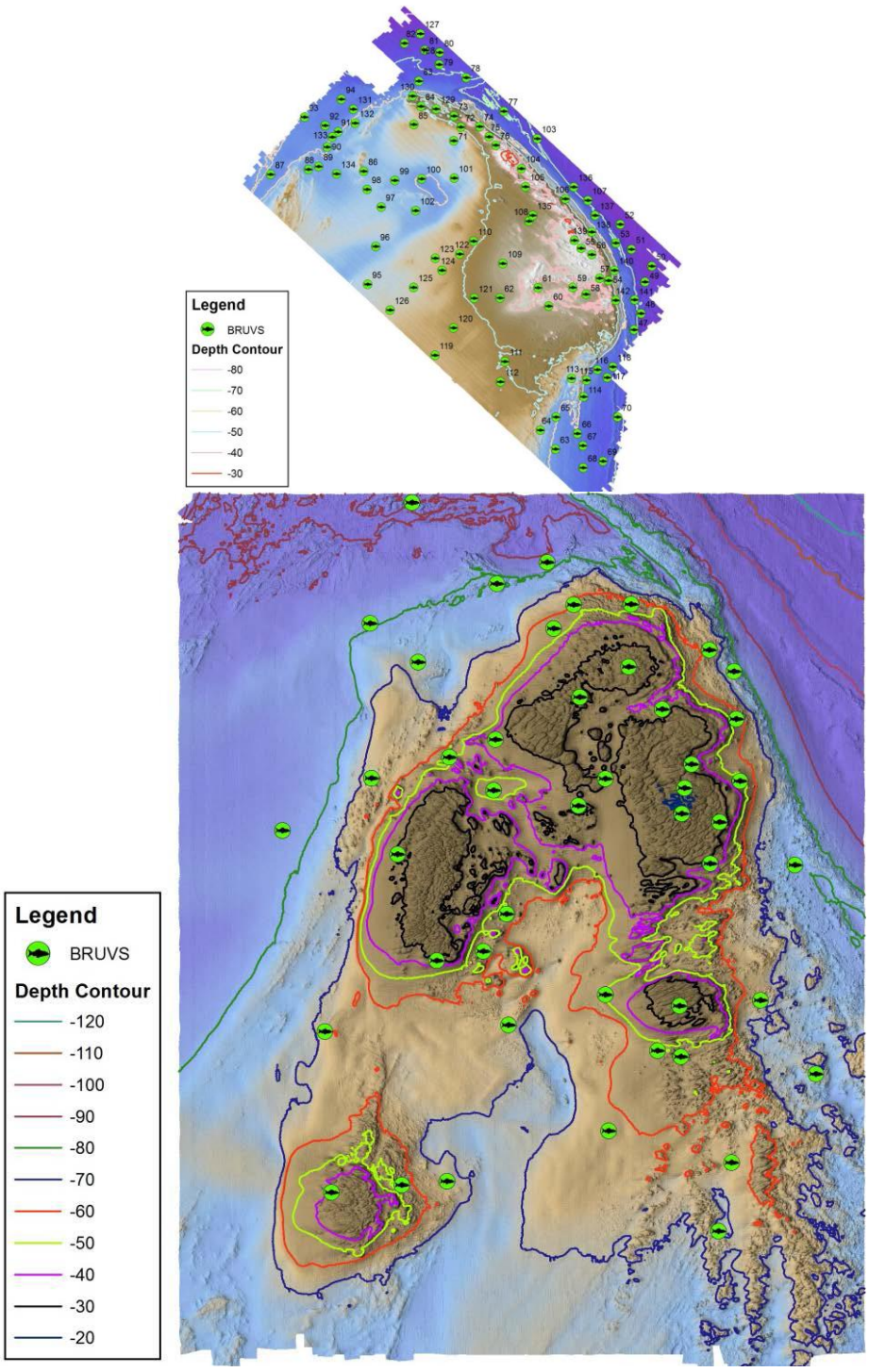
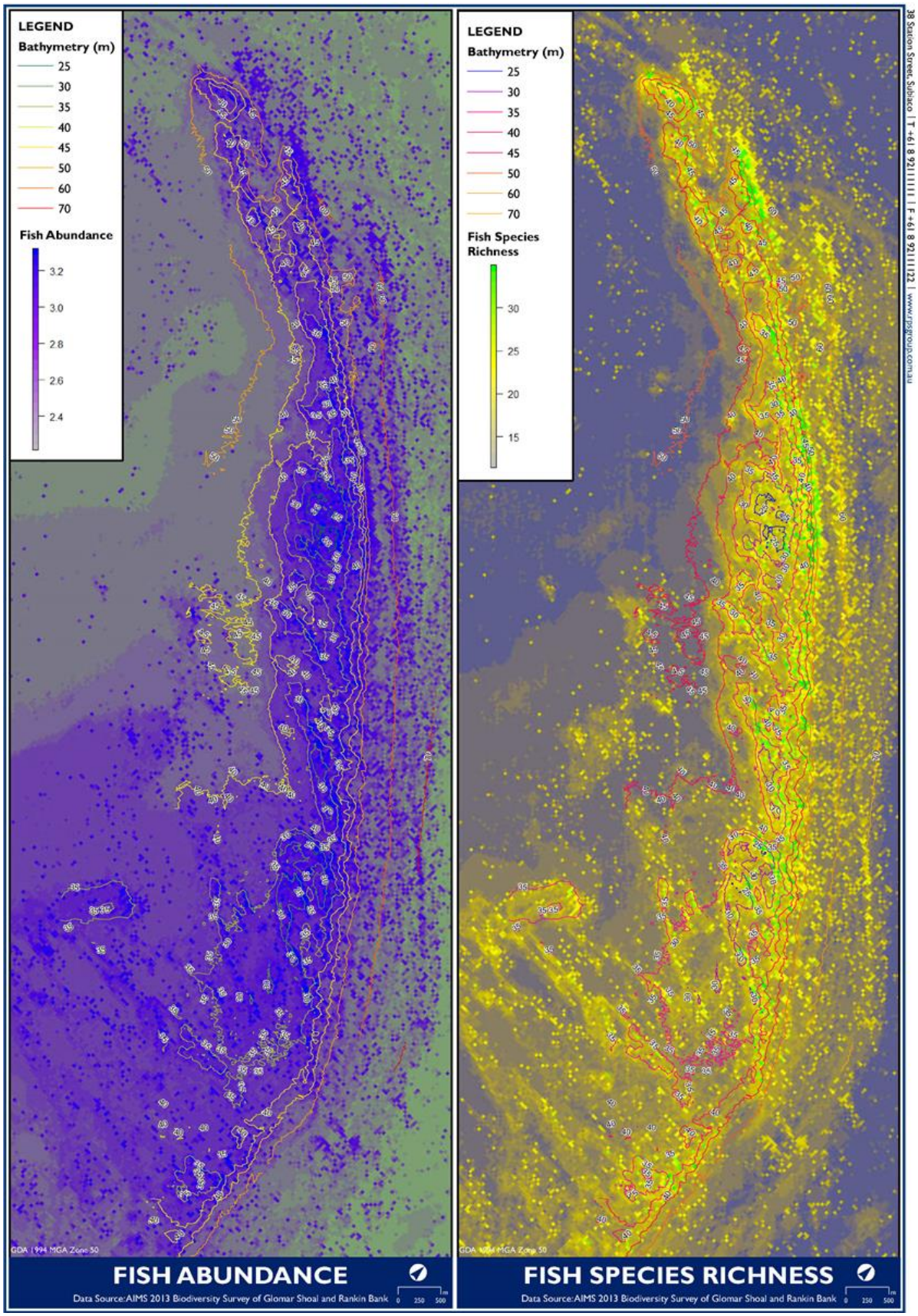
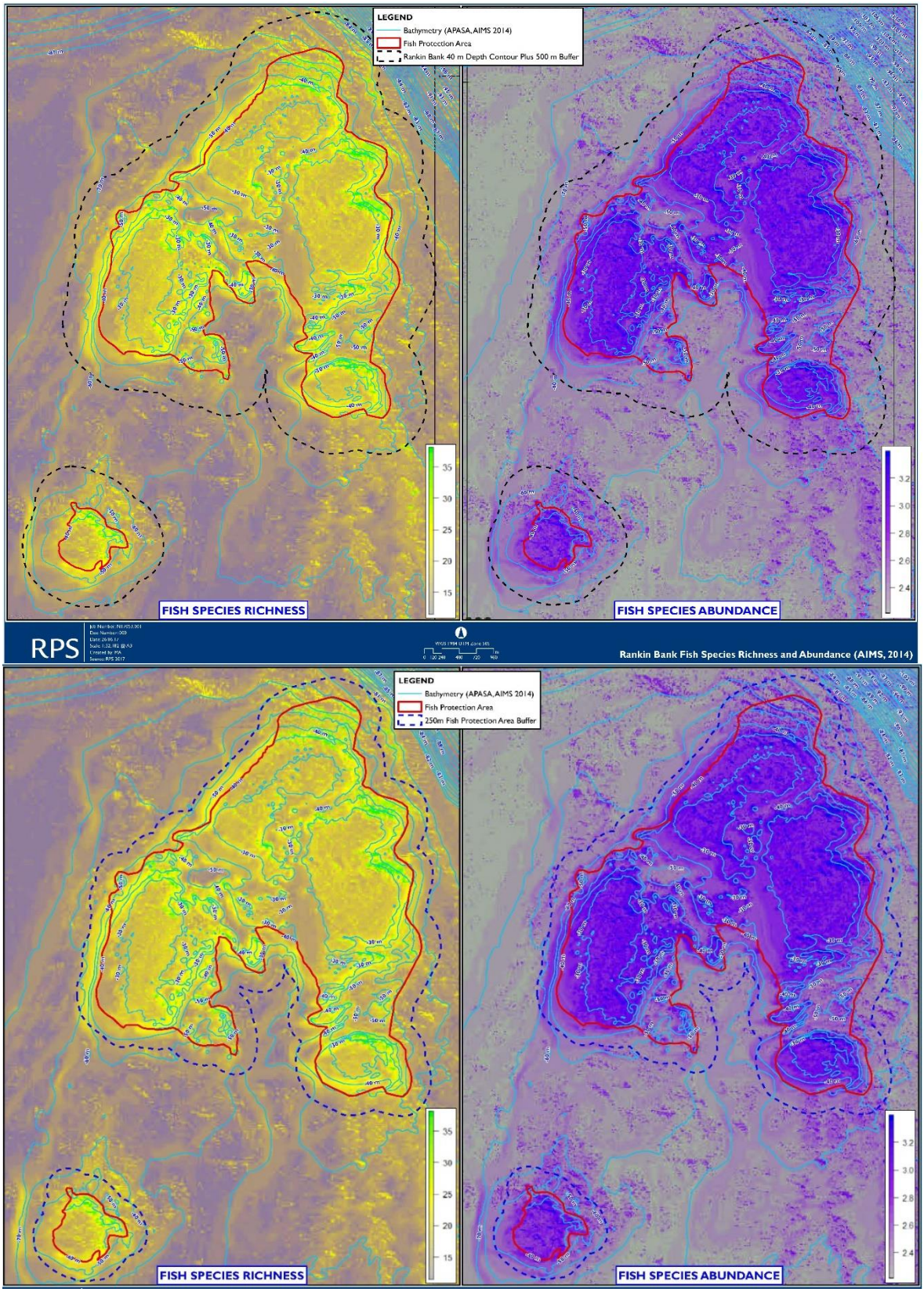


Figure 2-12 - Location of SBRUVS Deployments at Glomar Shoal (above) and Rankin Bank (below) (AIMS 2014)



(Source: AIMS 2014)

Figure 2-13 - Glomar Shoal Modelled Fish Species Richness and Abundance with Bathymetry



(Source: AIMS 2014)

Figure 2-14 - Rankin Bank Modelled Fish Species Richness (Left) and Abundance (Right) with Lidar Bathymetry

2.4.2 Pelagic Environment

2.4.2.1 Productivity and Plankton Communities

Seasonal changes in the region's oceanography are the primary drivers of biological productivity in the NWMR. These include: weakening of the ITF and Leeuwin Current; the seasonal reversal in wind direction, which supports the development of currents such as the Ningaloo Current; conditions more favourable for upwelling on the North West Shelf (NWS); and episodic events such as cyclones. As a result of the periodic nature of these changes, biological productivity follows boom and bust cycles, is sporadic and significantly geographically dispersed (DEWHA, 2007).

The offshore waters of the NWMR are oligotrophic and planktonic abundances are low. The area is characterised by high species diversity but relatively low endemicity. Bentho-pelagic fish (those that occur in water depths of ~200-1,000 m) are a vital link in the trophic systems of the region (Brewer *et al.,* 2007). As they migrate vertically between the pelagic and benthic (seafloor) systems they consume nutrients and aid the transfer of the nutrients between the two systems. Other processes also transfer nutrients from pelagic systems to benthic systems. For example, many deep water benthic communities are either attached to the seafloor or have limited ranges and are heavily reliant upon nutrients in the form of detritus falling through the water column into the benthic environment (DEWHA, 2008a).

Glomar Shoal is located in the mid shelf sub-system of the Pilbara. This drowned reef is believed to be a site of higher productivity, as evident in the high catches by commercial fisheries in this area (see **Section 2.5.5**). The processes facilitating increased productivity at this location are not known (DEWHA, 2007). The waters are clear and the thermocline (and therefore chlorophyll maxima) intersects with the seafloor. Primary productivity in the mid shelf sub-system in the Pilbara is pelagic driven, but in the past would have included a significant benthic component that has been removed/damaged through trawling activities. The sub-system comprises of productivity fronts that form "lines" of nutrients which act as feeding routes for migratory species (DEWHA, 2007).

2.4.2.2 Cephalopods

Approximately 81 different species of cephalopod are believed to occur in the NWMR, five of which may be endemic as they have only been recorded from one location or are thought to have a very restricted distribution (DEWHA, 2008a). The area between Kalbarri and the Dampier Archipelago appears to be particularly significant for octopus, dumpling squids and several species of cuttlefish (DEWHA, 2008a). Squid are an important food item for a number of species in the region. Sperm whales, for example, feed exclusively on the Japanese flying squid (*Todarodes pacificus*) and sharpear enope squid (*Ancistrocheirus lesueurii*), while seabirds such as black noddies and red-footed boobies feed on the purpleback flying squid (*Sthenoteuthis oualaniensis*; DEWHA, 2008a).

2.4.2.3 Pearl Oysters

The DoF Ecologically Sustainability Development (ESD) Report for the POMF in 2006 states that pearl oysters are known to occur in water depths of 0–50 m off the coast of WA. However, the Pearl Producers Association (PPA) identified that the *Pinctada maxima* distribution and in turn larval brood stock, extends as far as the 100 m isobath—probably an overly conservative limit. 'The Pearl Oyster' (Southgate and Lucas, 2008) is the source of both the PPA and DoF rationale for the 100 m distribution limit. The document (pg. 59) stated "The individuals are *typically found in shallow waters* of littoral and sublittoral zones *occasionally* reaching the maximal recorded depths of 100-120m." It also stated that 'some early reports from the Sulu Islands in the Philippines suggested that maxima live as deep as 120 m'. However, this latter statement was based on observations from 1930 in the Philippines and so not contemporary nor local.

Condie *et al.*(2006) specifically looked at recruitment at Eighty Mile Beach. Results indicated that spawning in the Eighty Mile Beach region was concentrated between 8 and 15 m water depth, with potential smaller contributions from further northeast. These spawning events were likely to lead to successful recruitment along to the southwest, thus enabling the main pearl oyster producing populations to be self-seeding. These

spawning events also fed larvae into neighbouring shallow waters and deeper waters to the west (~20 m). High numbers of Mother of Pearl (MOP) in deeper waters (~30 m) appeared to result from larvae transported from inshore populations. However, spawning in these deeper waters contributed little to the recruitment in the inshore populations.

There was some uncertainty in the modelling used for the study, and there may be some variation in the results, thereby leading the authors to make the following very definitive statement: *'the results of the model suggest that the long-standing hypothesis within the pearling industry, namely that deeper 'unfished' stocks are a brood stock source for commercially fished inshore stock is not likely to be true. The inshore stocks appear to be self-sustaining, and may even be providing larvae to deeper stocks …"*

2.4.2.4 Crustaceans

The NWMR is thought to contain a high diversity of crustaceans across a range of habitats, from intertidal sites to the deeper waters of the slope and the abyss. Dominant species groups include copepods, prawns, scampi and crabs. These groups display a strong biogeographic affinity with the Indo-west Pacific, with few endemic species present. As well as being preyed upon by large pelagic fish, crustaceans are also a significant food for cephalopods (squid and octopus species; DEWHA, 2008a).

The North West Shelf Trawl Fishery (NWSTF) targets Australian scampi (*Metanephrops australiensis*). However, smaller quantities of velvet scampi (*M. velutinus*) and Boschma's scampi (*M. boschmai*) are also harvested in the region. Data from the fishery shows that the majority of catch occurs over soft, muddy sediments or sandy habitats typically at depths of 350-600 m on the continental slope and therefore within the NCB and Beagle AMBAs (DoF, 2012).

The West Coast Deep Sea Crustacean Managed Fishery (WCDSCMF) targets crystal (snow) crabs (*Chaceon albus*), giant (king) crabs (*Pseudocarcinus gigas*) and champagne (spiny) crabs (*Hypothalassia acerba*). These species of crustaceans are deep-water species occurring on the continental shelf at depths of 300 – 1200 m.

It is unlikely that these species are present in the NCB and Beagles AMBAs based on:

- The champagne crab is found southwards of Kalbarri (Smith 2006).
- The crystal crab is found along the west coast of Australia ranging from just north of Carnarvon down around the south western cape to Bremer Bay on the south coast of WA (Chaceon website).
- The king crab is found along the southern coast of Australia from Albany to the Tasmanian east coast (Chaceon website).
- There has been no recent fishing effort within the NCB and Beagle AMBAs (Section 2.5.5.1.9).

2.4.2.5 Fish

Fish communities play an important ecological role in the NWMR. In particular, small pelagic fish (e.g. members of the Family Myctophidae - lantern fish) are believed to comprise a significant proportion of the fish biomass throughout the region. The NWMR supports a diverse assemblage of fish, particularly in shallow water near the mainland and around islands. Most fish have tropical distributions and are well distributed throughout the Indo-west Pacific region. The oceanic waters of the region are also believed to provide important spawning and nursery grounds for a number of large pelagic fish species (DEWHA, 2008a). However, none have been identified specifically within the NCB or Beagle OAs.

Some of the deep-water fish and school species that are likely to occur in the area are listed below:

- marlin (*Makaira* spp.);
- sailfish (*Istiophoridae* spp.);
- swordfish (*Xiphiidae* spp.);
- hardyhead (*Pranesus* spp.);
- sardine (*Amblygaster leiogaster*);

- sprat (*Spratelloides* spp.);
- northern bluefin tuna (*Thunnus tonggol*);
- skipjack tuna (*Katsuwonis pelamis*);
- mackerel tuna (*Euthynnus affinis*); and
- narrow-banded Spanish mackerel (*Scromberomorus commerson*).

Other fish species likely to occur in the area include lizardfish, goatfish, trevally, angelfish, tuskfish, red emperor, rock cod, sweetlips, trigger fish and threadfin bream (DEWHA, 2007).

Continental slope demersal fish communities are a KEF of the NWMR (Section 2.2.9), which support a high diversity of demersal fish species. This feature extends between the North-west Cape and the Montebello Trough and has more than 500 fish species, 76 of which are endemic, which makes it the most diverse slope bioregion in the whole of Australia. In addition, Glomar Shoal (also a KEF) is known to be an important area for a number of commercial and recreational fish species such as Rankin cod, brown striped snapper, red emperor, crimson snapper, bream and yellow-spotted triggerfish. This is because of purported increased biological productivity associated with localised upwelling at this location (Brewer et al. 2007). Catch rates at the Shoal are high, indicating that the area is a region of high productivity (DEWHA, 2008a). Full descriptions of the values and sensitivities of the Glomar Shoal and the Continental slope demersal fish communities are given in (Section 2.2.9).

Information in the relationship between fish communities and habitats associated with shoals is presented above in Section 2.4.1.4.

2.4.2.5.1 Syngnathids - Listed Marine Species

Other EPBC Act protected marine species that may occur within the proposed OA and surrounding waters include various species of pipefishes and seahorses (Family Syngnathidae). Information regarding the habitat, species numbers or life cycles of species from this family on the NWS is depauperate (DSEWPaC, 2012a). Seahorses and pipefishes are a diverse group and occupy a wide range of habitats. The species considered in the species group report card – bony fishes (DSEWPAC 2012a), which supplements and supports the NMR bioregional plan (DSEWPAC 2012, generally display a preference for seagrass and macroalgal beds, coral reefs, mangroves and sponge gardens. These habitats have not been identified within NCB and Beagle OAs and therefore Syngnathid species are unlikely to be present.

2.4.2.5.2 Pelagic and Demersal – Commercial Species

Commercial fish species targeted within the NCB and Beagle AMBA include demersal species; Carangidae (snapper species), Lutjanidae (Trevallies and Jacks) and pelagic species: Scombridae (mackerel species). These species rely less on the benthic habitat, have increased swimming ability and would be more likely to flee a seismic sound source. These findings are consistent with the main demersal and pelagic commercial fisheries operating within the survey area and target a range of tropical snappers and mackerel species. Based on information from the Department of Primary Industry and Regional Development – Fisheries (DPIRD-Fisheries), the main commercial species likely to be found within the Beagle and Beagle AMBAs are:

- Goldband snapper (*Pristipomoides multidens*)
- Blue spotted emperor (*Lethrinus laticaudis*)
- Crimson snapper (*Lutjanus erythropterus)*
- Spanish mackerel (*Scomberomorus commerson*)
- Grey mackerel (*S. semifasciatus*)
- Scad Mackerel (*Grammatorcynus bilineatus*)
- Wahoo (*Acanthocybium solandri*)

Goldband snapper is widely distributed throughout northern Australia and the tropical Indo-West Pacific (Figure 2-15). Gold band snappers are deepwater fish inhabiting tropical and sub-tropical waters. They are schooling fish and live in areas of hard, rocky and uneven sea floor and steep off islands. They feed on fishes, shrimps, crabs, lobsters, stomatopods, squids, gastropods and urochordates, Fast swimming predators of the

waters above the reef and some root in the sand for invertebrates and fishes. Usually in small groups over sand bottoms near reefs. (Fishbase, Accessed 8/5/2018). These species are not considered site attached due to good swimming ability and minimal reliance on reef structures for shelter.

Source: modified from Fishes of Australia (2018)

Figure 2-15 - Distribution of Goldband Snapper

Blue spotted emperor, also known as grass emperor. Juveniles are bottom feeding species and found in seagrass beds and mangrove swamps. Adults are found over coral reefs, often in schools, however, can be solitary or schooling and feeds mainly on crustaceans and fishes, and do not appear territorial. (Fishbase, Accessed 8/5/2018). These species are considered to be reef associated.

Source: modified from Fishes of Australia (2018)

Figure 2-16 - Distribution of Blue Spotted Emperor

Crimson snapper adults are known to inhabit trawling grounds and reefs. They are present over shoals, rubble, corals, large epibenthos, hard or sandy mud substrates and offshore reefs, usually in groups. Juveniles from about 2.5 cm length inhabit shallow waters over muddy substrates, and therefore outside of the NCB and Beagle AMBAs. Crimson snapper feed on a broad range of prey dominated by fish, and with small amounts of crustaceans, cephalopods and other benthic invertebrates and forage mostly at night (Fishbase,

Accessed 8/5/2018).). These species are not considered site attached due to good swimming ability and minimal reliance on reef structures for shelter.

Source: modified from Fishes of Australia (2018)

Figure 2-17 - Distribution of Crimson snapper

The Spanish mackerel is an important commercial species and their distribution is from near edge of continental shelf to shallow coastal waters, often of low salinity and high turbidity. They are also found in drop-offs, and shallow or gently sloping reef and lagoon water. Mackerels are usually solitary hunters and often swim in shallow water along coastal slopes. They are known to undertake lengthy long-shore migrations, but permanent resident populations are thought to exist. They can also be found in small schools and feed primarily on small fishes such as anchovies, clupeids, carangids, also squids and penaeoid shrimps. Mackerel eggs and larvae are pelagic (Fishbase, Accessed 8/5/2018). Mackerel species are not considered site attached due to excellent swimming ability and minimal reliance on reef structures for shelter.

Grey mackerel are found more commonly around coastal headlands and rocky reefs but are also caught offshore. They are pelagic predators, feeding exclusively on baitfish (sardines and herrings. Fishing for grey mackerel is undertaken with set lines as well as trolling with small lures or cut bait (Fishbase, Accessed 8/5/2018). Mackerel species are not considered site attached due to excellent swimming ability and minimal reliance on reef structures for shelter.

Scad Mackerel inhabits open water but they are also often seen swimming near outer reef walls or deep clear-water slopes. They are found mostly in shallow reef waters where it forms large schoolsand feeds on crustaceans and fishes, particularly clupeoids (*Sardinella* and *Thrissocles;* herrings), but also other fishes such as *Sphyraena* (Barracuda; Fishes of Australia, 2018; Fishbase, Accessed 8/5/2018). Mackerel species are not considered site attached due to excellent swimming ability and minimal reliance on reef structures for shelter.

Wahoo are an oceanic, epipelagic species frequently solitary or forming small loose aggregations rather than compact schools. They feed on fishes and squids and their eggs and larvae are pelagic. Wahoo are one of the fastest fish in the ocean, swimming at up to 80 km/hr. Like tunas, this voracious predator has specialised rigid gills that allow the uptake of enough oxygen to maintain fast, sustained swimming speeds and therefore they are also an important sport fish in some areas (Fishes of Australia, 2018; Fishbase, Accessed 8/5/2018). Mackerel species are not considered site attached due to excellent swimming ability and minimal reliance on reef structures for shelter.

Source: modified from Fishes of Australia (2018)

Figure 2-18 - Distribution of Spanish mackerel

Source: modified from Fishes of Australia (2018)

Figure 2-19 - Distribution of Grey mackerel

Source: modified from Fishes of Australia (2018)

Figure 2-20 - Distribution of Scad Mackerel

Source: modified from Fishes of Australia (2018)

Figure 2-21 - Distribution of Wahoo

2.4.2.5.3 Site-attached species

No specific areas within the NCB or Rollo OAs have been identified that would be an important habitat area for site attached fish. Site attached fish are generally small to medium sized that rely on the benthic habitat, have decreased swimming ability, and are less likely or unable to flee a seismic sound source due to their swimming ability. Site attached fish are typically found associated with banks, shoals and coral reefs. Within the AMBA Glomar Shoal and Rankin Bank are the only emergent features identified.

As described in Section 2.4.1.4**,** Glomar Shoal and Rankin Bank are located in high-energy environments where localised upwelling has resulted in enhanced productivity, supporting significant populations of commercially and recreationally important fish species, including Rankin cod, brown-striped snapper, red emperor, crimson snapper, bream and yellow-spotted triggerfish. These taxa are highly mobile and therefore the KEF is not recognised for site-attached reef fish. Productivity of commercially and recreationally important fish is specifically considered a defining value of the Glomar Shoal KEF (Director of National Parks, 2013a).

Given the very low proportion of shallow waters overlapped by the AMBA, and no shoal features located within the NCB or Beagle OA, it is reasonable to conclude that the OA is unlikely to include a high number of dense aggregations of site attached fish, or reef-associated demersal fish assemblages.

2.4.2.5.4 Spawning

No specific areas within the NCB or Beagle OAs have been identified as fish spawning areas. Information on spawning periods for some key commercial fish species for the North Coast Region (DoF 2013) is shown in Figure 2-22.

Consultation with DPIRD-Fisheries (Stakeholder Record DPIRD 0009) advised that the spawning grounds for most species occurs throughout their distribution. Fishers typically target areas of higher fish densities, which may include spawning individuals, and/or spawning aggregations. As it is difficult to identify spawning areas one way to undertake seismic surveys during time periods when there is the least overlap with spawning periods. Based on the current Departmental Seismic Guidance Statement (DoF 2013) the period of least overlap is June and July.

The fisheries that the NCB or Beagle OAs overlap are:

- Pilbara line, trap and trawl who catch goldband snapper, Rankin cod and red emperor. Pink snapper is not a species that is caught in large numbers in this fishery (Fletcher et al. 2017).
- Mackerel Managed Fishery who target Spanish mackerel.

Based on this the period of least overlap is May, June and July. This was confirmed by DPIRD-Fisheries (See consultation record DPIRD 15).

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Bioregion
Blacktip shark (*Carcharhinus tilstoni and C. limbatus*)													North Coast
Goldband snapper (*Pristipomoides multidens*)													North Coast
Rankin cod (*Epinephelus multiinotatus*)													North Coast
Red Emperor (*Lutjanus sebae*)													North Coast
Sandbar shark (*Carcharhinus plumbeus*)													North Coast
Spanish mackerel (*Scomberomorus commerson*)													North Coast
Pink snapper (*Pagrus auratus*)													North Coast (rare)

Figure 2-22 - Spawning periods for some key commercial fish species for the North Coast Bioregion

2.4.2.6 Cetaceans

2.4.2.6.1 Blue Whale

Blue whales are widely distributed throughout the world's oceans and may be present in the NCB and Beagle OAs as indicated from the EPBC Act database search (Table 2-8). There are four recognised subspecies of blue whales worldwide and two of these are known to occur in the southern hemisphere; the Antarctic blue whale (*Balaenoptera musculus intermedia*) and the pygmy blue whale (*B. musculus brevicaudia*). Both subspecies are listed as Endangered under the World Conservation Union (IUCN) Red List of Threatened Species. The Antarctic blue whale is recognised as a 'true' blue whale and has been recorded offshore in all states excluding the Northern Territory (DoE, 2015a).

Blue whales have an international distribution, their migration paths are widespread and do not clearly follow coastlines. Antarctic blue whales are usually found in waters south of 60° South and will generally migrate between (low-latitude) breeding grounds where both mating and calving take place during the winter, and (high-latitude) feeding grounds during the summer (DoE, 2015a). However, it is still unknown where the pygmy blue whale breeding grounds are located (Bannister *et al.,* 1996). Future research undertaken by the Australian Marine Mammal Centre (AMMC) and Australian Antarctic Division (AAD) aims to further define the Antarctic blue whale BIA, population structure, and the spatial and temporal distributions of animals (DoE, 2015a). The blue whale is rarely present in large numbers outside recognised aggregation areas, of which none are present within the NCB or Beagle AMBAs.

2.4.2.6.2 Pygmy blue whale

The NCB and Beagle AMBAs overlap the migratory pathway BIA for pygmy blue whales (Figure 2-23). Pygmy blue whales feeding off Australia use the west coast of Australia as part of their migratory route to and from breeding destinations (McCauley and Jenner 2010). Despite the presence of pygmy blue whale BIA in the NWMR, the area is not considered a "critical habitat". There are no pygmy blue whale foraging BIAs located within the NCB or Beagle AMBA (Figure 2-25).

The Conservation Management Plan for the Blue Whale (DoE 2015a) details the following in relation to migrating pygmy blue whales:

The pygmy blue whales tend to pass along the shelf edge at depths between 500 m to 1000 m during their migration. Recent tagging studies have provided important new information potentially indicating the general migration pattern and breeding grounds of pygmy blue that feed off the western coast of Australia (Double et al. 2014). Assuming these movements are representative of the animals that feed off the western Australian area as a whole, pygmy blue whales migrate north from the Perth Canyon / Naturaliste Plateau region in March / April reaching Indonesia by June where they remain until at least September. Southern migration from Indonesia may occur from September and finish by December in the subtropical frontal zone after which the animals may make their way slowly northwards towards the Perth Canyon by March / April. Figure 2-24 and Figure 2-26 detail the migratory route and timing.

Information on the migratory movements for pygmy blue whales within the Conservation Management Plan for the Blue Whale (DoE 2015a) are based on Double et al. (2014) who tagged eleven individuals off western Australia over two years. Of these 10 were tracked on their migratory route from the Perth Canyon with four being tracked past North West Cape and one being tracked to Indonesia (Figure 2-27).

The following information is from McCauley and Jenner (2010) who report on seasonal migrations of pygmy blue whales up and down the WA coast using passive acoustics:

Along the WA coast pygmy blue whales migrate south from Indonesian waters passing by the Exmouth Montebello Islands area through November to late December each year with a comparatively short burst of animals passing. Observations suggest most pygmy blue whales pass along the shelf edge out to water depths of 1000 m but centred near the 500 m depth contour. After spending summer in southern waters animals head north, this beginning early in the New Year for some animals. In the Perth Canyon animals stop on their northern migratory leg and pass through over an extended period with animals staying if the food supply is sufficient or leaving if not. The pygmy blue whales then head north along the WA coast passing the Exmouth-

Montebello Islands area over an extended period ranging from April to August before heading back to Indonesian waters. Peak abundance in the Exmouth Montebello Islands area is in June and July (90% of PBW passing Exmouth in 83 days) (Figure 2-28).

Based on the information provided within the Conservation Management Plan for the Blue Whale (DoE 2015a) and the research papers by Double et al. (2012, 2014) and McCauley and Jenner (2010) the following peak periods for pygmy blue whales in the OAs have been defined:

Southern: 1st November – 15th December. The conservation plan (DoEE 2015a) details that the southern migration from Indonesia may occur from September and finish by December in the subtropical frontal zone migration which aligns with McCauley and Jenner et al. (2010) acoustic monitoring which shows no recordings at Exmouth by late December (Figure 2-28). The logger at the Montebellos site did not continue through December so the 15th December date is based on that numbers at the Exmouth logger dropped off after the 20th December, so it is estimate that numbers at the Montebellos logger would drop off a few days before (Figure 2-28). Acoustic monitoring numbers increased in the Montebello area from the 1st November, so this was deemed the start of the peak period.

Northern: 15th May – 15th June. The conservation plan (DoEE 2015a) details that the pygmy blue whales migrate north from the Perth Canyon / Naturaliste Plateau region in March / April reaching Indonesia by June. This aligns with the McCauley and Jenner et al. (2010) acoustic monitoring which shows an increase in whales through the Montebellos area around the 15 May and that this drops off around the 15 June to a daily mean of about one whale a day (Figure 2-28).

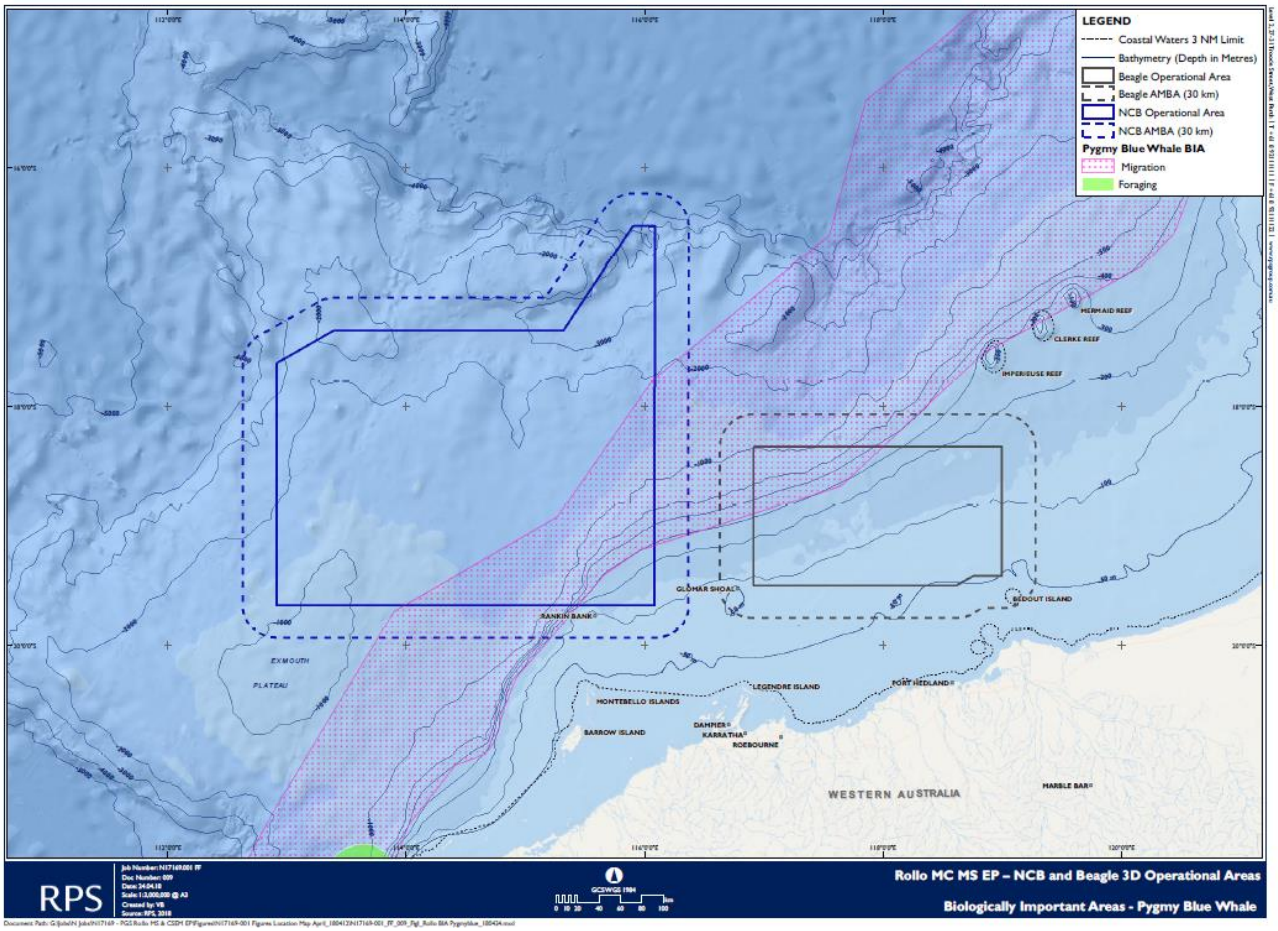
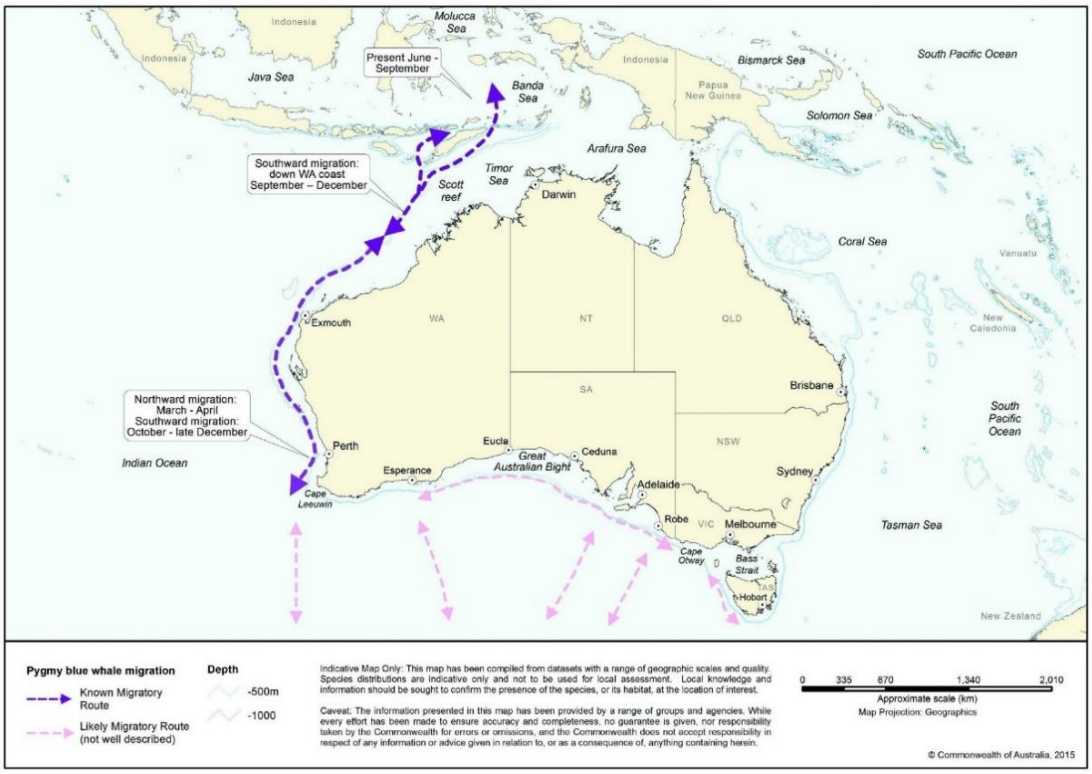
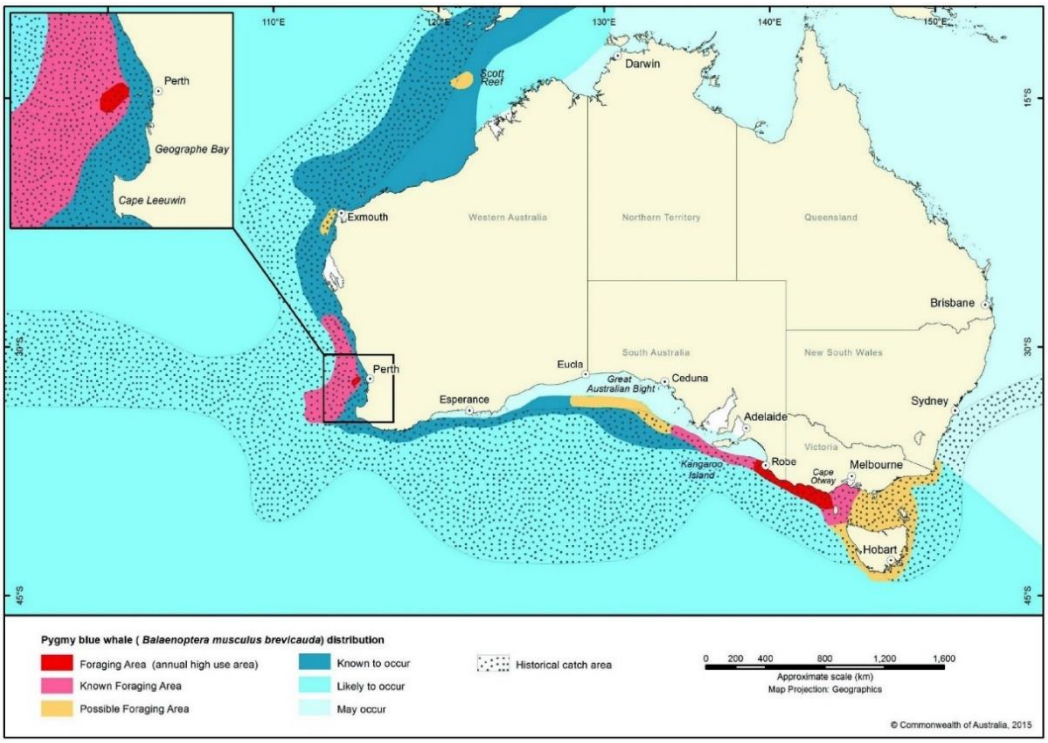


Figure 2-23 - Pygmy Blue Whale BIA and the NCB and Beagle AMBA



Source: modified from DoE (2015a).

Figure 2-24 - Pygmy blue whale migration routes



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

Source: modified from DoE (2015a).

Figure 2-25 - Pygmy blue whale distribution around Australia

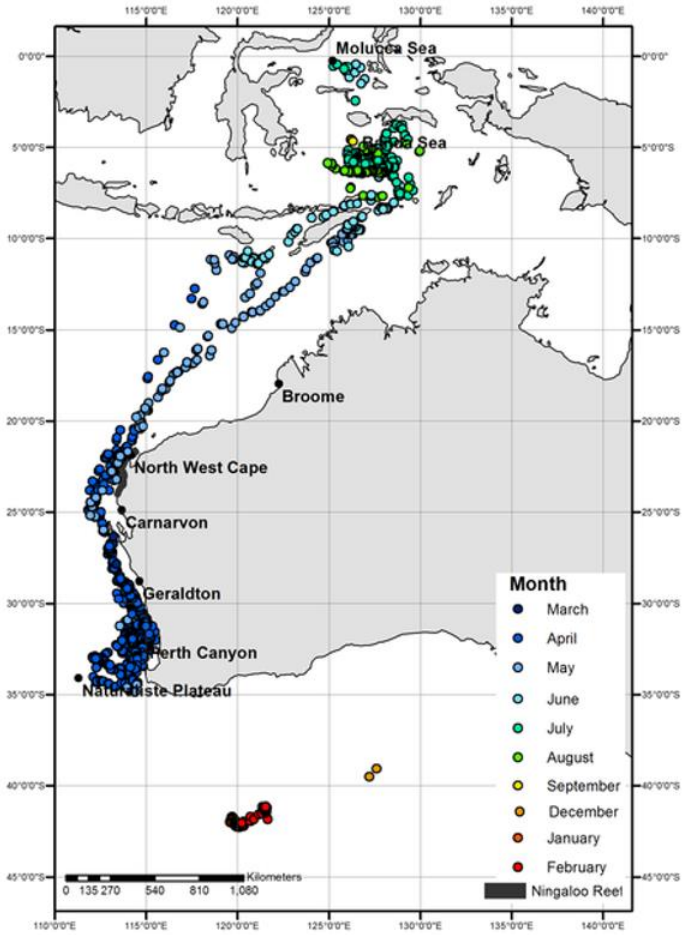


Figure 2-26 - Satellite tag derived locations of pygmy blue whales (n = 11) by month

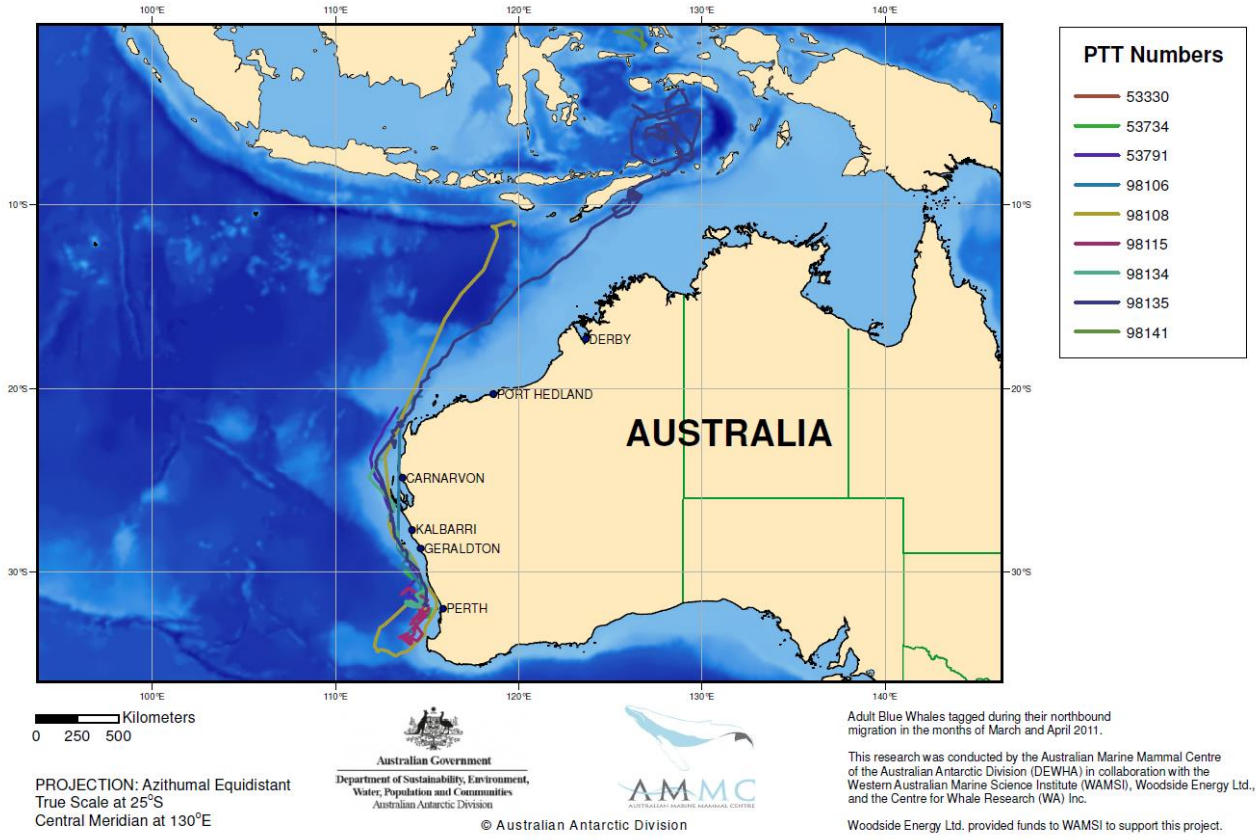


Figure 2-27 – Satellite tag derived locations of pygmy blue whales

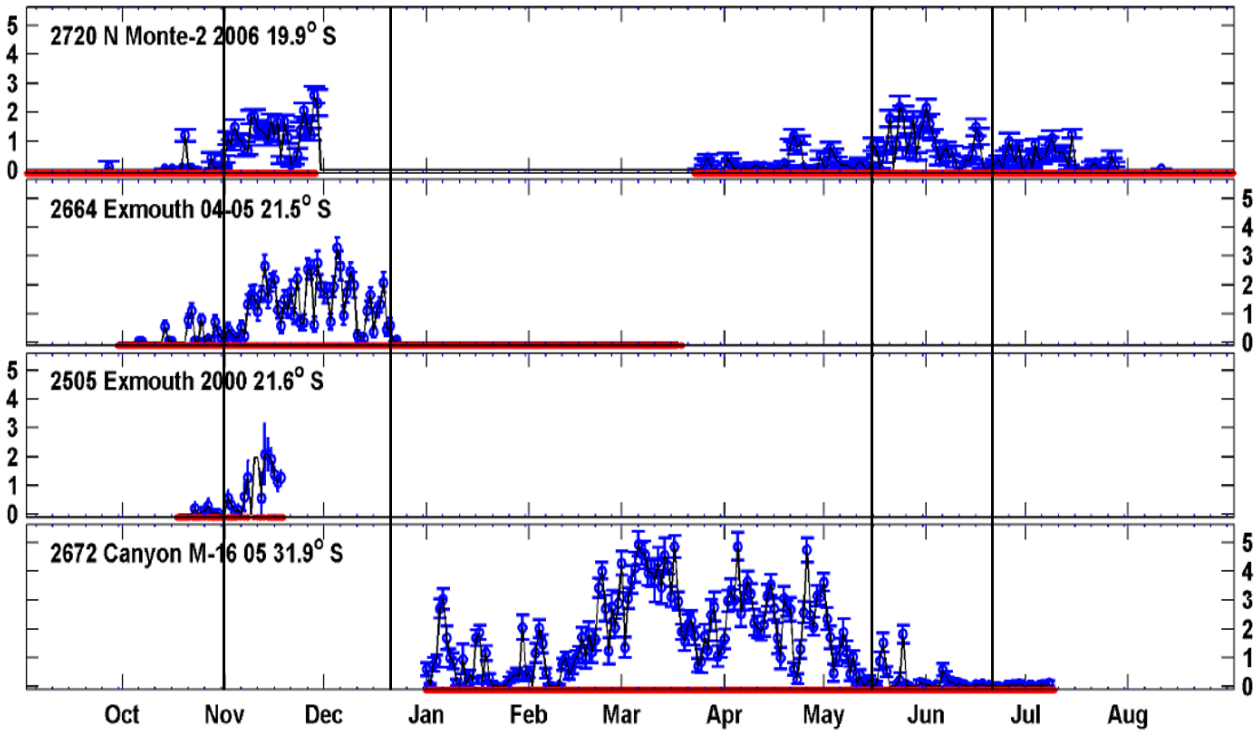


Figure 2-28 - 24 hr averaged counts of pygmy blue whales off Exmouth, Montebello Islands and Perth Canyon, WA. Daily means are given with error bars and smooth curve fitted through the data. The heavy line at the bottom of each plot is the noise logger sampling period. (McCauley & Jenner 2010).

2.4.2.6.3 Fin Whale and Sei Whale

The NWMR is an important migratory pathway between feeding grounds in the Southern Ocean and breeding grounds in tropical waters for several cetacean species such as fin whales, sei whales, dwarf and Antarctic minke whales. It is thought that these species may travel through the region on their way to breeding grounds, which are said to be in deep oceanic waters around the Indonesian archipelago, but have yet to be discovered (DEWHA, 2008a). A search of the EPBC Act database identified fin and sei whales (classified as Vulnerable and Migratory species), may transit the waters of the NCB and Beagle AMBAs. However, the NCVA (DoE, 2016b) indicates that there are no known BIA (feeding, breeding or resting areas) within the NCB or Beagle AMBAs.

Sei whales are one of the least studied great whales and their movements and distributions are not predictable nor well documented. Sei whales are similar in appearance to Bryde's whales, resulting in confusion about frequency of occurrence and distributional limits. Available information suggests that sei whales have the same general pattern of migration as most other baleen whales, although the timing is generally later, and the current scientific view is that the species does not go to such high latitudes (DEH, 2005c). Sei whales are generally not found near coasts and the species is infrequently recorded in Australian waters. Consequently, it is unlikely that sei whales will be encountered within the NCB and Beagle AMBAs.

The fin whale is the second largest species of whale. This species distribution is known primarily from stranding events and whaling records and is thought to occur along the west coast of Australia to NSW (DEH, 2005c). Australian Antarctic waters are important feeding grounds for the species, but there is no known mating or calving areas in Australian waters. The migration routes and location of winter breeding grounds are uncertain but their presence in Victorian and southern WA waters have also been detected in summer and autumn months (DEH, 2005c). Fin whales may be present in the NCB and Beagle AMBA; however, it is unlikely that they will be present in significant numbers.

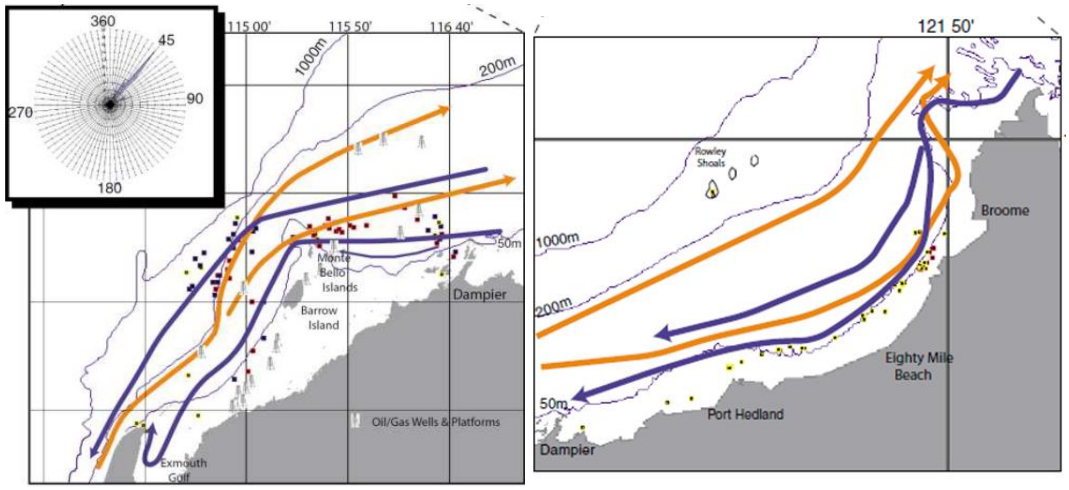
Other cetacean species whose broad distributions cover the region include whales that are infrequently observed and usually restricted to cooler or deep waters (e.g. Bryde's whale and killer whales) and may be encountered in deeper water areas during specific surveys undertaken within the NCB AMBA. However, it is unlikely they will be encountered in significant numbers.

2.4.2.6.4 Humpback Whale

Humpback whales are listed as Vulnerable and Migratory under the EPBC Act and are also protected under the WA *Wildlife Conservation Act 1950* and are the most commonly sighted whale in northern WA waters. The 2015 Threatened Species Scientific Committee 'Conservation Advice' states that the committee used the findings of Woinarski *et al.,* (2014) to consider whether reassessment of the conservation status of each of the threatened mammals listed under the EPBC Act is required (DoE, 2015i).

Humpback whales have been observed seasonally to complete their northern migration in Camden Sound in the west Kimberley (Jenner *et al.,* 2001), after feeding in Antarctic waters during the summer months (Bannister and Hedley, 2001). Based on the International Whaling Commission's distinct breeding stocks, the population that winters off WA is designated as the Group D population (Findlay *et al.,* 2009). Information regarding the migration patterns (temporal and physical) of this group is based on the findings presented by Jenner *et al.,* (2001, 2010) and Double *et al.,* (2010, 2012). Population abundance estimates in 2008 were between ~26,000 and 28,000 individuals and increasing at a rate of between 9.7-13% per year (Salgado Kent *et al.,* 2012; Hedley *et al.,* 2011b; Hedley *et al.,* 2009; Hedley *et al.,* 2011a).

During the northern migration humpback whales appear to remain on or within the 200 m isobath near the Montebello Islands and then moving closer to shore further north (Figure 2-29; Jenner *et al.,* 2001). Studies of populations between the Dampier Archipelago and Broome (Double *et al.,* 2012), indicated that northbound whales were encountered within tens of kilometres from the mainland coast and the migration corridor revealed by the tagged whales was frequently less than 60 km (Figure 2-30, Figure 2-31). Similarly, opportunistic observations from a fishing vessel in 1998 identified 31 pods that were both northbound and southbound, along the 30 m isobath (Jenner *et al.,* 2001). This was further reinforced by a subsequent transit survey conducted by the Centre for Whale Research when travelling from Broome to Fremantle.

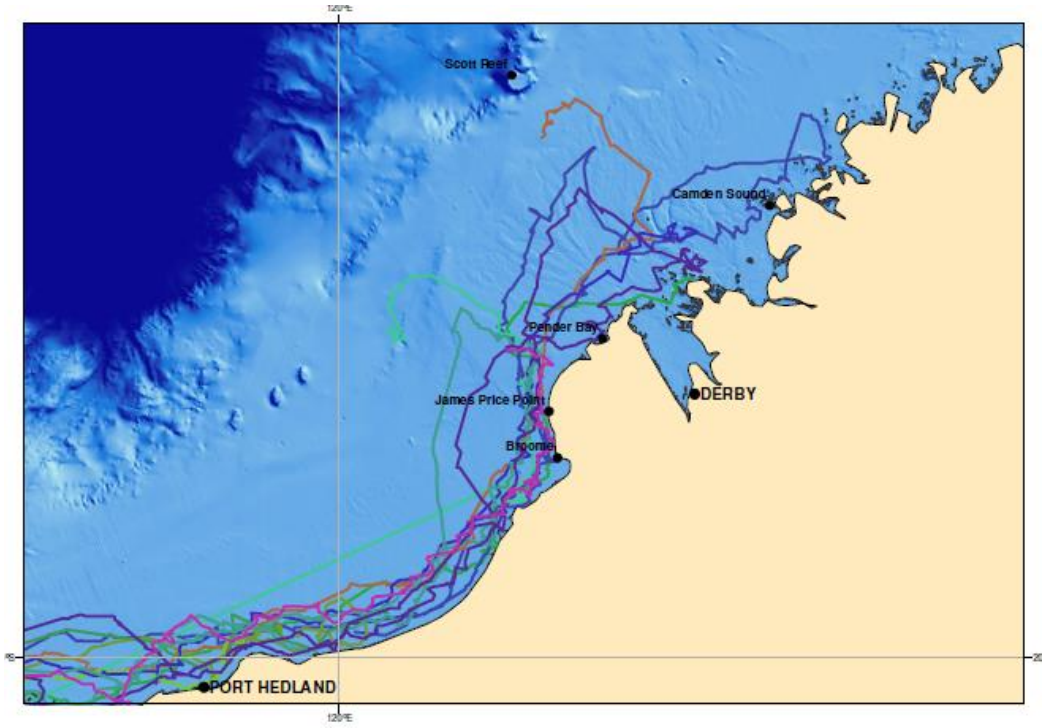


Source: modified from Jenner *et al.,* (2001).

Actual sightings are recorded as points (orange = northbound, purple = southbound)

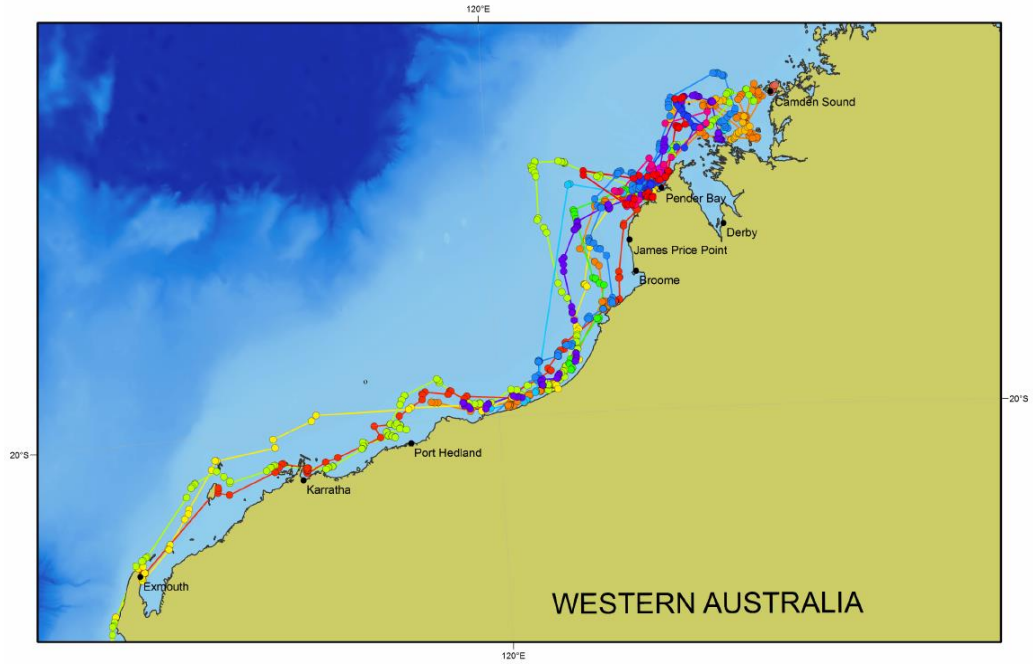
Figure 2-29 - Estimated humpback whale migratory routes and actual observation points between Carnarvon and Cape Leveque

The North-west Commonwealth Reserves Network Management Plan 2014-2024 (DNP, 2013) suggests that the northern migration may follow the Ancient coastline at 125 m depth contour (KEF; ~150 km offshore from Eighty Mile Beach); however, no references or supporting data are provided. Consequently, available evidence indicates that the majority of northern migrating whales stay close to the mainland coastline, migrating within the 50 to 200 m isobath. Despite a lack of empirical evidence, the northern migration route for humpback whales is generally further offshore (Paterson *et al.,* 1994; Noad and Cato, 2001). Various data presented by Double *et al.,* (2010) and Jenner *et al.,* (2001, 2010) in relation to the southern migration, is more consistent and indicate that the migration route is narrower and follows shallower waters.



Source: modified Double *et al.,* (2012).

Figure 2-30 - Northern migration - tracks of tagged whales



Source: modified from Double *et al.,* (2010).

Figure 2-31 - Tracks obtained in 2009 from 17 satellite-tagged humpback whales - southern migration

Research undertaken by Double *et al.,* (2010; Figure 2-31) noted that tagged whales migrated south close to the coastline and that the width of the migratory corridor was frequently less than 100 km. Off Eighty Mile Beach, the migratory corridor was observed to be less than 30 km wide and centred only ~15 km offshore. This supports observations of higher densities of humpback whales observed in nearshore waters <35 m depth during their southern migration made by Jenner *et al.,* (2001, 2010).

The Marine Bioregional Plan (MBP) for the NWMR (DSEWPaC, 2012) states: "The following BIA have been identified for humpback whale's migration corridor from the southern border of the North-west Marine Region to the breeding and calving grounds in the north of the Kimberley. The migration corridor represents

the route for northern and southern migrating humpback whales." Consequently, despite some outliers in deeper water, and based on the available scientific evidence, the DoE determined that the BIA for northern and southern migration extends to approximately 100 km offshore. The Beagle AMBA overlaps the humpback whale BIA migration corridor (Figure 2-32).

The humpback whale migration corridor is not an identified aggregation area or critical habitat, whales are in transit, and are migrating from their southern polar 'summer' feeding grounds to their northern tropical 'winter' calving / breeding grounds. While the humpback whale migration corridor BIA is not a critical habitat, it is likely that humpback whales will occur within the proposed OA during migration periods.

The migration of the Group D population in the region is broadly characterised by three distinct directional phases and the periods below are estimated peak migration periods (Table 2-15). Actual timing of annual migration may vary by as much as three (3) weeks from year to year due to food availability in the Antarctic (DMP, 2003). Breeding and calving takes place between mid-August and early September (start of southern migration) and females with calves are usually the last to leave the breeding grounds, stopping to rest in Exmouth Gulf and Shark Bay (DEWHA, 2008a).

Thus, based on the timing in Table 2-15, humpback whales on their northern migration are likely to pass through the Beagle OA from mid-July to early August and on their southward migration from late August to mid-October.

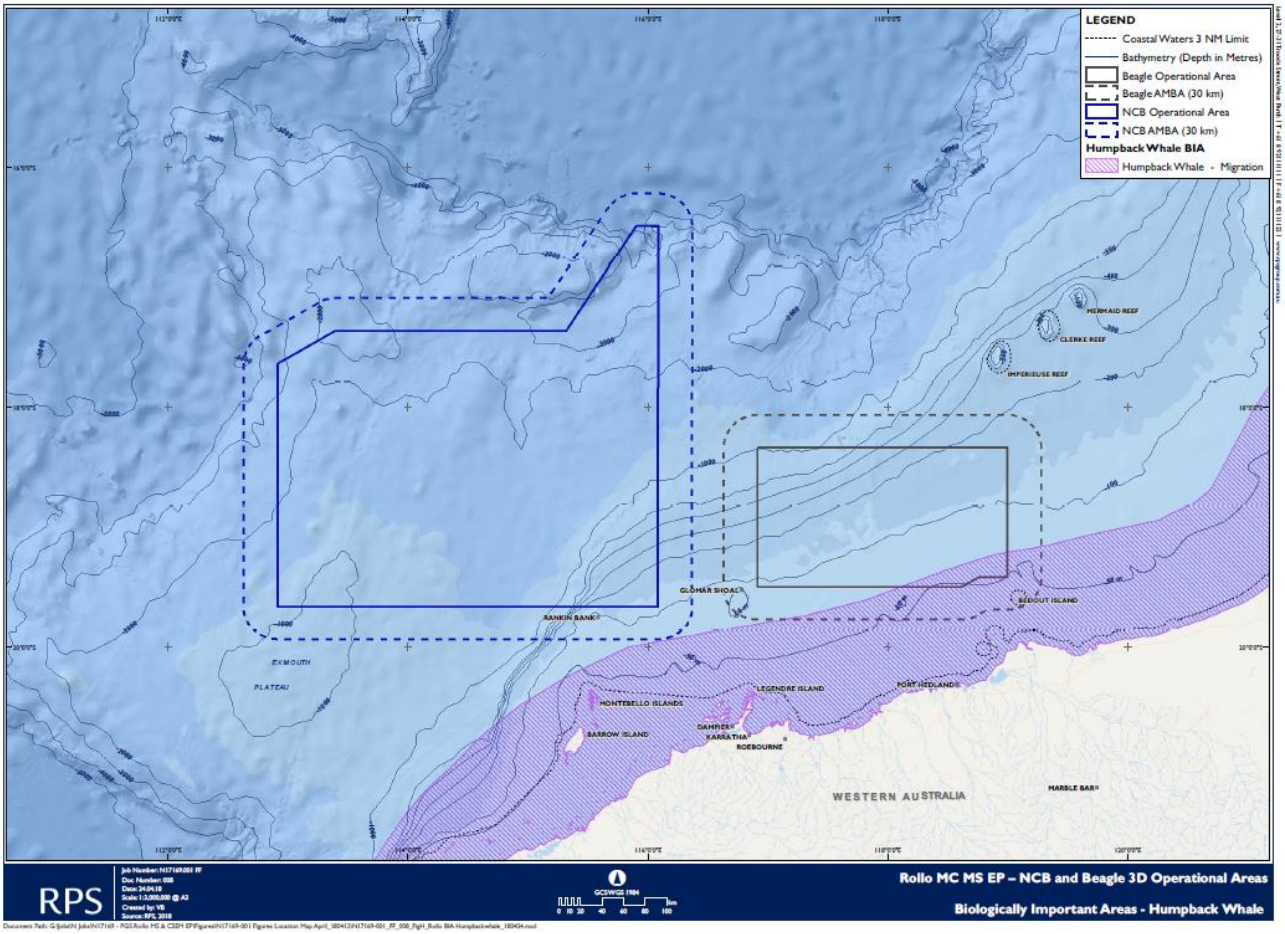
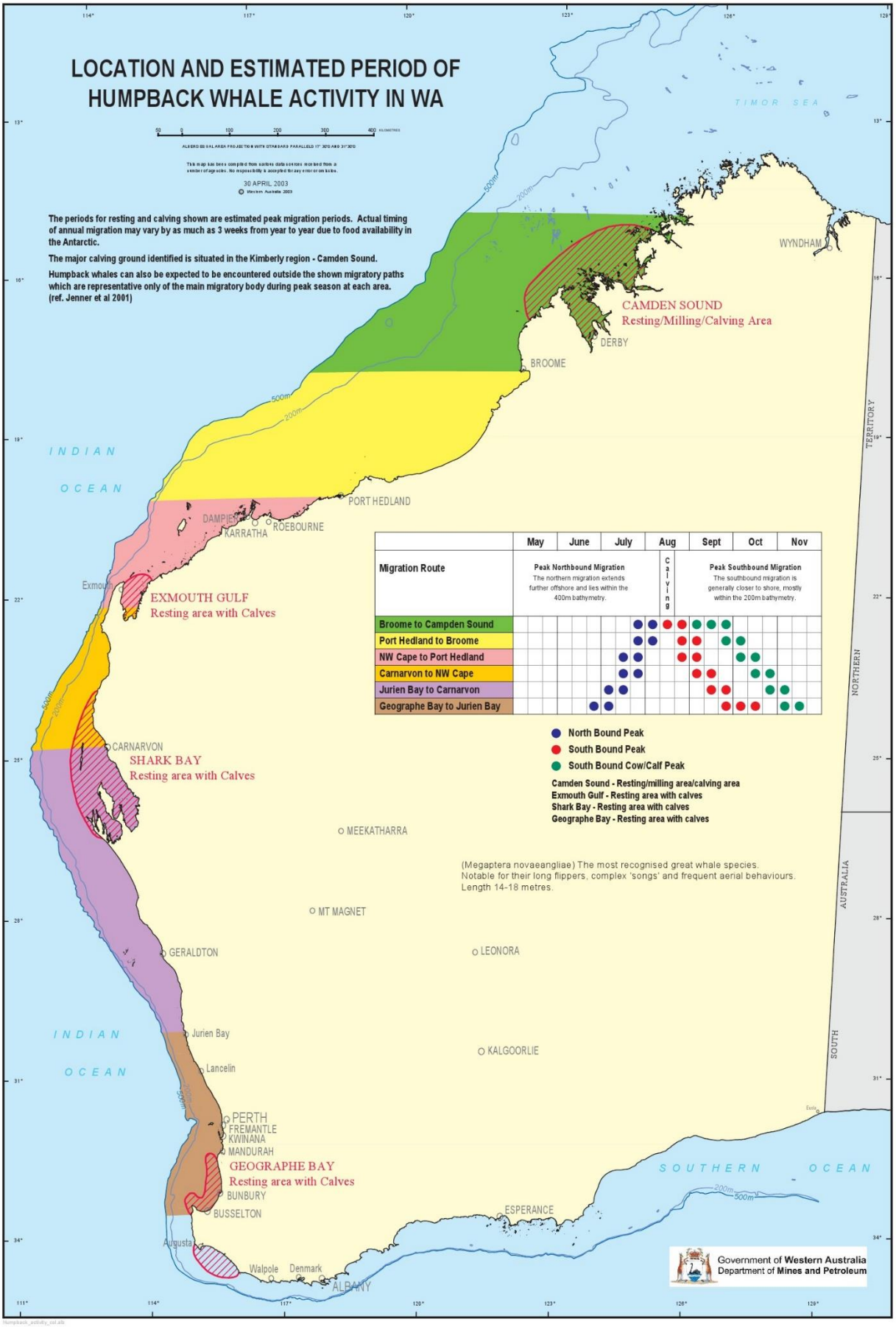


Figure 2-32 – Humpback whale BIA and the NCB and Beagle AMBAs

Table 2-15 - Humpback whale estimated peak migration periods

Phase	Description	Location	Period	Cow Calf Peak
Northbound	Starts April, peaks July and tapers off by August. Extends further compared to southern migration route.	NWC - Port Hedland	Mid - Late July.	n/a
		Port Hedland - Broome	Late July - Early August.	n/a
Southbound	Usually occurring between late August and early September, although smaller numbers may occur until November. This phase of migration is segmented by 2-4 week delay in appearance of peak numbers of cow/calf pods after the southern peak migration period Southerly migration in this area is contracted in a narrower band than the northerly migration route generally occurring closer to the coast within the 50 m isobath, generally in waters less than the 35 m deep	Broome - Port Hedland	Late September - Early October	Late September - Early October
		Port Hedland - NWC	Late August - Early September	Early October - Mid-October

Source: modified from Jenner *et al.,* (2001); DEWHA (2008a); DMP (2003).



Source: DMP (2003).

Figure 2-33 - Location and estimated period of humpback whale activity in WA

2.4.2.6.5 Sperm Whale

Sperm whales are found around the world but have a patchy distribution; they are gregarious and live in groups of up to 50 individuals, although male sperm whales are sometimes solitary in high latitudes (above 40° N; DoE, 2016c). Sperm whales prefer deep water (>200 m) and usually found in deeper offshore waters in areas with submarine canyons. Sperm whales generally move towards the poles in summer, large male bachelor sperm whales more so than females and juveniles migrate seasonally to higher latitudes, most likely due to better feeding conditions and reduced competition for food. Females usually inhabit water deeper than 1,000 m at latitudes less than 40-50° (DoE, 2016c). They are a deep diving species and can perform long and deep dives, often lasting 60–90 minutes, however most dives tend to last around 35-45 minutes (CRRU, 2017; Watwood *et al.,* 2006).

The offshore waters of the NWMR once supported substantial populations of sperm whales (DEWHA, 2007; DEWHA, 2008a). The presence of sperm whales as evidenced by 19th Century whaling industry data suggests occasional bursts in productivity, which may be associated with variations in slope (such as canyon heads) and may support species at a number of trophic levels. Whaling records (Townsend, 1935) identify historical sperm whaling grounds over the Exmouth Plateau and the majority of catches being further west over the Cuvier Plateau (>560 km from the NCB AMBA) and along the Wallaby-Cuvier Escarpment (>800 km from the NCB AMBA) (Townsend, 1935). The deeper waters of the inner edge of Exmouth Plateau, around the Montebello Trough, are believed to be an important feeding site for sperm whales, indicating an area of high biological productivity. However, little specific information is available on the biological communities of the Exmouth Plateau and associated slope. (DSEWPaC, 2012).

Therefore, large numbers and aggregations of sperm whales are not expected to be encountered within the AMBAs, and transient individual sperm whales may be encountered in the deeper waters of the NCB and Beagle AMBAs. Additionally, there are no BIA or critical habitats for sperm whales located within the NCB or Beagle AMBAs.

2.4.2.6.6 Dolphins

Dolphins are relatively common in the waters of the NWS. The Indo-Pacific humpback dolphin and the spotted bottlenose dolphin (Arafura / Timor Sea populations) are classified as Migratory, and no species are listed as Vulnerable or Endangered.

Spotted bottlenose dolphins inhabit warmer coastal areas, in waters less than 10 m deep (Bannister *et al.,* 1996) and their distribution is thought to extend as far south as Exmouth. Indo-Pacific humpback and spotted bottlenose dolphins have been observed together in similar habitats such as mangrove systems in predominantly shallow near-shore coastal waters (DSEWPaC, 2012). Both species habitat preference is for complex tidal areas and creek systems and dense mangroves where there are high prey densities. Although there are anecdotal reports of both species occurring around deep water islands such as the Rowley Shoals, the BIA of the Indo-Pacific humpback and spotted bottlenose dolphins are not located within either of the NCB or Beagle AMBAs and therefore it is unlikely that these species will be encountered.

Other species known to occur in this region include the common, bottlenose and Risso's dolphins. Common dolphins are recorded in all Australian waters and are not thought to be migratory. The species is associated with high topographical relief of the ocean floor, escarpments and upwelling areas, and there are no known key localities in Australia. The bottlenose dolphin is a cosmopolitan species found in all Australian waters (except the Northern Territory), and is coastal, estuarine, pelagic and oceanic in nature. Risso's dolphin is distributed through all oceans, occurs inshore and offshore, but is generally considered pelagic and oceanic.

2.4.2.7 Marine Reptiles

2.4.2.7.1 Marine Turtles

The PMST identified five species of marine turtle that may occur within the NCB and Beagle AMBAs: flatback turtle; green turtle; hawksbill turtle (all classified as Vulnerable and Migratory); leatherback turtle; and loggerhead turtle (all classified as Endangered and Migratory; Table 2-8). A summary of the ecology of these five species of marine turtle is described below and summarised in Table 2-16.

The Recovery Plan for Marine Turtles in Australia (DoEE 2017a) details habitat critical to the survival of the species which are habitat areas important to turtle species and biologically important areas (BIAs) which are areas where turtle undertake important behaviour. In relation to nesting and internesting buffers, the information and distances within the Recovery Plan for Marine Turtles in Australia (DoEE 2017a) are based on the latest available information and advice from the DoEE (Stakeholder Record DoEE 01) was that these were appropriate to be used. However, consideration is to be given to the BIAs for nesting and internesting as well.

A habitat critical to the survival of the species (internesting) for flatback turtles slightly overlaps the Beagle AMBA and is 27 km from the Beagle OA (Figure 2-34).

A nesting BIA for flatback turtles is at North Turtle Island which is 45 km from the Beagle OA. The internesting buffer for this BIA is based on an 80 km distance and overlaps the Beagle OA (Figure 2-35). A nesting BIA for flatback turtles is at Montebello Islands which is 72 km from the Beagle OA. The internesting buffer for this BIA is based on an 80 km distance and overlaps the Beagle OA (Figure 2-35).

A foraging BIA for loggerhead, hawksbill and green turtles is within the Beagle AMBA and is 10 km from the Beagle OA (Figure 2-35).

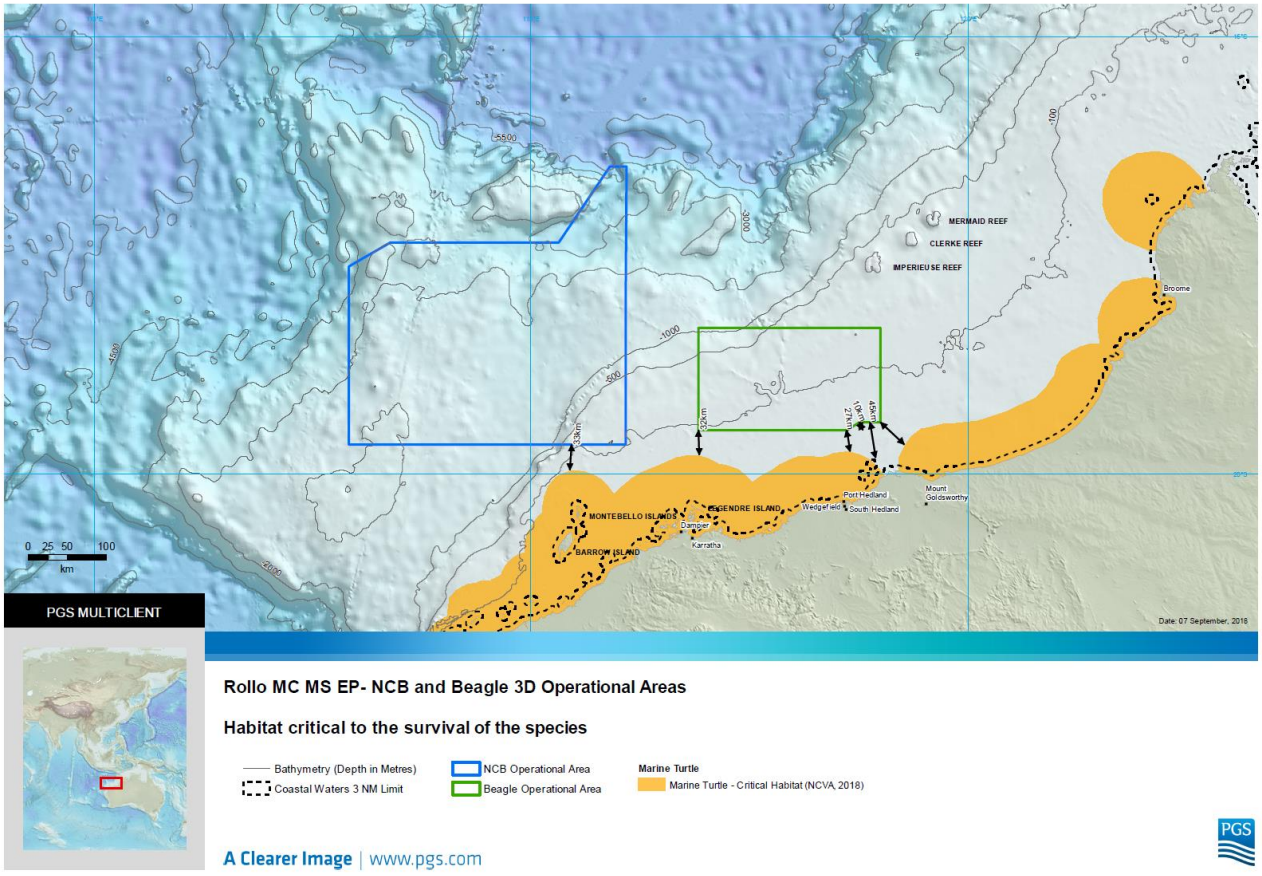


Figure 2-34 - Turtle habitat critical to the survival of the species

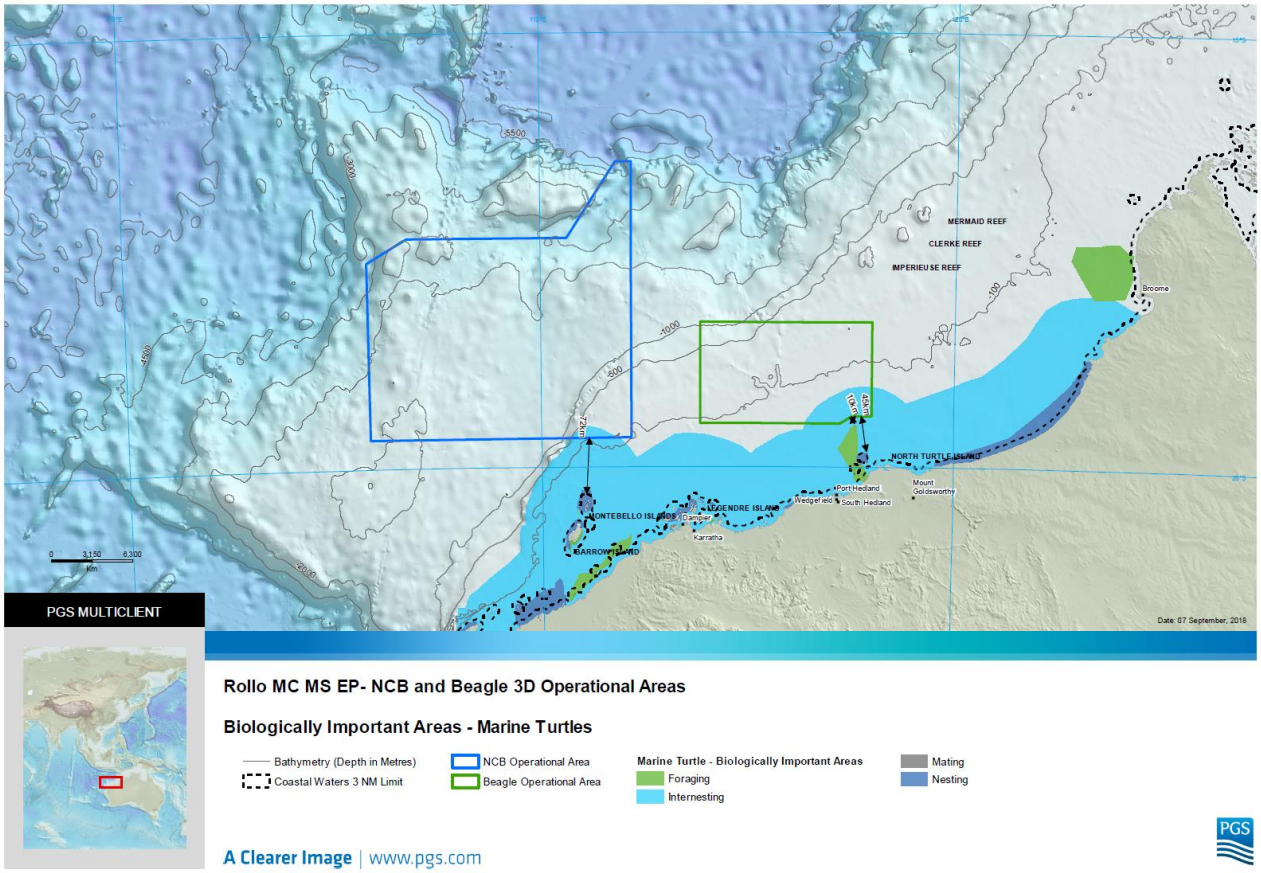


Figure 2-35 – Turtle biologically important areas

Flatback turtle

The flatback turtle (listed as Migratory and Vulnerable under the EPBC Act) has an Australasian distribution, with all recorded nesting beaches occurring within tropical to sub-tropical Australian waters (Limpus, 2007). The management of the flatback turtle in Australia is broken up into four breeding units; the NWS Breeding Unit being the most relevant in this case. Breeding in the NWS region peaks in the summer months and they display the most constrained nesting season reported to date with 86% of animals recorded in December and January only (Pendoley, 2005). Nesting areas relevant to the NCB and Beagle AMBAs occur from approximately Exmouth in the south, to the Lacepede Islands in the north. Important breeding areas relevant to the NCB and Beagle AMBAs include the Montebello Islands, Thevenard, Varanus and Barrow islands, islands within the Dampier Archipelago and areas around Port Hedland, Eighty Mile Beach (DEWHA, 2008a; Limpus, 2007).

Foraging areas relevant to the NCB and Beagle AMBAs include Bedout Island and inshore from Barrow Island and the Montebello Islands (Pendoley, 2005). While the foraging habitats for post-hatchlings and young juveniles remain unknown and likely over the Australian continental shelf, juvenile and adult flatback turtles forage primarily in habitats with soft-sediments that support benthic invertebrates (DoE, 2016c). For the Pilbara stock, post-nesting telemetry data documented juvenile and adult flatback turtles foraging in coastal waters <130 m deep and within 315 km from shore, where high-use areas relevant to the NCB and Beagle AMBAs were around Thevenard Island, Eighty Mile Beach.

Unlike other marine turtles, the flatback turtle lacks a wide oceanic dispersal phase and adults tend to be found in soft sediment habitats within the continental shelf of northern Australia (DoE, 2016c). Limited migration information on the NWS group is available; post nesting recaptures have been recorded from Exmouth Gulf to the Kimberly coast (Limpus, 2007).

The nesting rookeries on the eastern beaches of Barrow Island are a major part of the North-west shelf genetic stock. This summer breeding Pilbara Coast (Northwest Shelf) stock effectively will not interbreed with the neighbouring winter (mid-year) breeding Flatback Turtle stock that aggregates to breed in western Arnhem Land and the Joseph Bonaparte Gulf (DoE, 2016c; Table 2-16).

A habitat critical to the survival of the species (internesting) for flatback turtles slightly overlaps the Beagle AMBA and is 27 km from the Beagle OA (Figure 2-34).

A nesting BIA for flatback turtles is at North Turtle Island which is 45 km from the Beagle OA. The internesting buffer for this BIA is based on an 80 km distance and overlaps the Beagle OA (Figure 2-35). A nesting BIA for flatback turtles is at Montebello Islands which is 72 km from the Beagle OA. The internesting buffer for this BIA is based on an 80 km distance and overlaps the Beagle OA (Figure 2-35).

Green turtle

Green turtles are listed under the EPBC act as Migratory and Vulnerable (Table 2-16). The green turtle has a worldwide tropical and sub-tropical distribution and is widespread and abundant in WA waters, with an estimated 20,000 individuals occurring in WA; arguably the largest population in the Indian Ocean (DSEWPaC, 2012). Green turtles spend the first five to ten years of their life drifting on ocean currents, before moving to reside in shallower benthic habitats, including tropical reef and seagrass beds (Limpus, 2008). Green turtles are omnivores, mainly feeding in shallow benthic habitats on seagrass and/or algae, but are also known to feed on sponges, jellyfish and mangroves. They are the most common turtle breeding and seen in nearshore waters in the NWMR (DSEWPaC, 2012).

The main nesting season for green turtles begins in November, peaks in January - February (summer; DSEWPaC, 2012) and extends to March (Pendoley, 2005; DoE, 2016c). The Dampier Archipelago is a principal near-coastal rookery relevant to the NCB and Beagle AMBAs (DSEWPaC, 2012d; Pendoley, 2005; Table 2-16). Along the North West Shelf foraging habitats for post-hatchling and young juvenile green turtles are unknown, although they are likely to forage throughout most of the Indian Ocean and Arafura Sea (DOE, 2016c). While some juvenile and adult green turtles remain in the open ocean waters, most forage in tidal and sub-tidal habitats, such as coral reefs, mangroves and mudflats with algal turfs or seagrass meadows. Important foraging areas relevant to the NCB and Beagle AMBAs are located at Barrow Island, Montebello Islands, Bedout Island and the Dampier Archipelago.

There is no green turtle habitat critical to the survival of the species within the NCB and Beagle AMBAs. A foraging BIA is within the Beagle AMBA and 10 km from the Beagle OA and therefore it is not anticipated that flatback turtles will be encountered in large numbers (Table 2-16).

Hawksbill turtle

The hawksbill turtle, listed under the EPBC Act as Migratory and Vulnerable, breeds extensively throughout the region and along the adjacent coastal areas (DSEWPaC, 2012). There is a single stock in the region (the Western Australian stock), which is centred on the Dampier Archipelago and is the largest stock of hawksbill turtles in the Indo-Pacific region (Limpus, 2009). Significant nesting areas relevant to the NCB and Beagle AMBAs include Rosemary Island within the Dampier Archipelago, Varanus Island in the Lowendal group, and some of the Montebello Islands, (Pendoley, 2005). Hawksbill turtles breed all year, with a peak between October and January (DoE, 2016c).

In WA, juvenile and adult hawksbill turtles feed mainly on sponges and are more often found in deeper waters of the NWMR. Foraging sites relevant to the NCB and Beagle AMBAs are in the tidal and sub-tidal coastal waters off Bedout Island, the Dampier Archipelago, Barrow Island and the Montebello Islands (DSEWPaC, 2012). Hawksbill turtles are known to forage on algae, sponges and soft corals found in coral reefs, seagrass meadows and soft-bottom habitats (DoE, 2016c). There are no known foraging habitats for post-hatchlings or young juveniles in WA, and there are no known important or monitored foraging habitats.

There is no hawksbill turtle habitat critical to the survival of the species within the NCB and Beagle AMBAs. A foraging BIA is located within the Beagle AMBA and is 10 km from the Beagle OA and therefore it is not anticipated that hawksbill turtles will be encountered in large numbers (Table 2-16).

Loggerhead turtle

Loggerhead turtles are listed under the EPBC Act as Migratory and Endangered and under the WA *Wildlife Conservation Act 1950* as a Threatened species. The loggerhead turtle has a worldwide distribution, living and breeding in sub-tropical to tropical and locations (Limpus, 2008a). Breeding aggregations in Australia occur on both the east coast (Queensland and NSW) and the west; with nesting and breeding occurring from

November to March, with a peak in January (DEWHA, 2008a; DoEE, 2017a). Major nesting locations relevant to the NCB and Beagle AMBAs include the Muiron Islands and the Dampier Archipelago, which are one of the principal nesting sites in WA (Limpus, 2008a). The Dampier Archipelago is the current known northern limit of nesting for the loggerhead turtle in WA, where it has been recorded on Rosemary and Cophen Island (Pendoley, 2010; Table 2-16). It is thought that the WA nesting area probably supports the third largest population in the world (Limpus, 2008a).

Foraging areas are widespread for loggerhead turtle populations and migrations from nesting to feeding grounds can stretch thousands of kilometres, including feeding grounds as far north as the Java Sea off Indonesia for the WA population (Limpus, 2008a). Loggerhead turtles are carnivorous and feed primarily on benthic invertebrates and can forage in depths of up to ~50 m to nearshore tidal areas, including areas of rocky and coral reef, muddy bays, sand flats, estuaries and seagrass meadows (DoE, 2016c; Limpus, 2008a).

There is no loggerhead turtle habitat critical to the survival of the species within the NCB and Beagle AMBAs. A foraging BIA is located within the Beagle AMBA and is 10 km from the Beagle OA and therefore it is not anticipated that loggerhead turtles will be encountered in large numbers (Table 2-16).

Leatherback turtle

Found in tropical, sub-tropical and temperate waters throughout the world, the leatherback turtle is a pelagic feeder on gelatinous prey (DoE, 2016c; Márquez, 1990). Despite their year-round presence on the continental shelf and south west Australia, there are no important foraging habitats in WA.

Nesting is mainly confined to tropical beaches although some nesting occurs on sub-tropical beaches. No major nesting has been recorded in Australia, although scattered isolated nesting (1-3 nests per annum) occurs in southern Queensland and the Northern Territory (Limpus and McLachlin, 1994). No leatherback turtle habitat critical to the survival of the species or BIA is within the NCB and Beagle AMBAs thus the likelihood of encountering this species is low.

Table 2-16 - Summary of marine turtle ecology within the NWMR

Species	Flatback turtle			Green turtle	Hawksbill turtle	Loggerhead turtle	Leatherback turtle
Stock	**Pilbara Stock**	**South-west Kimberley**	Unknown genetic stock Kimberley, Western Australia	**NWS Stock**	**Western Australian Stock**	Western Australian Stock	n/a
Area	Exmouth to Lacepede Islands	Eighty Mile Beach	Kimberley	North West Shelf	Centred on the Dampier Archipelago	Dirk Hartog Island Shark Bay	-
Mating	Sep–Jan	year round	unknown	Sep–Dec	all year	unknown	unknown
Nesting	Oct–Mar (peak: Nov–Jan)	all year (peak: Dec–Jan)	May-July	Nov–Mar (peak: Dec–Feb)	all year (peak: Oct–Jan)	Nov–Mar (peak Jan)	Dec–Jan
Hatching	Feb–Mar	all year	unknown	Jan–May (peak: Feb–Mar)	all year (peak: Dec–Feb)	Jan–May	Jan–Feb
Internesting Buffer	**60 km**	**60 km**	**60 km**	**20 km**	**20 km**	**20 km**	**20 km**
Important Nesting Areas	Major: Barrow Island, Mundabullangana Station, Delambre Island. Minor: Thevenard, Varanus, Muiron Islands, Montebello Group, Cemetery Beach, Dampier Archipelago.	Major: Eco Beach, Eighty Mile Beach.	Maret Islands, Montilivet Islands, Cassini Island, Coronation Islands (includes Lamarck Island), Napier-Broome Bay Islands (West Governor Island, Sir Graham Moore Island – near Kalumbaru), Champagny, Darcy and Augustus Islands (Camden Sound)	Major: Lacepede Islands, Montebello, Barrow, Muiron, Browse Islands and Northwest Cape. Minor: Boodie, Middle, Serrurier, Thevenard, Lowendal, Rosemary, Legendre, Delambre Islands and various mainland beaches, Shark Bay to Ningaloo and Kimberley Coast.	Major: Dampier Archipelago (Rosemary Island), Delambre Island and Montebello Islands. Minor: Ah Chong, South East and Timouille, Sholl Island, Lowendal Islands including Varanus, Beacon, Bridled, Barrow, Muiron Islands and mainland beaches from Cape Range to Ningaloo and Gnaraloo to Red Bluff.	Major: Dirk Hartog Island, South Muiron Island, North West Cape, Gnaraloo Bay. Minor: Mainland from Shark Bay to southern North-West Shelf (Northern end Ningaloo Marine Park).	Major: None. Minor: Cobourg Peninsula, Maningrida and Croker Island (Northern Territory) and unconfirmed nesting in Western Australia. There are no confirmed leatherback turtle nesting sites in Western Australia. Scattered nesting occurs in southern Queensland and Northern Territory.
Foraging Habitat	Post-hatchling/young juveniles: Unknown, likely to remain in waters over the Australian continental shelf.	Post-hatchling/young juveniles: Unknown, likely to remain in waters over the	Post-hatchling/young juveniles: Unknown, likely to remain in waters over the	Post-hatchling/young juveniles: Unknown. Likely to disperse through much of the	Post-hatchling/young juveniles: Unknown. Juvenile-adult: Tidal and sub-tidal coral	Post-hatchling/young juveniles: Unknown. Likely to disperse through waters of the Indian Ocean.	Post-hatchling/young juveniles: Unknown. Juvenile-adult: Leatherback turtles

	Juvenile-adult: Flatback turtles are known to favour soft sediment habitats that support benthic invertebrates. Post-nesting satellite tracking indicates foraging occurs along the Western Australian coast in water shallower than 130 m and within 315 km of shore. High use areas included water around Thevenard Island, adjacent to Eighty Mile Beach and Quondong Point, Lynher Banks and the Holothuria Banks.	Australian continental shelf. Juvenile-adult: Flatback turtles are known to favour soft sediment habitats that support benthic invertebrates. Important foraging habitat has not been identified for this stock.	Australian continental shelf. Juvenile-adult: Flatback turtles favour soft sediment habitats that support benthic invertebrates. Important foraging habitat has not been identified for this stock	Indian Ocean/Arafura Sea. Juvenile-adult: Tidal/sub-tidal habitats with coral reef, mangrove, sand, rocky reefs and mudflats where there are algal turfs or seagrass meadows present. A proportion of turtles may also remain resident in the open ocean.	and rocky reef habitats where they feed on algae, sponges and soft corals. Hawksbill turtles can be found in clear or turbid water, on reefs, seagrass meadows or on soft-bottom habitats.	Juvenile-adult: Tidal/sub-tidal habitats with hard and soft substrates including rocky and coral reefs, muddy bays, sand flats, estuaries and seagrass meadows. A proportion of turtles may also remain resident in the open ocean.	forage in oceanic waters on gelatinous prey (i.e. jellyfish). They occur in waters over Australia's continental shelf year round. They are commonly observed in waters of the Northern Territory and south-western Western Australia.

Source: Modified from DoEE (2017a)

2.4.2.7.2 Sea Snakes

Sea snakes are widespread through the waters of the NWS in offshore and near-shore habitats. They can be highly mobile and cover large distances or they may be restricted to relatively shallow waters and some species must return to land to eat and rest. Twenty-six different species of sea snake are listed as occurring within and around the proposed OA (Table 2-8). Of these, the short-nosed sea snake is listed as Critically Endangered.

Cogger (1975) stated that most sea snakes have shallow benthic feeding patterns and are rarely found in water depths exceeding 30 m. There is no information on their frequency of occurrence in deeper offshore waters (except for Scott Reef), though individuals are often observed at the surface. Very little is known about the distribution of the individual species of sea snakes in the NWMR region (DEWHA, 2008a).

The short-nosed sea snake is endemic to WA and has been recorded near Exmouth Gulf but is known primarily from Ashmore and Hibernia reefs in the shallow waters (<10 m in depth). The species prefers the reef flats or shallow waters along the outer reef edge in water depths to 10 m where they have been observed during daylight hours, resting beneath small coral overhangs or coral heads in 1-2 m of water. True sea snakes are strongly reef-associated or inter-reefal with small home ranges and high rates of site fidelity (Likoschek and Shine, 2012). In 2005, Guinea and Whiting (cited in DSEWPaC, 2012) reported that very few short-nosed sea snakes moved more than 50 m away from the reef flat. As such, their restricted distribution and limited genetic flow make sea snakes especially vulnerable to local population declines or extinctions.

Conservation Advice attributed the short-nosed sea snake decline to the main threats of reef habitat degradation (primarily from coral bleaching), bycatch in trawl nets and illegal fishing, while potential impacts from seismic surveys were coincidental but unquantified (TSSC, 2010). Given the water depths within the NCB and Beagle AMBA distance offshore and the highly-restricted, small home ranges of sea snakes, it is unlikely that a significant numbers of sea snakes will be encountered.

2.4.2.8 Sharks and Rays

The NWMR also supports large populations of cartilaginous fishes such as sharks and rays. They are typically higher order predators and perform an important ecological role in the NWMR through the regulation of prey species. The most prolific of the sharks are the whalers, represented by 17 species in the region[4]. Sharks are common in all environments and the oceanic white tipped sharks (*Carcharhinus longimanus*) live in the deeper offshore areas. Various species of shark, including whale sharks, tiger sharks and great white sharks, may occasionally transit through the NCB and Beagle AMBA. Little is known of their movements through the region with the exception of the whale shark. There are approximately 157 species of sharks and rays in the region, of which 18 are endemic.

White shark and Grey nurse shark

The white shark (*Carcharodon carcharias*) is a protected species listed as Vulnerable and Migratory under the EPBC Act (Table 2-8) and the species is also listed under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). They inhabit temperate waters normally close inshore or on the continental shelf and although their range extends into the NWMR it is not commonly found north of NWC (DEWHA, 2008a). There are no known aggregation sites for white sharks in the NWMR, and this species is most likely to be found south of NWC, probably in low densities (EA, 2002). There are no BIA or critical habitats for white sharks located within the NCB or Beagle AMBAs and it is unlikely that significant numbers of white sharks will be encountered.

[4] http://www.fish.wa.gov.au/documents/occasional_publications/fop001.pdf

The grey nurse shark (*Carcharias taurus*) is listed as Vulnerable under the EPBC Act in Australia (Table 2-8). While it is thought that grey nurse sharks have a high degree of site fidelity, some studies (McAuley, 2004) suggest that grey nurse sharks move between different habitats and localities, exhibiting some migratory characteristics. The status of the west coast population is poorly understood although they are reported to remain widely distributed along the WA coast and are still regularly encountered, albeit with low and indeterminate frequency (Chidlow *et al.,* 2006).

Grey nurse sharks are often observed hovering motionless just above the seabed, in or near deep sandy-bottomed gutters or rocky caves, and in the vicinity of inshore rocky reefs and islands (Pollard *et al.,* 1996). The species has been recorded at varying depths but is generally found between 15-40 m (Otway and Parker, 2000). Grey nurse sharks have also been recorded in the surf zone, around coral reefs, and to depths of around 200 m on the continental shelf (Pollard *et al.,* 1996). Grey nurse sharks feed primarily on a variety of teleost and elasmobranch fishes and some cephalopods (Gelsleichter *et al.,* 1999; Smale, 2005).

There are no BIA or critical habitats for grey nurse sharks located within the NCB or Beagle AMBAs and therefore it is unlikely that significant numbers of grey nurse sharks will be encountered.

Sawfish species

Sawfish are rays, somewhat resembling sharks, with an elongated and serrated rostrum that are used for stunning prey.

Dwarf sawfish

The dwarf sawfish is a small robust shark-like sawfish that grows to ~1.4 m long (Ward and Larson, 2012). It is considered to be restricted to northern Australia, ranging from northern Queensland to the Pilbara coastline where they generally inhabit shallow coastal waters along with estuaries, which are utilised as nurseries for juveniles. Adults are known to seasonally migrate back into inshore waters (Peverell, 2007). Surveys have found most captures of dwarf sawfish over soft sediment environments and up to 100 km inshore from the river mouth (DoE, 2016b).. Due to their habitat preference of shallow inshore rivers and estuaries and no BIA for the dwarf sawfish are located within the NCB and Beagle AMBAs, it is highly unlikely that these species will be encountered.

Green sawfish

The green sawfish is a species of shark that is currently listed as Vulnerable under the EPBC Act (Table 2-8). This species has been recorded across northern Australia, generally in coastal waters. As with other species of sawfish, the green sawfish mainly inhabits shallower soft sediment coastal and estuarine environments but has also been recorded in up to 70 m of water in the tropical and sub-tropical waters of northern Australia. The shallow waters off Eighty Mile Beach are a designated BIA for the green sawfish. (DEWHA, 2008a; DoE, 2016b). Due to their habitat preference of coastal waters and no BIA for the green sawfish are located within the NCB and Beagle AMBAs, it is highly unlikely that these species will be encountered.

Largetooth sawfish

The largetooth sawfish (previously known as the freshwater sawfish) is found over a wide range of salinities from freshwater to the oceans, giving rise to the fish being categorised as a 'euryhaline' species. Northern Australia represents one of the only remaining population strongholds for this species of sawfish (DEWHA, 2008a; DoE, 2016b).Due to their habitat preference of shallow inshore waters and no BIA for the largetooth sawfish are located within the NCB and Beagle AMBAs, it is highly unlikely that these species will be encountered.

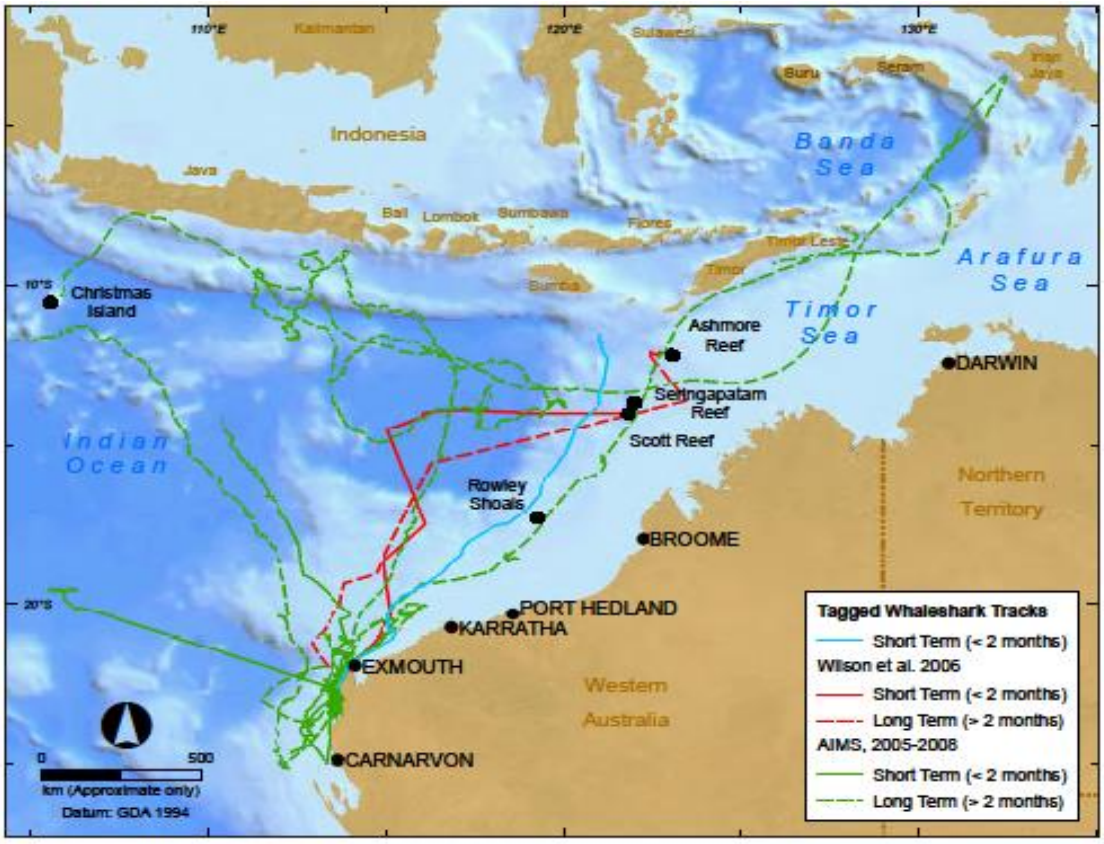
Shortfin and longfin Mako

The shortfin mako and longfin mako sharks are listed as Migratory under the EPBC Act (Table 2-8). The longfin mako is a widely distributed but rarely encountered oceanic shark that ranges from Geraldton around the north coast to at least Port Stephens in New South Wales (DSEWPaC, 2012f). The shortfin mako is an oceanic and pelagic species, although they are occasionally seen inshore. They are found throughout temperate seas but are rarely found in waters colder than 16°C.

Whale shark

The whale shark (*Rhincodon typus*) is listed as Vulnerable and Migratory under the EPBC Act and is also classified as Vulnerable on the IUCN Red List of Threatened Species (IUCN, 2016). In WA, whale sharks are protected under the *Wildlife Conservation Act 1950*, the *Conservation and Land Management Act 1984* and the *Fish Resources Management Act 1994*. This species is normally oceanic and cosmopolitan in their distribution occurring in both tropical and temperate waters. There is a general lack of knowledge in relation to definitive migration patterns. They are known to aggregate in the reef front waters adjacent to the Ningaloo Reef between March and July where they are commonly encountered close to, or on the surface; although they are known to be deep divers and absent for long periods of time (Wilson *et al.,* 2001, 2006). They are a strong but slow swimmer, typically travelling ~24 km/day (Eckert *et al.,* 2002). Although widely distributed, whale sharks are generally infrequently recorded, and little is known of their biology or ecology (DEWHA, 2008a).

The aggregations at Ningaloo Reef coincide with the seasonal intensification of the Leeuwin Current and mass synchronous coral spawning events in March and April (Taylor, 1996 as cited in DEWHA, 2008a). However, it is not clear whether whale sharks feed on the coral spawn or take advantage of an associated increase in krill and other zooplankton (Taylor, 2007 as cited in DEWHA, 2008a).



Source: McKinnon *et al.,* (2002), Wilson *et al.,* (2006), Meekan and Radford (2010).

Figure 2-36 - Short and long term satellite tracking of 18 whale sharks tagged between 2002 and 2008

Preliminary research on the migration patterns of whale sharks has shown that after departing Ningaloo Reef they head north through the NWMR with some individuals passing Scott and Ashmore Reefs (Wilson *et al.,* 2006; (Meekan and Radford, 2010; Figure 2-36). Short-term tags have indicated whale sharks move northwest into the Indian Ocean but may also move directly north towards Sumatra and Java.

Recent satellite telemetry was used to remotely track the long-term movements of whale sharks (Reynolds *et al*., 2017), the study found that four whale sharks did not make their annual migration away from Ningaloo Reef, instead the range of sharks shifted south within the Ningaloo Marine Park. Scientist now

suggest that Ningaloo Reef could also be a post-nursery conditioning area, a coastal location where juvenile *R.typus* gather to feed and mature (Reynolds *et al*., 2017). The southern movement of these four animals was also towards warmer shallower coastal waters within the Ningaloo Marine Park.

A migratory and foraging BIA for the whale shark is located within the NCB and Beagle AMBAs (Figure 2-37), so it is possible that whale sharks may be encountered within the NCB and Beagle AMBAs. The majority of the migration corridor is over 75 km wide and so is not considered 'restricted', however, the migration corridor narrows to ~30 km wide northwest of the Montebello Islands through to NWC and also in the waters adjacent to the Lacepede Islands. Whale sharks are not regarded as social animals and are most often encountered singularly. Due to low numbers of the animals and their irregular movements, it is not expected that whale sharks will be encountered in significant numbers, and those individuals that are encountered are likely to be transient.

Conservation Advice (DoE, 2015j) for whale sharks (DoE, 2015j) details:
Whale sharks form seasonal aggregations at Ningaloo Reef (March – July); off the coastal waters off Christmas Island (December – January); and in the Coral Sea (November – December). These seasonal aggregations are thought to be linked to localised seasonal 'pulses' of food productivity. These aggregations are all considered biologically important areas for whale sharks. The 200 m isobath along the northern part of the Western Australia coast is an important migration route, with migration occurring mainly between July and November. Therefore, it is likely that whale sharks could be encountered within the AMBAs from July to November.

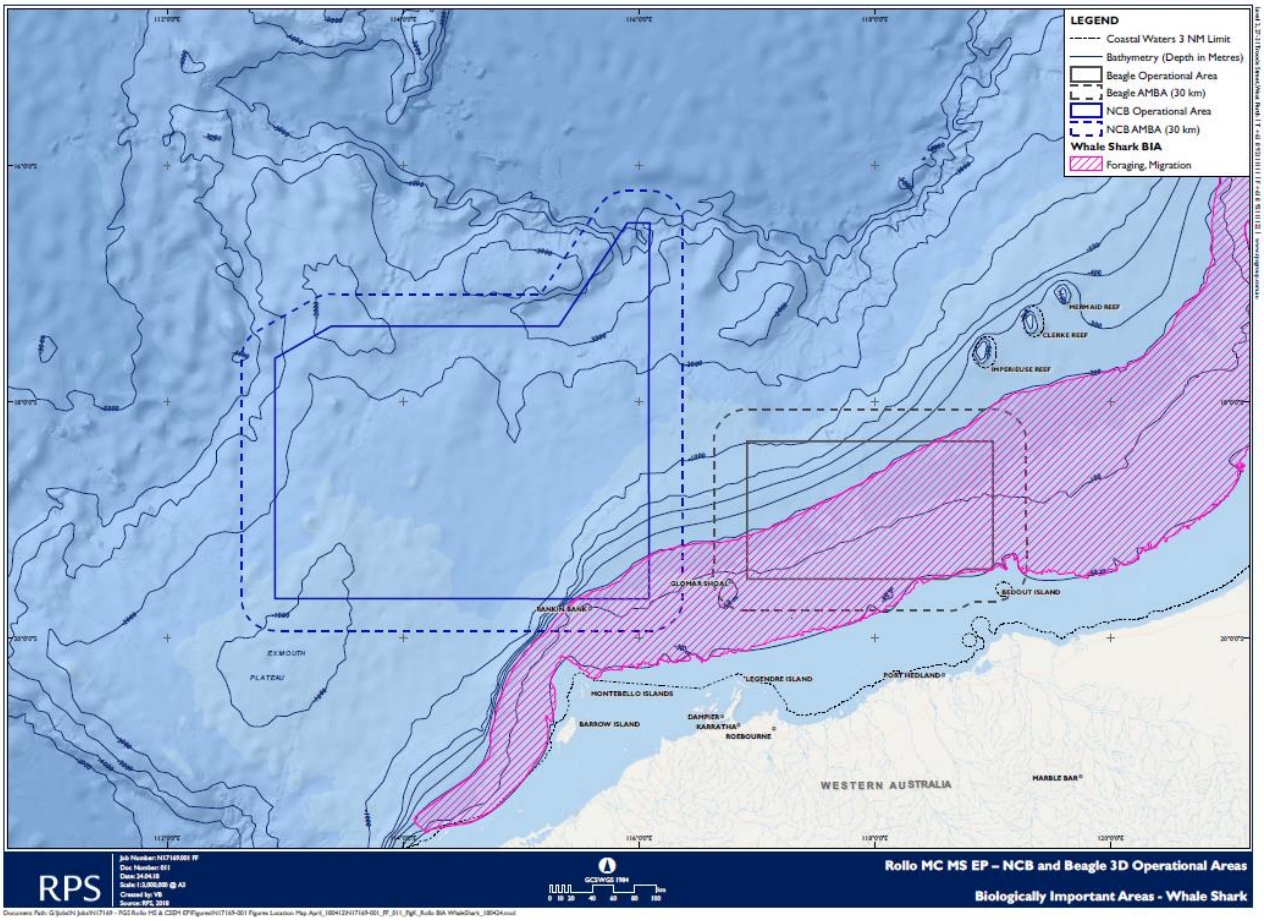


Figure 2-37 – Whale Shark BIA and the NCB and Beagle AMBAs

2.4.2.9 Birds (migratory seabirds and shorebirds)

Marine waters and coastal habitat within and adjacent to the NCB and Beagle AMBAs contain some habitats that are important to birds, such as one offshore island (Bedout Island) and coastal and pelagic waters. These habitats support a variety of birds that utilise the area in different ways and at different times of the year (DSEWPaC, 2012, 2012e). Birds can be broadly grouped according to their preferred foraging habitat as coastal/ terrestrial birds, seabirds and shorebirds. Coastal or terrestrial species inhabit the offshore islands and coastal areas of the mainland throughout the year. These species are either primarily terrestrial, or they may forage in coastal waters. Resident coastal and terrestrial species include the osprey (*Pandion haliaetus*), and white-bellied sea eagle (*Haliaeetus leucogaster*; DEWHA, 2008a).

Seabirds include those species whose primary habitat and food source is derived from pelagic waters. These species spend the majority of their lives at sea, ranging over large distances to forage over the open ocean. Seabirds present in the area include terns, noddies, petrels, shearwaters, tropicbirds, frigatebirds and boobies (DEWHA, 2008a).

Shorebirds, including waders, inhabit the intertidal zone and adjacent areas. Some shorebird species are resident while others are migratory and include species that utilise the East Asian-Australasian Flyway, a migratory pathway for millions of migratory shorebirds that travel from Northern Hemisphere breeding grounds to Southern Hemisphere resting and foraging areas. Shorebirds that regularly migrate through the area include the Scolopacidae (curlews, sandpipers etc.) and Charadriidae (plovers and lapwings) families.

The eastern curlew is the largest migratory shorebird in the world, has a primarily coastal distribution and is endemic to the East Asian-Australasian Flyway. They have a continuous distribution from Barrow Island and the Dampier Archipelago, through to the Kimberley. During the non-breeding season, the eastern curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass and therefore outside of the NCB and Beagle AMBAs (DoE, 2015b).

Migratory shorebirds are listed as Migratory and Marine species under the EPBC Act and many are also listed under the Convention on Migratory Species (CMS). Additionally, some species are listed under the CAMBA, the JAMBA or the Republic Of Korea Australia Migratory Bird Agreement (ROKAMBA). Two species of the streaked shearwater are listed under the migratory provision of the EPBC Act. The streaked shearwater is listed on the China-Australia Migratory Bird Agreement (CAMBA) as *Puffinus leucomelas* and the Japan-Australia Migratory Bird Agreement (JAMBA) as *Calonectris leucomelas*.

The NCB AMBA extends beyond the continental shelf and out to the boundary of the EEZ, and there is little information concerning the populations of seabirds utilising these offshore waters. Even so, the proposed NCB and Beagle AMBAs overlap the distribution of some common seabirds and these species are expected to occur in the area.

Bird BIAs within the NCB and Beagle AMBAs are shown in Figure 2-38 to Figure 2-43 and information in regards to locations and timing of activities is summarised in Table 2-17.

Numerous seabirds and shorebirds commonly feed on fish, cephalopods and crustaceans by means of plunge diving (brown booby), scooping /surface seizing (lesser frigatebird, streaked shearwater), foraging (terns, common noddy, white-tailed tropicbird) stealing from other birds (lesser frigatebird; DSEWPAC 2012; DSEWPaC 2012e). A summary of seabird and shorebird foraging behaviour and prey types is provided in Table 2-18.

Table 2-17 - Seabird BIA location and timing

Species	BIA location	Peak times	Activity	Overlaps AMBAs
Brown Booby	Bedout Island	February to October	Breeding / Foraging	Yes
Lesser crested tern	Muiron Islands, Montebello Islands	March to June	Breeding / Foraging	Yes
	Bedout Island, Lowendal Islands, Thevenard Island			Yes
Lesser Frigatebird	Bedout Island	March to September	Breeding / Foraging	Yes
Roseate tern	Dampier Archipelago, Lowendal Island, Bedout Island	Mid-March to July	Breeding	Yes
	Eighty Mile Beach		Breeding, Resting	No
Wedge-tailed shearwater	Dampier Archipelago, Passage Island, Montebello Islands, Lowendal Islands, off Barrow Island,	Mid-August to April	Foraging and Breeding	Yes
White-tailed tropicbird	Rowley Shoals	May and October	Foraging	Yes
			Breeding	No

Table 2-18 - Bird foraging behaviour and prey species

Species	Foraging behaviour	Diet (prey species)
Brown booby	Plunge diver and often forages closer to land than other booby species	fish cephalopods
Greater frigatebird	Scoops up prey species from the surface of the water and takes flying fish from just above the surface	flying fish cephalopods
Lesser crested tern	Plunge dive for prey close to the surface in relatively shallow near-shore waters	small pelagic fish shrimps
Lesser frigatebird	Scoops up prey species from the surface of the water and takes flying fish from just above the surface. Also known to steal prey off other seabirds (boobies and terns)	fish cephalopods
Roseate tern	Known as a specialist forager. Forages in sheltered estuaries, creeks, inshore waters and up to several kilometres offshore	small pelagic fish
Wedge-tailed shearwater	Plunge-diving	fish cephalopods crustaceans
White-tailed tropicbird	Plunge-diving	fish cephalopods

Source: modified from DSEWPaC (2012).

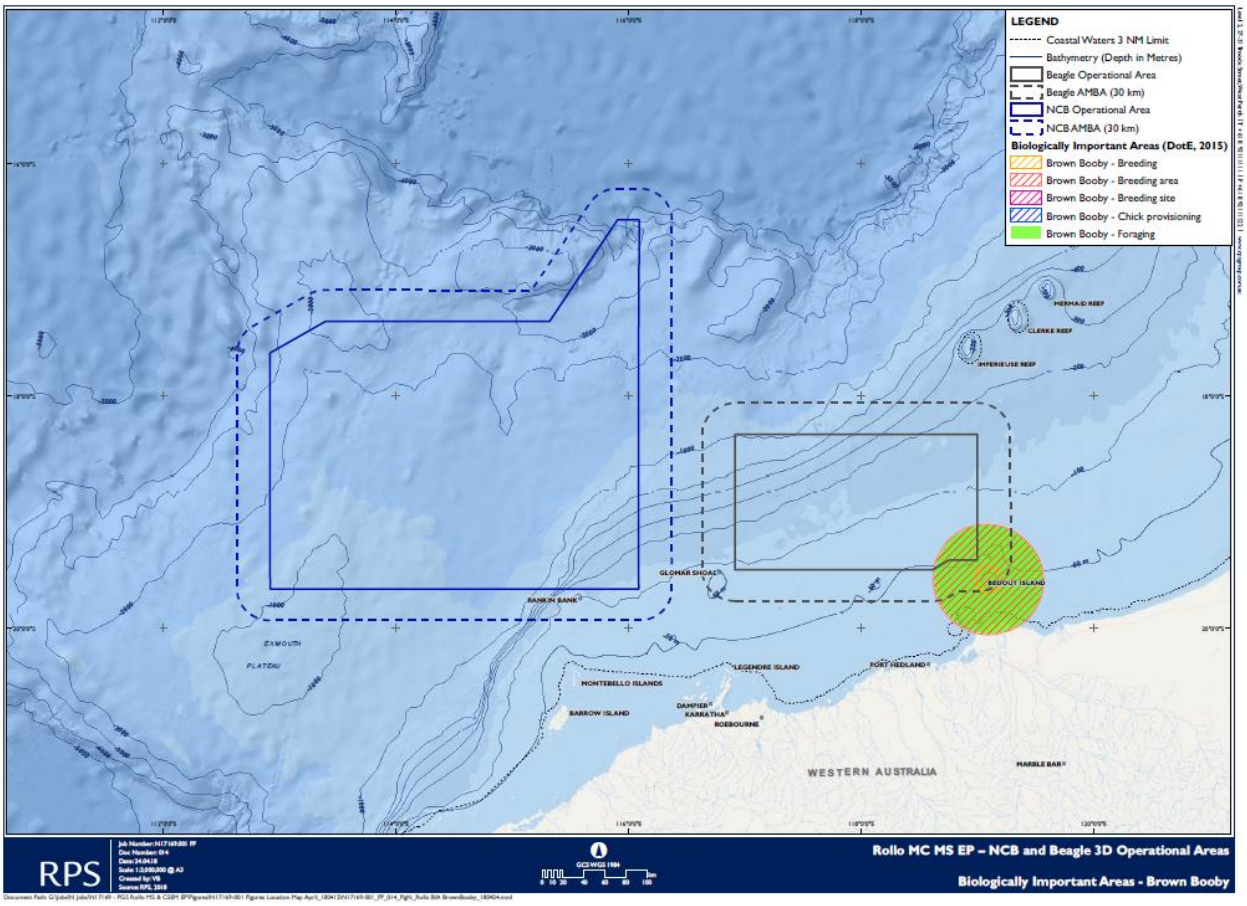


Figure 2-38 - Brown Booby BIA and the NCB and Beagle AMBAs

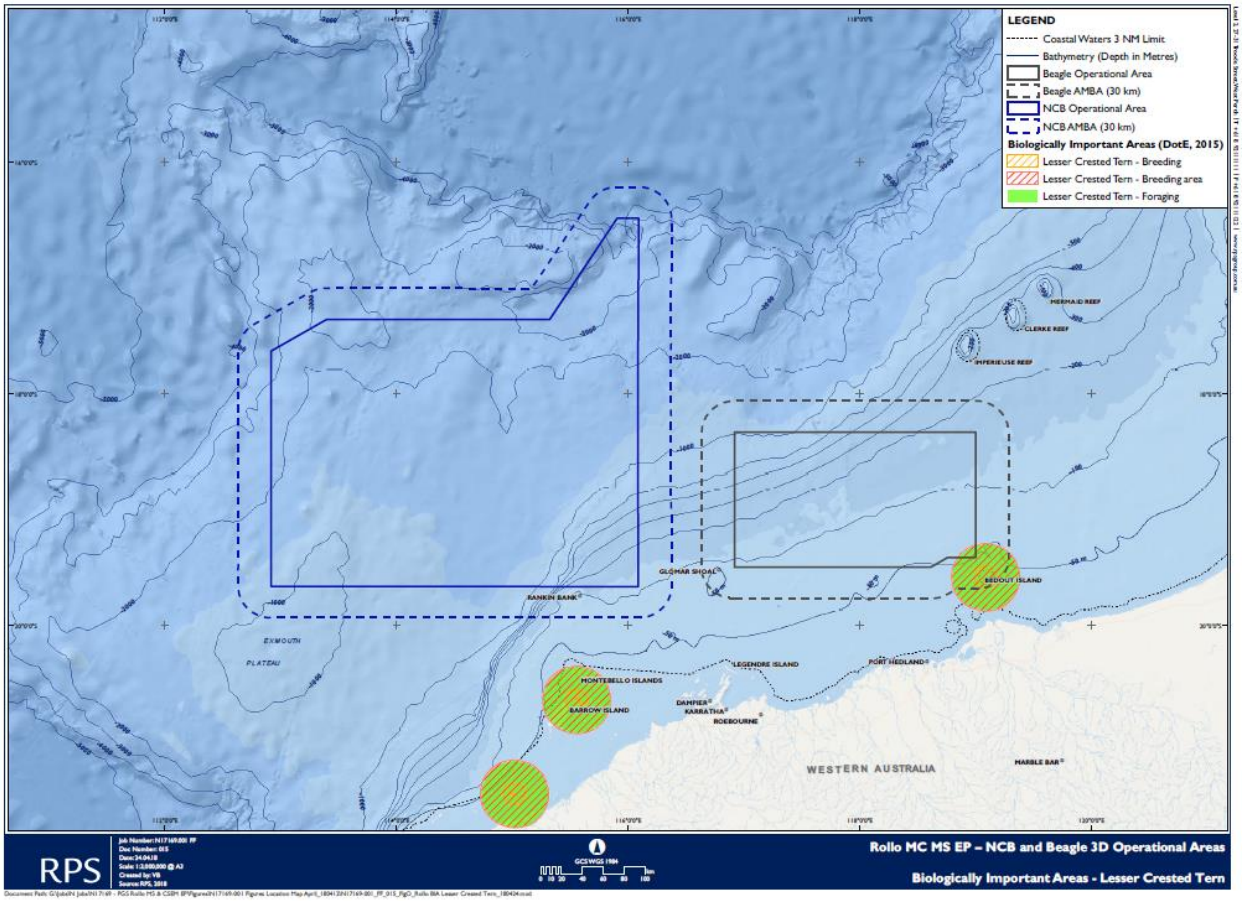


Figure 2-39 - Lesser Crested Tern BIA and the NCB and Beagle AMBAs

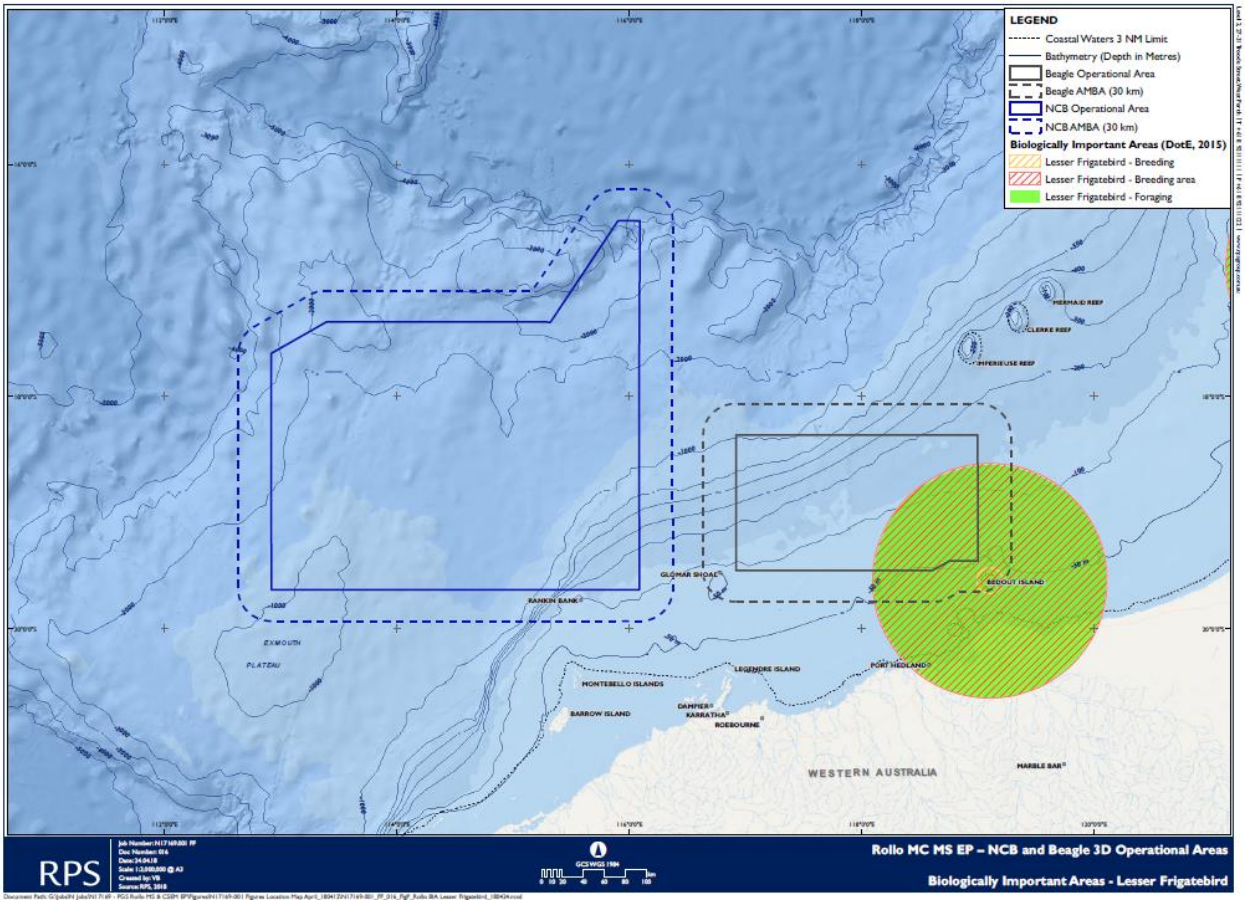


Figure 2-40 – Lesser Frigatebird BIA and the NCB and Beagle AMBAs

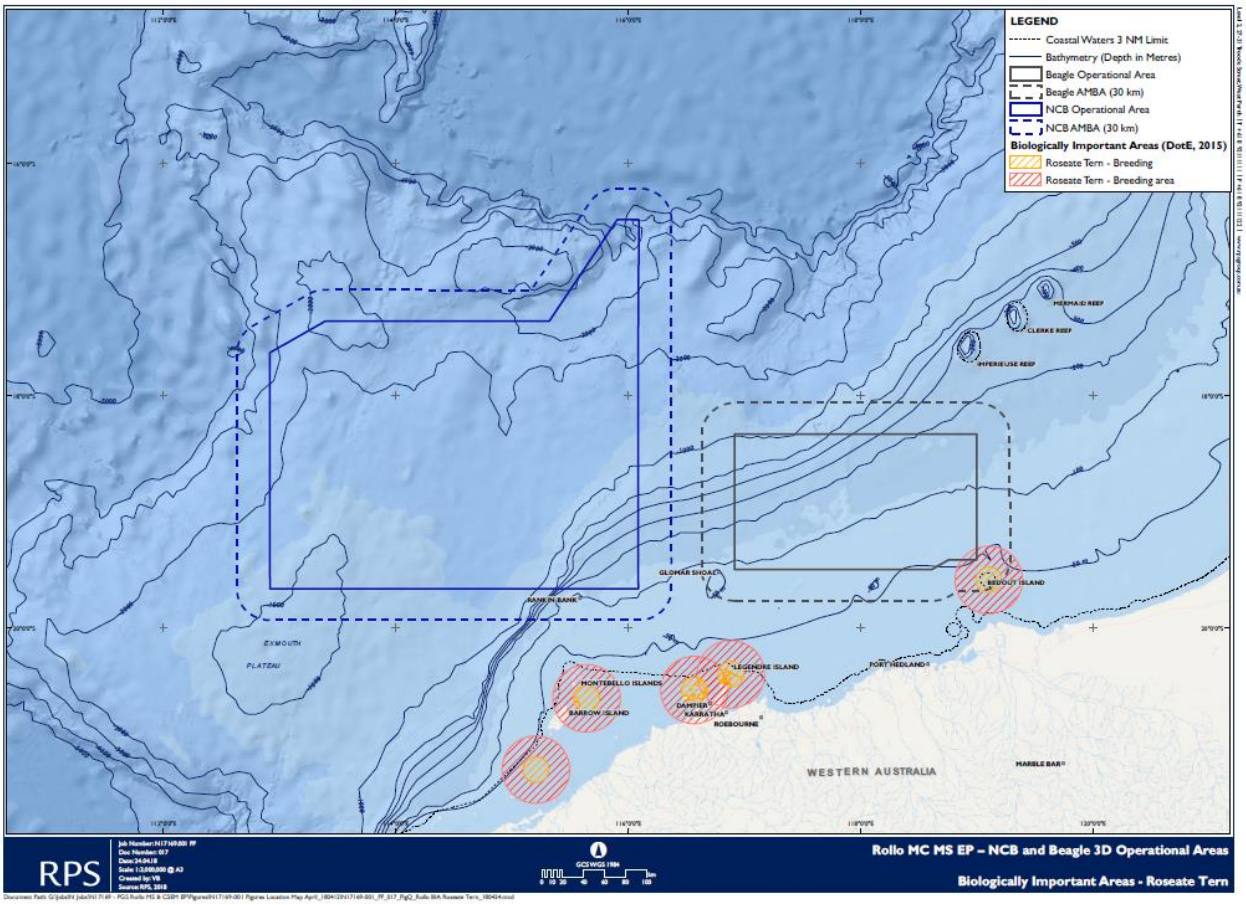


Figure 2-41 – Roseate Tern BIA and the NCB and Beagle AMBAs

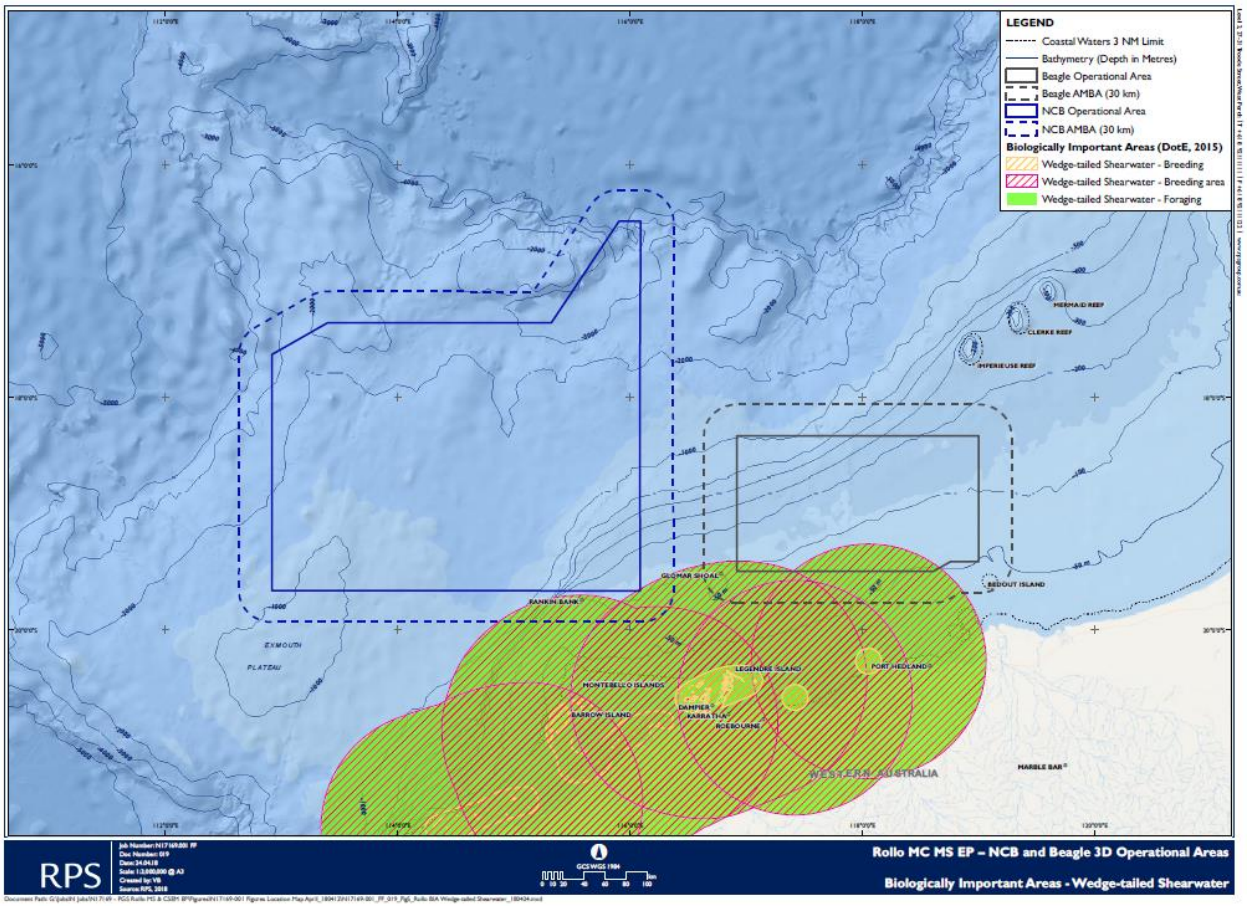


Figure 2-42 – Wedgetailed Shearwater and the NCB and Beagle AMBAs

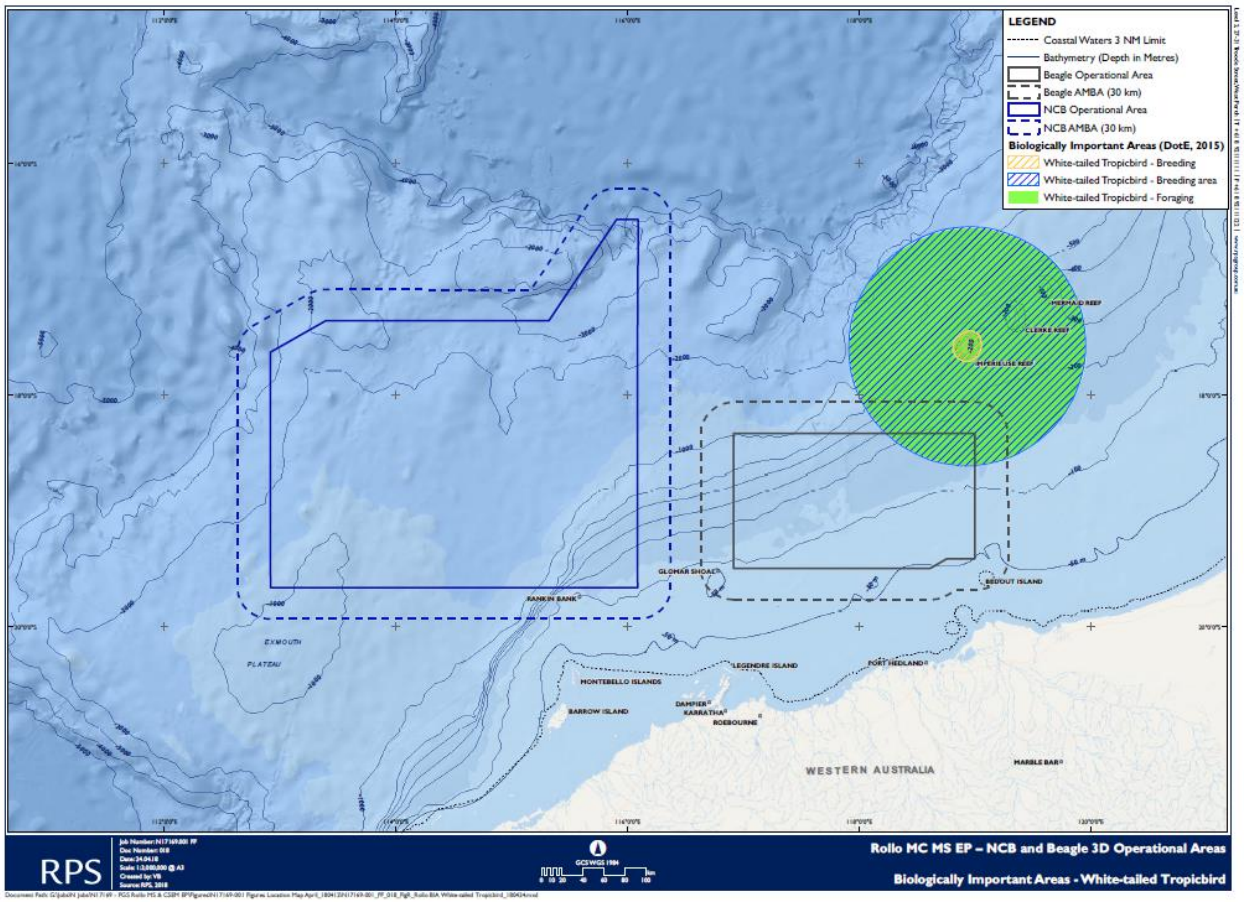


Figure 2-43 – White-tailed Tropicbird and the NCB and Beagle AMBAs

2.5 SOCIO-ECONOMIC ENVIRONMENT

2.5.1 Marine Parks and Reserves

2.5.1.1 Commonwealth Marine Parks

The Beagle AMBA overlaps the Eighty Mile Beach CMP multiple use zone (VI), however, the OA does not (Figure 2-44). The Eighty Mile Beach CMP covers approximately 10,785 km^2 of the Commonwealth marine environment. It covers part of the continental shelf, adjacent to the entire length of Eighty Mile Beach, from Cape Bosset in the north to Commonwealth waters adjacent to Bedout Island. The waters off Eighty Mile Beach are important for several species including dugongs, humpback whales, sawfish and migratory seabirds (DNP, 2018).

The North-west Marine Parks Network Management Plan came into effect on 1 July 2018. Under this plan mining operations, which include seismic surveys, are regulated using a class approval. The class approval for mining operations, including seismic surveys, within the Eighty Mile Beach CMP multiple use zone (VI) came into effect on the 1 July 2018

For the Rollo EP the activity is not within the Eighty Mile Beach CMP multiple use zone (VI), however, there is the potential for a vessel diesel spill to impact on the Eighty Mile Beach CMP multiple use zone (VI) thus there is a requirement to show how:

- Impacts and risks to park values will be managed to an acceptable level.
- Impacts and risks to park values will be managed to as low as reasonably practicable (ALARP). In demonstrating how impacts will be managed to reduce to ALARP, consideration should be given to identifying and evaluating alternative, additional and improved control measures that may further reduce impacts and risks.
- The ongoing consultation measures proposed to be in place are appropriate to ensure the DNP will be kept informed during implementation of the activity.

The values of the Eighty Mile Beach CMP relative to the multiple use zone (VI) are detailed in Table 2-19.

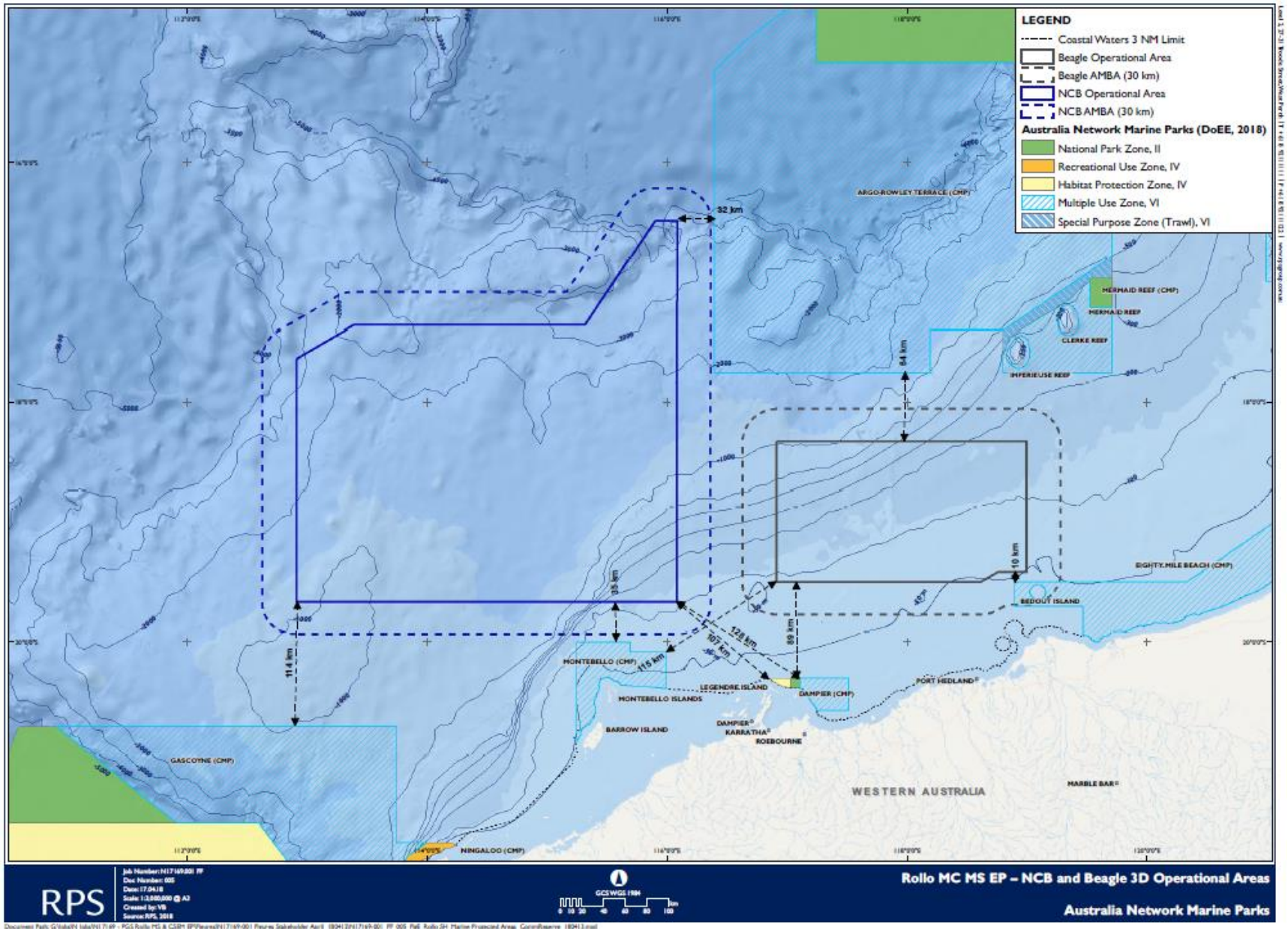


Figure 2-44 - Location map - CMP and the NCB and Beagle AMBAs

Table 2-19 - Eighty Mile Beach Commonwealth Marine Park Values

Name	Eighty Mile Beach Commonwealth Marine Park
Area	10,785 km^2
Depth range	<15-70 m (approx.)
Statement of significance	The Eighty Mile Beach Marine Park is significant because it contains habitats, species and ecological communities associated with the Northwest Shelf Province and consists of shallow shelf habitats, including terrace, banks and shoals. The Marine Park is adjacent to the Eighty Mile Beach Ramsar site, recognised as one of the most important areas for migratory shorebirds in Australia; and the Western Australian Eighty Mile Beach Marine Park, providing connectivity between offshore and inshore coastal waters of Eighty Mile Beach.
Natural values	The Marine Park includes examples of ecosystems representative of the Northwest Shelf Province—a dynamic environment influenced by strong tides, cyclonic storms, long-period swells and internal tides. The bioregion includes diverse benthic and pelagic fish communities, and ancient coastline thought to be an important seafloor feature and migratory pathway for humpback whales. The Marine Park supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. Biologically important areas within the Marine Park include breeding, foraging and resting habitat for seabirds, internesting and nesting habitat for marine turtles, foraging, nursing and pupping habitat for sawfish and a migratory pathway for humpback whales.
Cultural values	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. The sea country of the Nyangumarta, Karajarri and Ngarla people extends into Eighty Mile Beach Marine Park. Sea country is culturally significant and important to their identity. They have an unbroken, deep spiritual connection to their sea country, with traditional practices continuing today. Staple foods of living cultural value for the Nyangumarta, Karajarri and Ngarla people 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 native title holders for the Nyangumarta, Karajarri and Ngarla people are represented by the Karajarri Aboriginal Corporation, Nyangumarta Karajarri Aboriginal Corporation, Nyangumarta Warrarn Aboriginal Corporation, and Wanparta Aboriginal Corporation. These Prescribed Body Corporates represent traditional owners with native title over coastal area adjacent to the Marine Park and are the points of contact for their respective areas of responsibility for sea country in the Marine Park. The Kimberley Land Council and the Yamatji Marlpa Aboriginal Corporation are the Native Title Representative Bodies for Kimberley and Pilbara regions.
Heritage values	No international, Commonwealth or national listings apply to the Marine Park at commencement of this plan. The Marine Park contains three known shipwrecks listed under the Historic Shipwrecks Act 1976: Lorna Doone (wrecked in 1923), Nellie (wrecked in 1908), and Tifera (wrecked in 1923).
Social and economic values	Tourism, commercial fishing, pearling and recreation are important activities in the Marine Park. These activities contribute to the wellbeing of regional communities and the prosperity of the nation.

Source: modified from DNP (2018).

Table 2-20 - Summary of IUCN Reserve Management Principles relevant to the proposed OA

Relevant IUCN Reserve Management Principles	Survey Consistent with IUCN Reserve Management Principles?	EMB CMP
Strict nature reserve (category Ia)		
1.01 The reserve or zone should be managed primarily for a strict nature reserve (IUCN protected area management category Ia).	Yes - No Category 1a parks located within the NCB and Beagle AMBAs.	n/a[5]
1.02 Habitats, ecosystems and native species should be conserved in as undisturbed a state as possible.		n/a[5]
1.03 Genetic resources should be maintained in a dynamic and evolutionary state.		n/a[5]
1.04 Established ecological processes should be maintained.		n/a[5]
1.05 Structural landscape features or rock exposures should be safeguarded.		n/a[5]
1.06 Examples of the natural environment should be secured for scientific studies, environmental monitoring and education, including baseline areas from which all avoidable access is excluded.		n/a[5]
1.07 Disturbance should be minimised by careful planning and execution of research and other approved activities.		n/a[5]
1.08 Public access should be limited to the extent it is consistent with these principles.		n/a[5]
Marine national park zone (category II)		
3.02 Natural and scenic areas of national and international significance should be protected for spiritual, scientific, educational, recreational or tourist purposes	Yes – No category II parks located within the NCB and Beagle AMBAs as mining (including exploration) is not permitted	n/a[5]
3.03 Representative examples of physiographic regions, biotic communities, genetic resources, and native species should be perpetuated in as natural a state as possible to provide ecological stability and diversity.		
3.04 Visitor use should be managed for inspirational, educational, cultural and recreational purposes at a level that will maintain the reserve or zone in a natural or near natural state.		
3.05 Management should seek to ensure that exploitation or occupation inconsistent with these principles does not occur		
3.06 Respect should be maintained for the ecological, geomorphic, sacred and aesthetic attributes for which the reserve or zone was assigned to this category.		
Habitat/species management area (category IV)		
5.02 Habitat conditions necessary to protect significant species, groups or collections of species, biotic communities or physical features of the environment should be secured and maintained, if necessary through specific human manipulations.	Yes - No Category 1a reserves located within the NCB and Beagle AMBAs.	n/a[5]
5.05 Management should seek to ensure that exploitation or occupation inconsistent with these principles does not occur.		
Managed resource protected area (category VI)		
7.01 The reserve or zone should be managed mainly for the ecologically sustainable use of natural ecosystems based on the following principles.	Yes - survey activities will adhere to the Environmental Performance Outcomes (**Section 4**)	*Yes*
7.02 The biological diversity and other natural values of the reserve or zone should be protected and maintained in the long-term.		
7.03 Management practices should be applied to ensure ecologically sustainable use of the reserve or zone.		
7.04 Management of the reserve or zone should contribute to regional and national development to the extent that this is consistent with these principles.		

[5] n/a - Not applicable as the CMP does not contain any areas designated as this IUCN principle.

2.5.1.2 WA State Reserves

There are no WA State Marine Reserves within the NCB or Beagle AMBAs. The nearest WA State Marine Park adjacent to the NCB AMBA is the Montebello Islands Marine Park, and to the Beagle AMBA is the Eighty Mile Beach Marine Park, which are located >76 km and 77 km from the AMBAs, respectively.

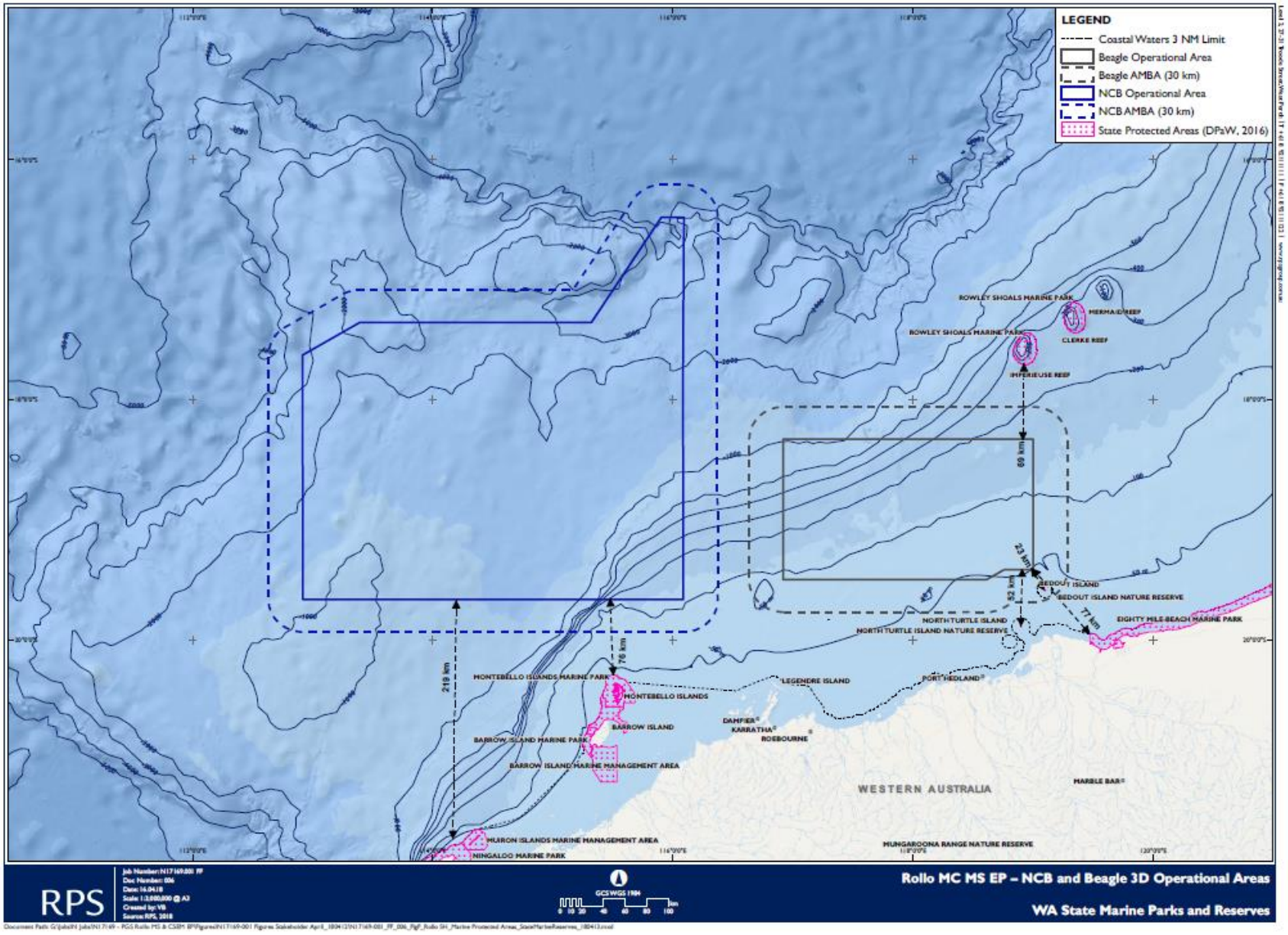


Figure 2-45 - Location map – WA State Marine Parks and Reserves adjacent to the proposed NCB and Beagle OAs

2.5.2 European heritage

Under the *Historic Shipwrecks Act 1976* (Commonwealth), all historic wrecks and associated relics older than 75 years are protected; if located in waters from the low water mark out to the continental shelf edge (DoE, 2015f). A search of the National Shipwrecks Database (DoE, 2016g) indicates that there are over 300 listed historic shipwrecks in the NWMR alone, and these are located mainly around islands, emergent and shallow water features, which are outside the proposed OAs.

The nearest historic shipwreck is thay of the *Alfred*, which was a sailing vessel that grounded in 1908 during a cyclone. It is located approximately 150 km north of the Beagle OA. The Trial was wrecked on Tryal Rocks (approximately 70 km south of the NCB OA) in 1622. It is the oldest known shipwreck in Australian waters.

2.5.3 Indigenous heritage

There are no recorded Indigenous heritage sites within the NCB or Beagle AMBAs. Considering the water depths and distance offshore, the proposed OA is not expected to support any Indigenous heritage values. Indigenous fishing activities are largely confined to inshore and coastal waters. Therefore, Indigenous heritage is not considered further in this EP.

2.5.4 Tourism and Recreation

2.5.4.1 Marine Based Tourism

The Gascoyne and North coasts are popular visitor destinations—sites of interest to tourists include places to fish, areas for sightseeing and secluded locations for general relaxation. Most tourism and recreation activities are confined to coastal areas and islands, plus luxury cruises that take tourists along the coastline and increasingly out to isolated coral atolls for fishing and diving (Fletcher and Santoro, 2014).

2.5.4.1.1 Charter Boat Operators (Fishing and Diving)

In the Pilbara area, there are 13 charter vessels, five (5) of which have commercial fishing boat licences and target demersal scalefish (Fletcher and Santoro, 2015). Charter fishing includes consumptive and non-consumptive utilization of the fish resources. The reported charter vessel catches for the north coast bioregion in 2013 is estimated to be ~4.1 t of barramundi and ~2.2 t of threadfin salmon. The charter vessel sector is an increasing user of the resource. There is however a high degree of spatial separation between the charter and commercial user groups due to the inshore closures to the commercial fishery sector.

Fishing vessels operating in the Charter Boat Industry may operate in the vicinity of Glomar Shoal. A review of charter boat website did not identify Glomar Shoal, Rankin Bank or Bedout Island as areas where charter fishing or dive companies offer services to.

Given the offshore location of the proposed NCB and Beagle AMBA and the spatial separation between the proposed OA and remote tourism destinations, there will be very little interaction, if any, with tourism and recreation industries.

2.5.4.1.2 Recreational Fishing

Recreational fishing and other recreational activities constitute the largest single use group in the region. WA has a very high ownership of recreational vessels there are ~90,000 registered vessels in WA (Fletcher and Santoro, 2015).

Recreational fishing activities in the Pilbara region are concentrated around key population centres, with a seasonal peak in activity during the dry season in the north between winter months April/May to September/October. Further south peak periods are August to November (Fletcher and Santoro, 2015). The areas of highest recreational fishing activity in the Montebello/Barrow Island Marine Conservation Reserves are reported to be off the north-eastern end of Trimouille Island and in the waters south of the Montebello group (DEC, 2007a) and throughout the islands of the Dampier Archipelago. Occasional recreational fishing occurs at Glomar Shoal; however, due to the distance from land (130 km north of Dampier) it is very

sporadic and short in duration. The main demersal scalefish targeted by recreational fishers are nor-west snapper (the lethrinids), emperor and coral trout.

Recfishwest suggests that recreational fishing activities mostly occur within a 40 nm radius of townships (Ms Eileen Smith and Matt Gillet, Recfishwest, pers.comm. email, March 2014 and March 2015). Therefore, as the proposed OA is located more than 40 km from the nearest town site, recreational fishing activities are not likely to be encountered in great numbers. Those that are encountered are likely to be transiting through the area to and from the Rowley Shoals and / or Mermaid Reef, and Scott and Seringapatam reefs.

A search of the internet identified that some recreational fishing and spearfishing occurs at Bedout Island.

2.5.5 Commercial Fisheries

The NWMR supports a variety of fisheries of commercial importance. The proposed AMBAs are located within several Commonwealth and WA State managed fishery areas.

The Department of Fisheries defines different suites of 'exploited fish' that are fished in the following aquatic zones (Fletcher and Santoro, 2015):

- Finfish:
    - Estuarine/Nearshore 0-20 m.
    - Inshore (shelf) demersal 20-250 m depth (demersal fisheries).
    - Offshore demersal >250 m.
    - Pelagic.

Records of consultation with AFMA, DPIRD-Fisheries and appropriate fisheries associations and licence holders are provided in Chapter 1.

2.5.5.1 State Administered Fisheries

The NCB AMBA is within the Gascoyne and North Coast Fisheries Bioregion and the Beagle AMBA is within the North Coast Fisheries Bioregion (Figure 2-46). State fisheries administered by DPIRD-Fisheries that can operate within the proposed AMBAs are:

- Mackerel Managed Fishery (MMF)
- North Coast Demersal Fisheries (NCDF)
    - Pilbara Demersal Scalefish Fishery (PDSF)
        - Pilbara Fish Trawl Interim Managed Fishery (PFTIMF)
        - Pilbara Trap Managed Fishery (PTMF)
        - Pilbara Line Fishery (PLF)
- North Coast Prawn Managed Fishery (NCPMF)
    - Nickol Bay Prawn Managed Fishery (NBPMF)
    - Onslow Prawn Managed Fishery (OPMF)
- Pearl Oyster Managed Fishery (POMF)
- Shark Fisheries
    - Northern Shark Fishery (NSF)
- West Coast Deep Sea Crab (Interim) Managed Fishery (WCDSCMF)

PGS used the following information sources to identify State commercial fisheries operating areas and catch/effort within those areas:

- Fletcher WJ, Mumme MD and Webster FJ. (eds). 2017. Status Reports of the Fisheries and Aquatic Resources of Western Australia 2015/16: The State of the Fisheries. Department of Fisheries, Western Australia.
- Fish Cube data from 2012 – 2016. 2017 data was not available at the time of writing the EP.

Based on the information reviewed and consultation with WAFIC and DPIRD-Fisheries it was identified that the NCB or Beagle AMBA overlap the following fisheries operating areas:

- Mackerel Managed Fishery (MMF)
- Pilbara Fish Trawl Interim Managed Fishery (PFTIMF)
- Pilbara Trap Managed Fishery (PTMF)
- Pilbara Line Fishery (PLF)
- Pearl Oyster Managed Fishery (POMF)
- Nickol Bay Prawn Managed Fishery (NBPMF)
- Onslow Prawn Managed Fishery (OPMF)

A summary of these fisheries is provided in the following sections.

Based on the Fish Cube data it was identified that the following fisheries have catch/effort within the NCB or Beagle AMBA:

- Mackerel Managed Fishery (MMF)
- Pilbara Fish Trawl Interim Managed Fishery (PFTIMF)
- Pilbara Trap Managed Fishery (PTMF)
- Pilbara Line Fishery (PLF)

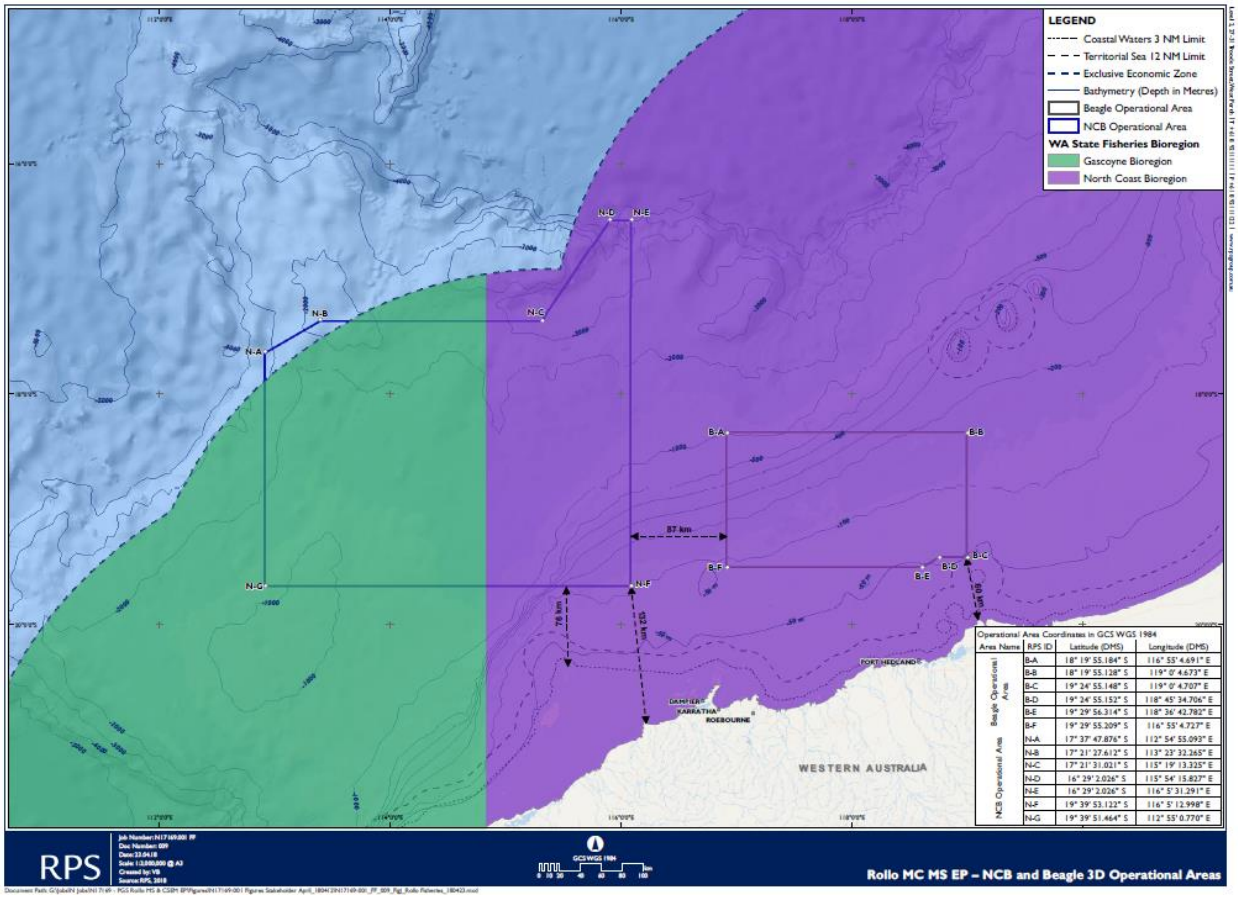


Figure 2-46 - NCB and Beagle OAs vs. WA State Fisheries Bioregions

2.5.5.1.1 Mackerel Managed Fishery (MMF)

The NCB survey OA overlaps Area 2 and 3 of the MMF and the Beagle survey OA overlaps Area 2 (Figure 2-47). Based on the DPIRD-Fisheries Fishcube data (2012 – 2016) there has been no catch effort in Area 3 where it overlaps the NCB survey OA. In Area 2 there has been a low level of catch effort as shown by the light grey 60 x 60 blocks which indicate that there has only been up to 2 vessels fishing in those blocks within the period of 2012 – 2016 (Figure 2-47).

Where there has been catch effort within the light grey 60 x 60 blocks this is shown by the dark grey 10x10 blocks. Figure 2-47 only shows the 10x10 catch effort blocks within or adjacent to the NCB and Beagle OAs. Within Area 2 there are 99 catch effort 10x10 blocks. The average area of a singular 10x10 block is approximately 323 km^2 therefore an approximate area of effort for the fishery within Area 2 is 31,977 km^2. Based on this the area of overlap with the MMF catch effort areas is 323 km^2 (1%) for the NCB AO and 2,584 km^2 (8%) for the Beagle OA (9%).

The MMF uses near-surface trolling gear from small vessels in coastal areas around reefs, shoals and headlands to target Spanish mackerel (*Scomberomorus commerson*). Jig fishing is also used to capture grey mackerel (*S. semifasciatus*), with other species from the genera *Scomberomorus*, *Grammatorcynus* and *Acanthocybium* also contributing to commercial catches. Permit holders may only fish for mackerel by trolling or handline. The fishery extends from the West Coast Bioregion to the WA/NT border, with most effort and catches recorded north of Geraldton.

In WA, most commercial fishing for mackerel occurs from May to October, with a peak in activity around July/August except for the Pilbara where two fishers target mackerel throughout the year (Mackie et al. 2010). This correlates with available data from Fish Cube for 2012 – 2016 which shows that the number of vessels that fish within the NCB and Beagle OAs is less than 3 (Figure 2-48) and that within the broader MMF area peak fishing months are May to October (Figure 2-48).

Spanish mackerel are an offshore, pelagic (surface-dwelling) fish and live around offshore and coastal reefs (DPIRD website). There are no offshore or coastal reefs within the Rollo or NCB OAs though Glomar Shoal and Rankin Bank are within the AMBA, so mackerel maybe present in these areas.

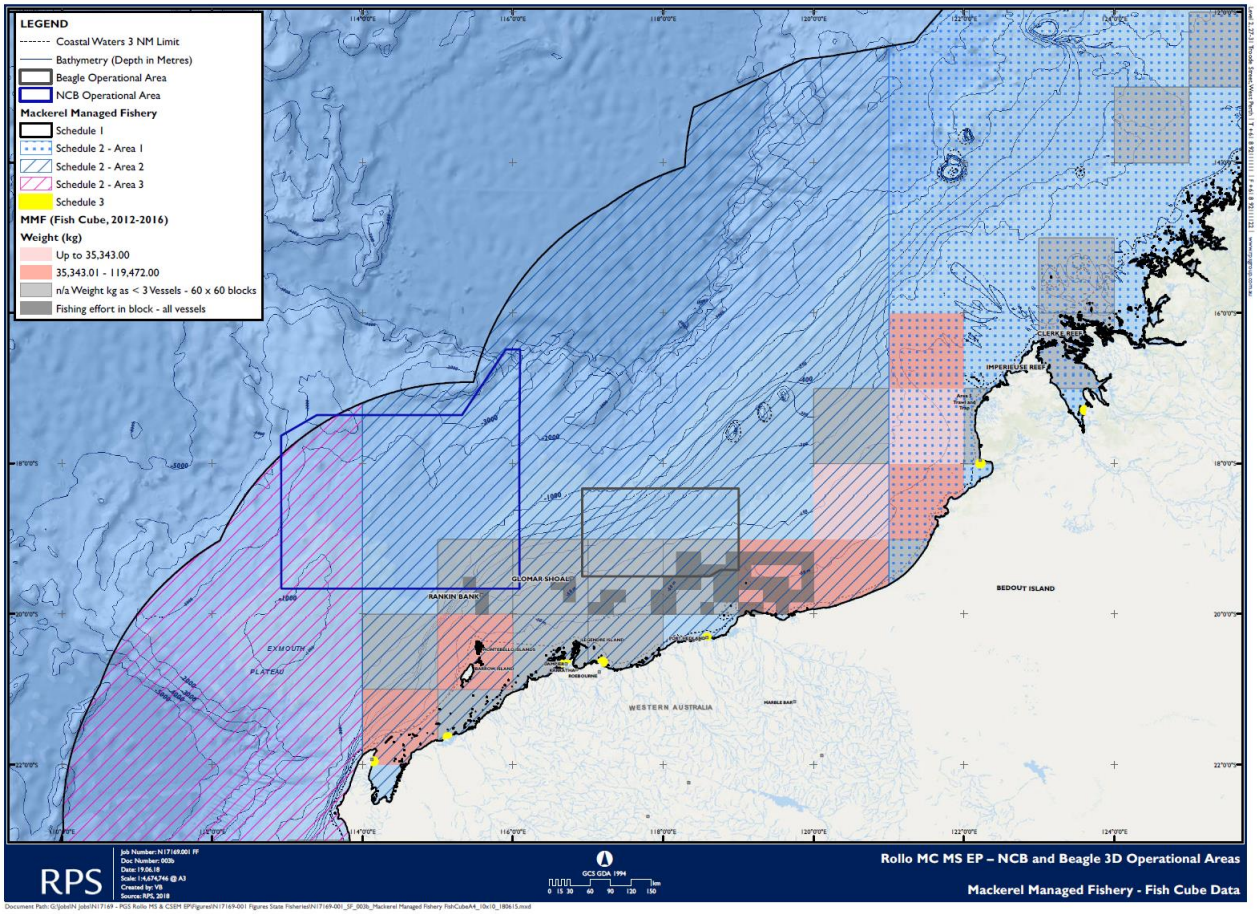


Figure 2-47 - NCB and Beagle OAs vs. Mackerel Managed Fishery

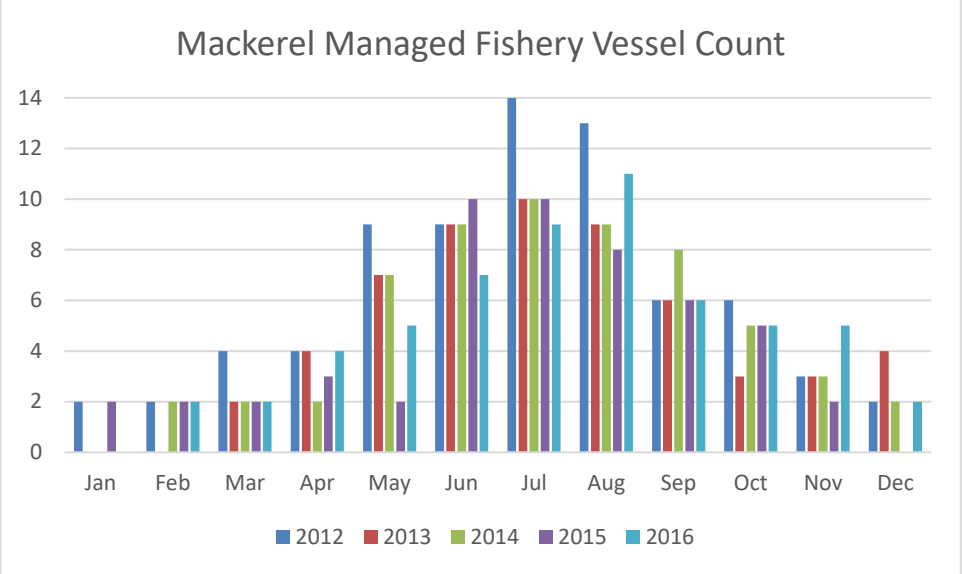


Figure 2-48 - Mackerel Managed Fishery Vessel Count by Month and Year (Fish Cube)

2.5.5.1.2 Pilbara Fish Trawl Interim Managed Fishery (PFTIMF)

The NCB OA and Beagle OA overlap Zone 2 Area 6 (Figure 2-49) which has had no fish trawl effort allocation since 1998 (Fletcher et al. 2017). This was confirmed by DPIRD-Fisheries (Stakeholder Record DPIRD 0010). The Beagle OA also overlaps Zone 2 Area 3 (Figure 2-49) which has been closed to trawling since 1998 (Fletcher et al. 2017). DPIRD-Fisheries (Stakeholder Record 0010) confirmed that the Zone 2 fishing area for the trawl fishery should include Areas 1, 2, 4 and 5.

The Beagle OA overlaps Zone 2 Areas 2, 4 and 5 (Figure 2-49). The Zone 2 area available for trawl fishing (Area 1,2,4,5) is 23,141 km^2 of which 23,108 km^2 has been actively fished from 2012 – 2016 (Fish Cube data Figure 2-49). The Beagle OA overlaps 8,192 km^2 or 35% of the area actively fished.

The fishery is seaward of the 50 m isobath and landward of the 200 m isobath (Fletcher and Santoro, 2015). There are 11 permits for the PTIMF, with the combined effort allocations being consolidated over time onto three full-time vessels.

Data from Fish Cube (2012 – 2016) show that there has been a maximum of three vessels fishing in the fishery with only two operational in 2015 and 2016 (Figure 2-50). From this data fishing is consistent throughout the year.

The PFTIMF is part of the Pilbara demersal fishery. Major species taken by the Pilbara demersal fishery in 2015 were goldband snapper, bluespotted emperor, and crimson snapper (Fletcher et al. 2017). The total demersal scalefish catch in the PFTIMF was within the acceptable catch range in 2015. The Pilbara demersal fishery annual catches from the domestic trawl, trap and line fisheries peaked at 3,600 t in 1996 but have not exceeded 2,000 t since 2008. In 2015, 66% (1,172 t) of the total commercial catches of demersal scalefish in the Pilbara (1,779 t) were landed by the trawl sector, with 29% (510 t) taken by the trap sector and 5% (97 t) taken by the line sector (Fletcher et al. 2017).

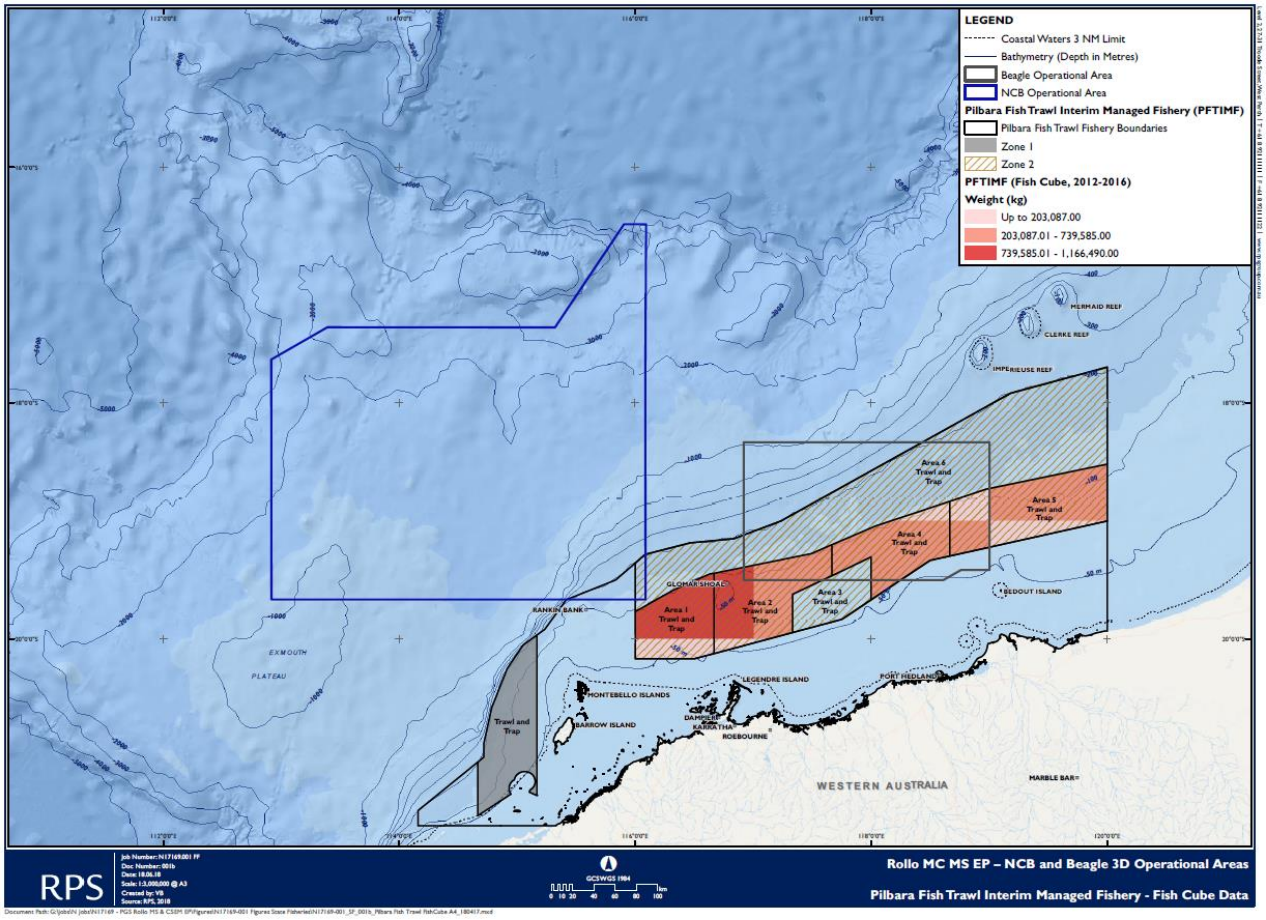


Figure 2-49 - NCB and Beagle OAs vs. Pilbara Fish Trawl Interim Managed Fishery

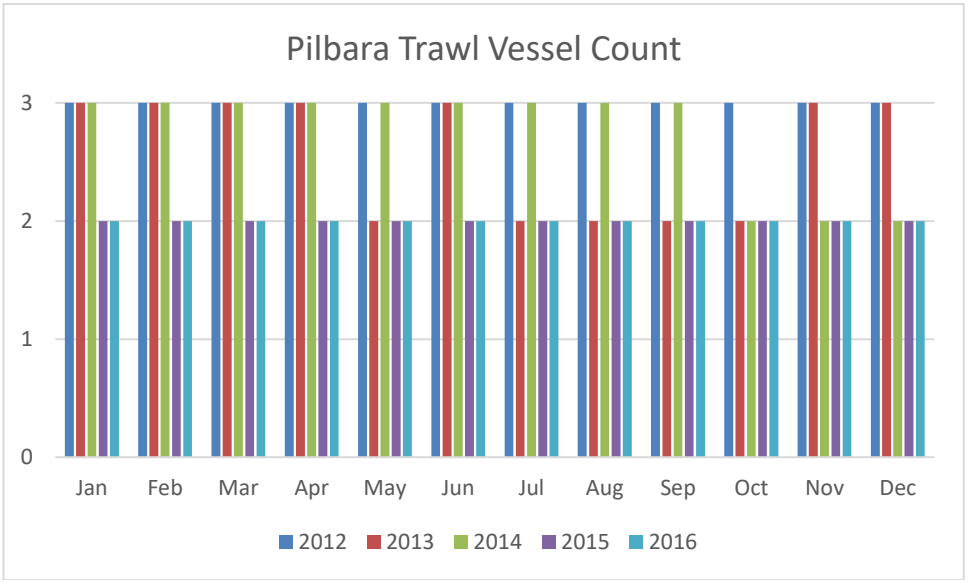


Figure 2-50 - Pilbara Fish Trawl Interim Managed Fishery Vessel Count by Month and Year (Fish Cube)

2.5.5.1.3 Pilbara Trap Managed Fishery (PTMF)

The NCB and Beagle OAs overlap Schedule 1 of the PTMF where fishing occurs (Figure 2-51). The Beagle OA also overlaps Schedule 3 of the fishery, but this area is closed. The area where there is catch effort from 2012 – 2016 within Schedule 1 is 84,112 km^2 and the area of overlap with NCB is 1,221 km^2 (1.5%) and with Beagle 18,300 km^2 (22%).

The PTMF lies north of latitude 21°44'S and between longitudes 114°9.6'E and 120°00'E on the landward side of a boundary approximating the 200 m isobath and seaward of a line generally following the 30 m isobath (Fletcher and Santoro, 2015). There are 8 permits for the PTMF, with the combined effort allocations being consolidated over time onto three full-time vessels which have no seasonal restrictions. Data from Fish Cube (2012 – 2016) show that there are typically two vessels that operate in the PTMF and that there is no seasonality to the fishery (Figure 2-52).

The PTMF is part of the Pilbara demersal fishery. Major species taken by the Pilbara demersal fishery in 2015 were goldband snapper, bluespotted emperor, and crimson snapper (Fletcher et al. 2017). The Pilbara demersal fishery annual catches from the domestic trawl, trap and line fisheries peaked at 3,600 t in 1996 but have not exceeded 2,000 t since 2008. In 2015, 66% (1,172 t) of the total commercial catches of demersal scalefish in the Pilbara (1,779 t) were landed by the trawl sector, with 29% (510 t) taken by the trap sector and 5% (97 t) taken by the line sector (Fletcher et al. 2017).

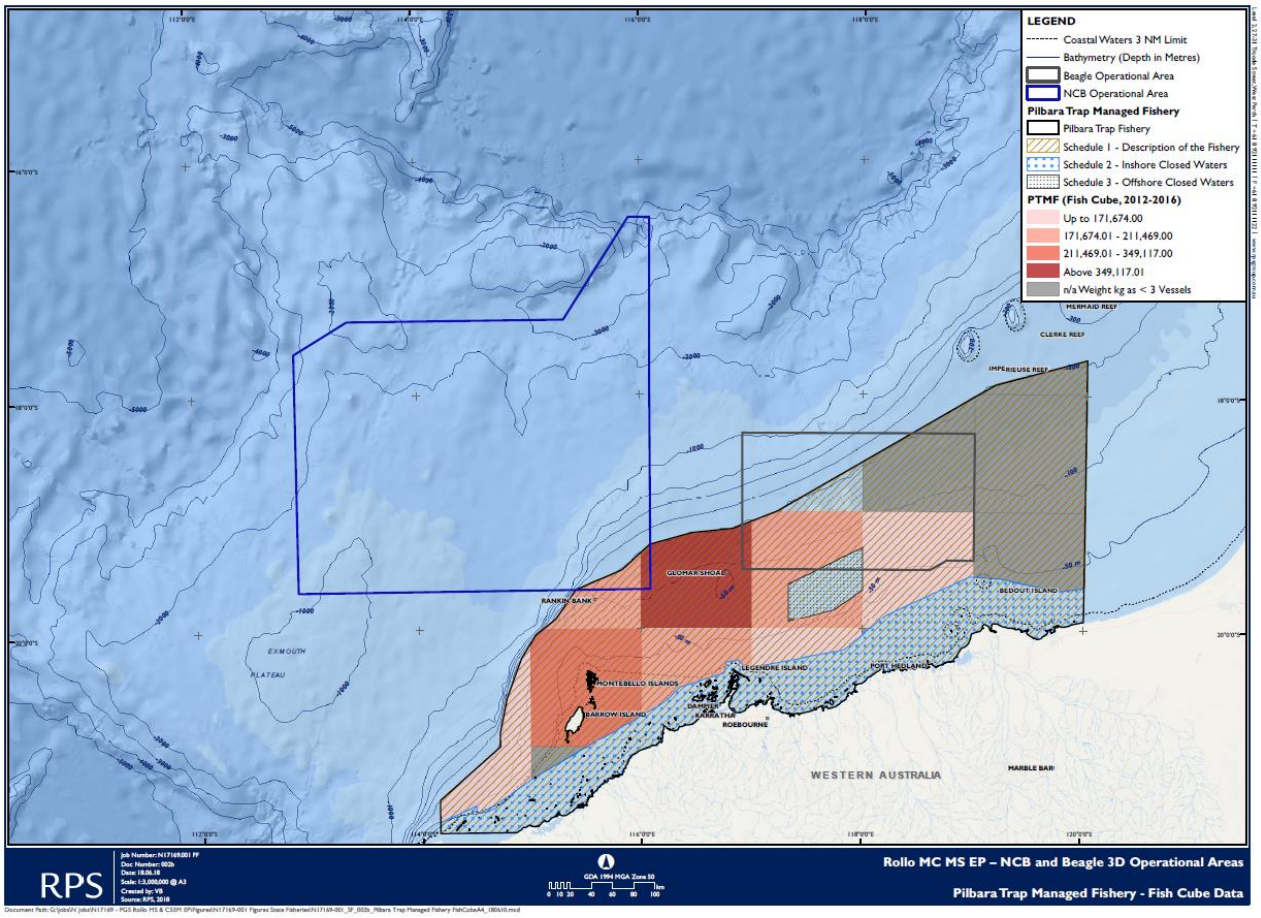


Figure 2-51 - NCB and Beagle OAs vs. Pilbara Trap Managed Fishery

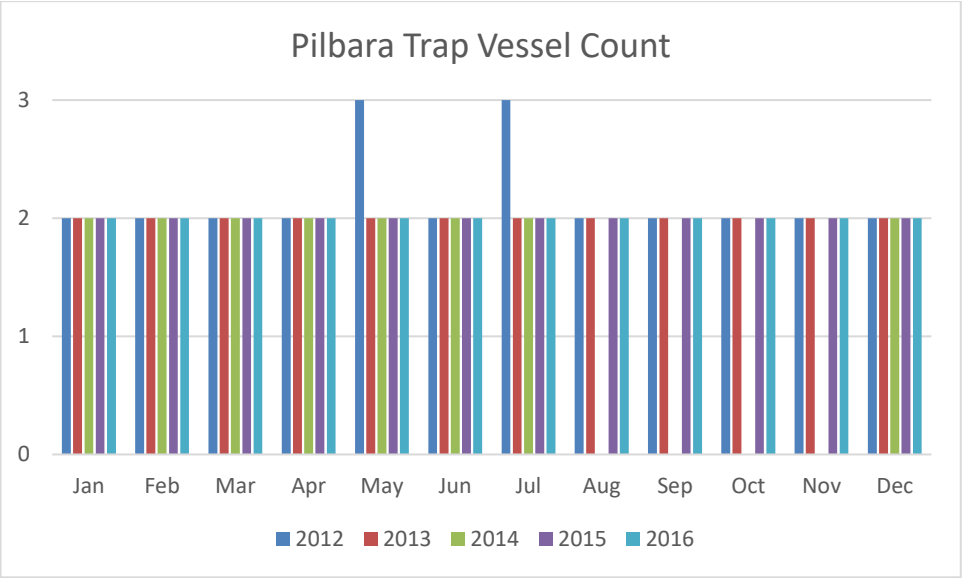


Figure 2-52 - Pilbara Trap Managed Fishery Vessel Count by Month and Year (Fish Cube)

2.5.5.1.4 Pilbara Line Fishery (PLF)

The NCB OA and Beagle OA overlaps the PLF where fishing effort has occurred from 2012 – 2016 (Figure 2-53). The area where there is catch effort from 2012 – 2016 within the PLF is 135,649 km^2 and the area of overlap with NCB is 15,467 km^2 (11%) and with Beagle 11,771 km^2 (9%) giving a total of 20%.

The PLF licences are permitted to operate anywhere within "Pilbara waters". This means all waters bounded by a line commencing at the intersection of 21°56'S latitude and the high-water mark on the western side of the NWC on the mainland of WA; thence west along the parallel to the intersection of 21°56'S latitude and the boundary of the Australian Fishing Zone (AFZ) and north to longitude 120°E. The PLF is managed under the Prohibition on Fishing by Line from Fishing Boats (Pilbara Waters) Order, 2006. Seven fishing vessels are exempted from this prohibition for any nominated 5-month block period within the year (Fletcher et al. 2017).

The PLF is part of the Pilbara demersal fishery. Major species taken by the Pilbara demersal fishery in 2015 were goldband snapper, bluespotted emperor, and crimson snapper (Fletcher et al. 2017). The Pilbara demersal fishery annual catches from the domestic trawl, trap and line fisheries peaked at 3,600 t in 1996 but have not exceeded 2,000 t since 2008. In 2015, 66% (1,172 t) of the total commercial catches of demersal scalefish in the Pilbara (1,779 t) were landed by the trawl sector, with 29% (510 t) taken by the trap sector and 5% (97 t) taken by the line sector (Fletcher et al. 2017).

Figure 2-54 shows that there is up to four vessels that operate in the PLF and they typically fish from March to December. Based on the vessel data from Fish Cube shown in (Figure 2-53) it can be concluded that up to 4 vessels may operate within the NCB OA and up to 2 in the Beagle OA.

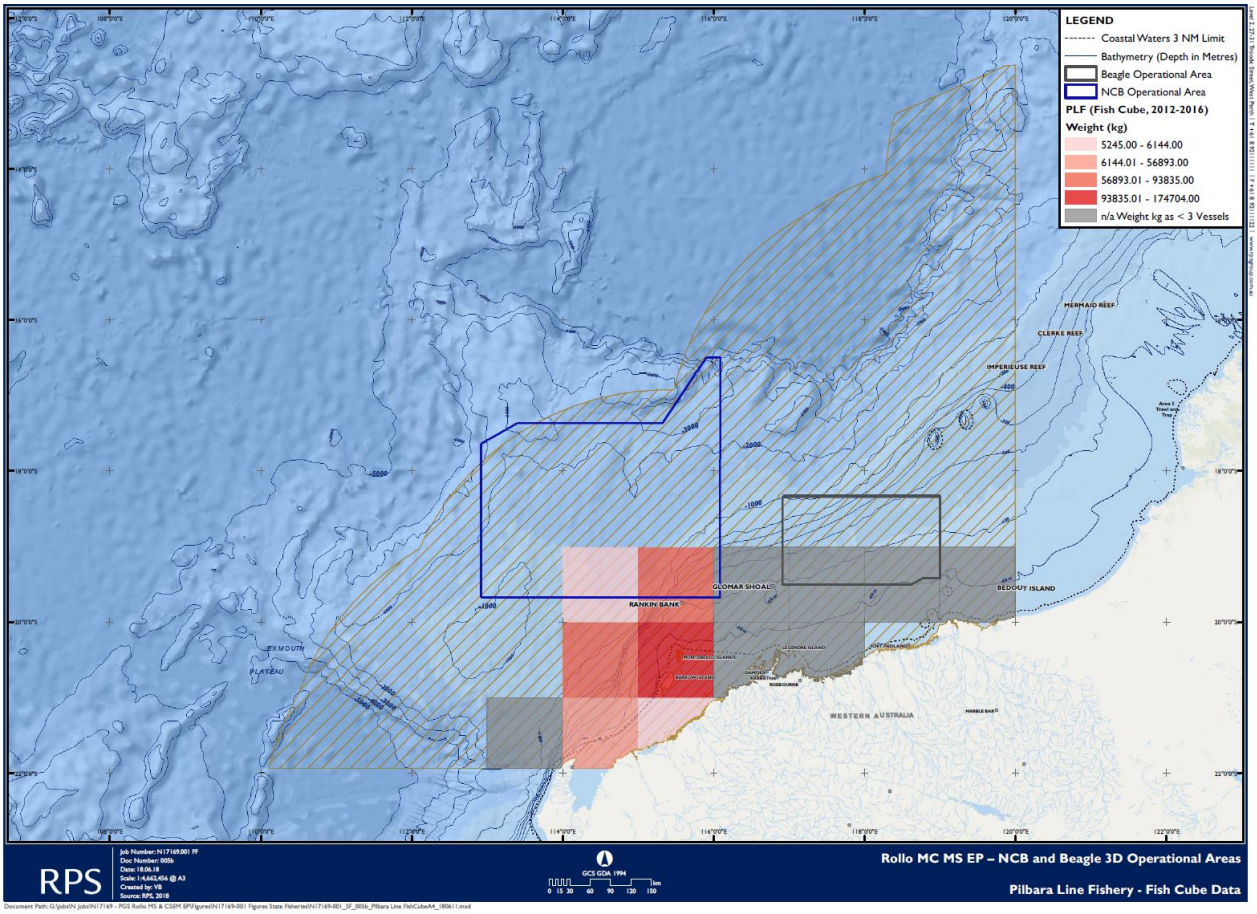


Figure 2-53 - NCB and Beagle OAs vs. Pilbara Line Fishery (PLF)

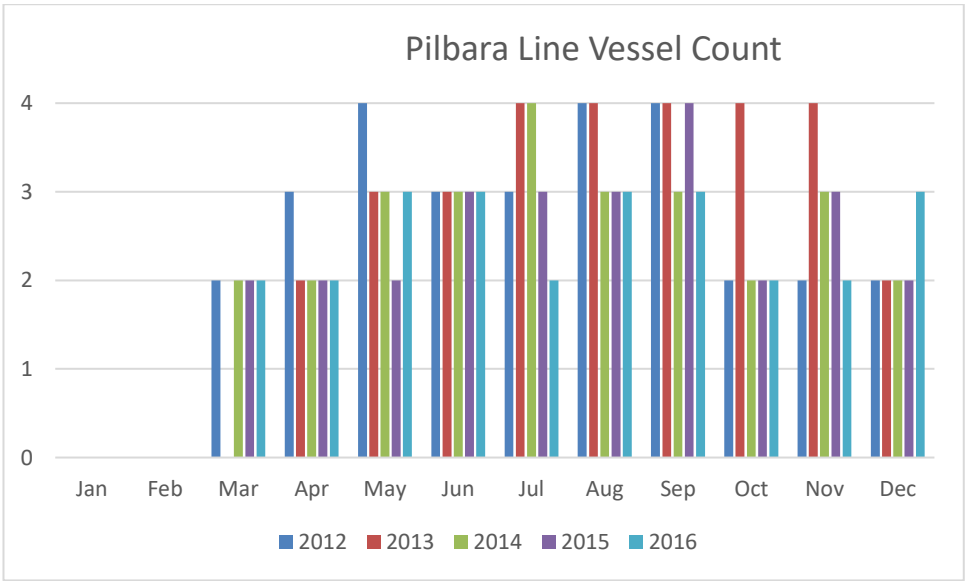


Figure 2-54 - Pilbara Line Fishery Vessel Count by Month and Year (Fish Cube)

2.5.5.1.5 Nickol Bay Prawn Managed Fishery (NBPMF)

The Beagle OA overlaps the NBPMF but does not overlap areas of fishing effort based on Fish Cube data from 2012 to 2016 (Figure 2-55).

The boundaries of the NBPMF are all the waters between of the Indian Ocean between 116°45'E and 120°E on the landward side of the 200 m isobaths (Fletcher and Santoro, 2016). The NBPMF incorporates the Nickol Bay, and extended Nickol Bay, Depuch and De Grey managed fishing grounds which are confined to the coastal waters of the Pilbara. Fishing effort is primarily restricted to shallow coastal waters.

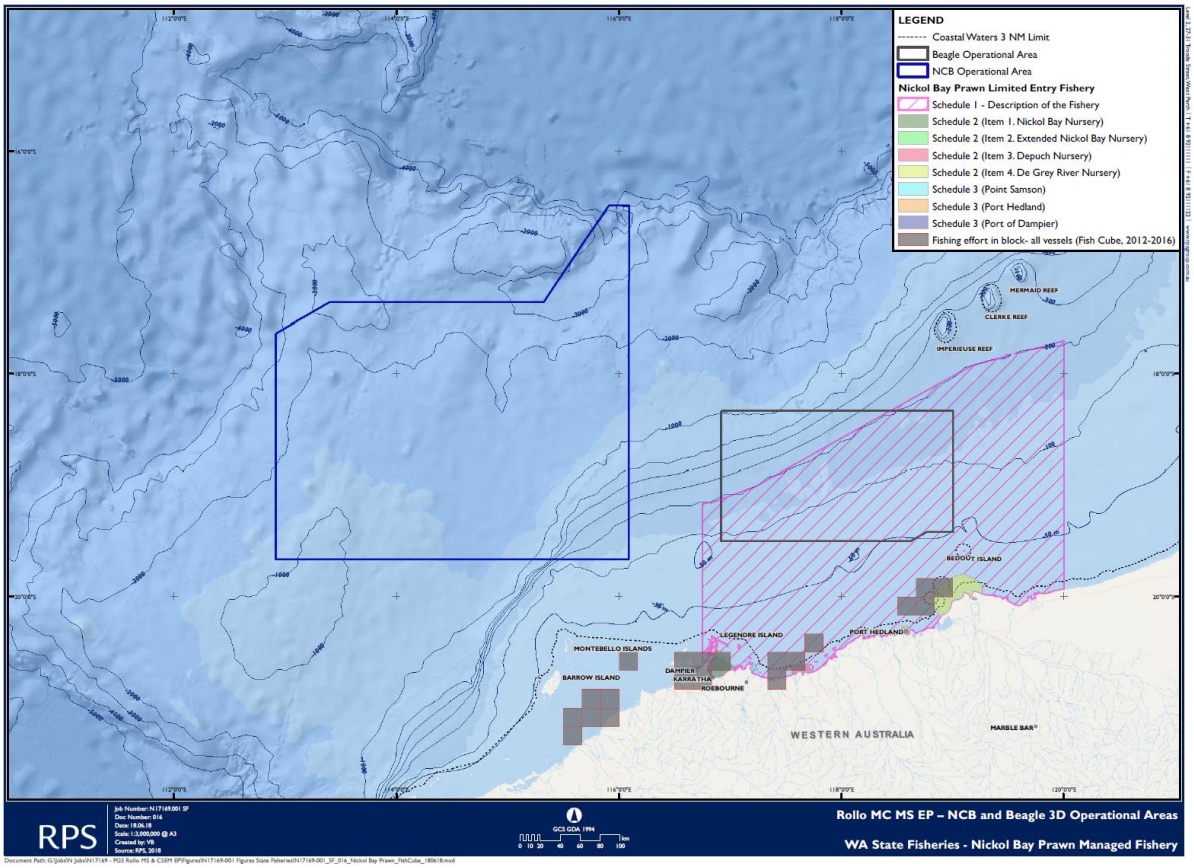


Figure 2-55 - NCB and Beagle OAs vs. Nickol Bay Prawn Managed Fishery (NBPMF)

2.5.5.1.6 Onslow Prawn Managed Fishery (OPMF)

The NCB OA overlaps the OPMF but does not overlap areas of fishing effort based on Fish Cube data from 2012 to 2016 (Figure 2-56). This is supported by information in the 2016 State of the Fisheries Report that details that the current fishing effort of the OPMF are within WA State waters between the Exmouth Prawn Fishery and the Nickol Bay Prawn Fishery east of 114º39.9' on the landward side of the 200 m isobath (Fletcher and Santoro, 2016).

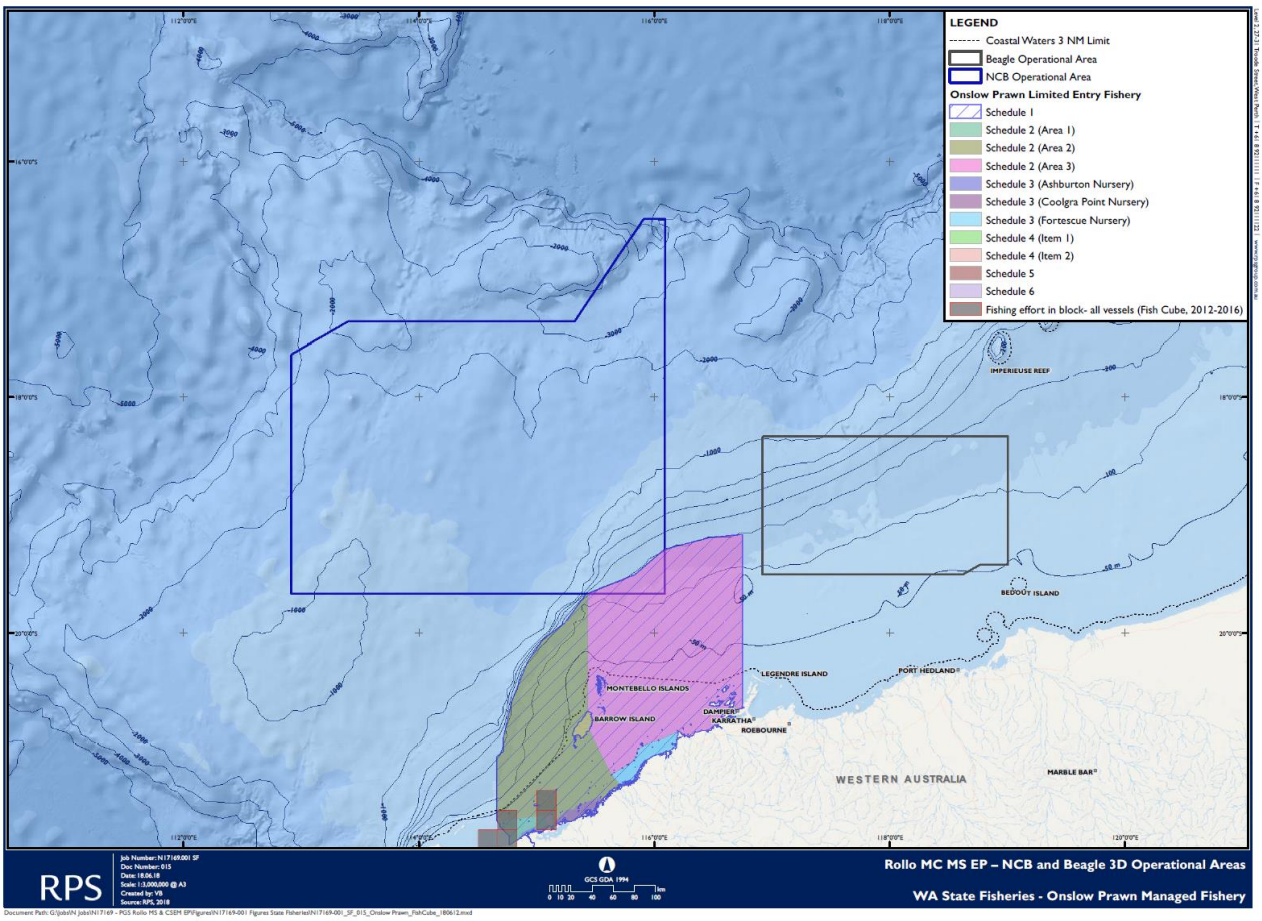


Figure 2-56 - NCB and Beagle OAs vs. Onslow Prawn Managed Fishery (OPMF)

2.5.5.1.7 Pearl Oyster Managed Fishery (POMF)

The NCB OA overlaps the WA Pearl Oyster Managed Fishery (POMF) Zone 1 and the Beagle Operating Area overlaps the POMF Zone 1 and Zone 2 (Figure 2-57). The nearest pearl farm is 79 km from the NCB Operating Area and 49 km from the Beagle Operating Area. The nearest fishing area is 35 km from the NCB OA

The POMF is the only remaining significant wild-stock fishery for pearl oysters in the world. It is a quota-based, dive fishery, operating in shallow coastal waters along the North West Shelf, targeting silver lipped pearl oyster (*Pinctada maxima)*. The fishery is managed under its own *Act* and uses output controls in the form of a total allowable catch (TAC) divided up into individually transferable quotas (ITQ). Fishing for pearl oyster is one component of the pearling industries activities with seeding and grow out of pearls oysters to produce pearls (Fletcher and Santoro, 2017).

P. maxima is widespread in the Indo-west Pacific and is not limited to Western Australia (Wells and Jernakoff, 2006). In WA, the species has been recorded as far south as Dirk Hartog Island in Shark Bay, but it is not commercially fished south of North West Cape (Fletcher *et al.* 1996). It is distributed from the shallow sub-tidal waters to depths in excess of 70 m with some early reports from the Philippines suggesting that they may live as deep as 120 m (Talavera 1930 cited in Daume *et al.* 2016). Analysis undertaken in Western Australia in 2015 suggests that *P. maxima* at Eighty Mile Beach (the primary fishery for *P. maxima* in Australia) are distributed to depth in excess of 100m (Daume *et al.* 2016).

Harvesting of *P. maxima* is focussed between Exmouth Gulf and Cape Leveque, with the main fishing areas off Eighty Mile Beach and a channel (10 to 20 m depth) between the mainland (north of Broome) and the Lacepede Islands (Figure 2-57) (Travaille et al. 2016). Fishing activity primarily occurs in water depths of 10 to 35 m (DoF 2016). Collection of wild *P. maxima* generally occurs for three to four months of the year, between March and July, during the neap phase of the tidal cycle when currents are reduced (Hart et al. 2016b). The number of vessels operating in the fishery has been slowly reducing from 16 in 1997 to six in 2014 (Hart et al. 2016a).

The breeding season of pearl oysters starts in the spring months of September or October, extending to the autumn months of April and May. Although there is variability from month to month, the primary spawning occurs from the middle of October to December (Daume *et al.* 2016). The planktonic larvae stage of the pearl oyster is 28 to 35 days, when they are ready to metamorphose they settle to the bottom and test for a suitable habitat. If an appropriate area is found, they settle on it and metamorphose into the juvenile stage. They begin growing a shell and become a sedentary bottom-dweller filter-feeder (Fletcher and Santoro, 2014). If a suitable settlement site is not located within a short period, the animals will metamorphose and die (Fletcher *et al.* 1996). As with most bivalve fisheries, the *P. maxima* fishery is characterised by relatively large variability in recruitment.

Spawning in the main fishing areas of the Eighty Mile Beach region is concentrated around broodstock distributed between 8 and 15 m depth, with potential smaller contributions from the north-east (towards fishing Zone 3), (Condie et al. 2006) These spawning events lead to recruitment locally and alongshore to the south-west and also feed larvae into neighbouring shallow coastal environments and deeper waters to the west (~20 m depth). Larval dispersion from known broodstock populations mostly travel less than 30 km, however, some have been modelled as potentially travelling up to 60 km (Condie et al. 2006). High local abundances of broodstock and spat observed occasionally in deeper water (~30 m depth) are supported by intermittent larval transport from inshore populations, however spawning in these deeper waters appears to contribute little to recruitment in inshore populations (Condie et al. 2006).

Generally, pearl divers are not allowed to collect pearl oysters unless they are a minimum size of 120 mm in shell length. However, for the 2012 to 2014 fishing seasons, pearl divers were permitted to take a sustainable amount of pearl oysters of a size no less than 100 mm, on a trial basis, for research purposes - this has been approved to continue until the end of 2016 (Fletcher and Santoro, 2014). Recruitment into the pearl oyster breeding stock exceeds natural mortality, and hence breeding stocks are likely to be increasing in most years (Fletcher and Santoro, 2014).

Total catch since 1979 has oscillated between 330,000 and 830,000 oysters, with an overall average of 530,000 (± 120,000 SD) (Daume *et al*. 2016). This fishery is primarily based on pearl oyster stocks in the Zone 2 region. In recent years, the proportion of harvest coming from Zone 2 has been 100 % due to the cessation of fishing in the Zone 1 and Zone 3 regions of the fishery. The cessation of fishing in Zone 1 and Zone 3 was due to economic reasons (Daume *et al*. 2016). Fishing continued in Zone 1 for the second year, after a hiatus from 2008 to 2013, however was only a minor proportion (3%) of the catch (Fletcher and Santoro, 2017). In the 2015 season, the TAC for culture shells was 519,743 shells and 40,626 MOP shells (Fletcher and Santoro, 2017).

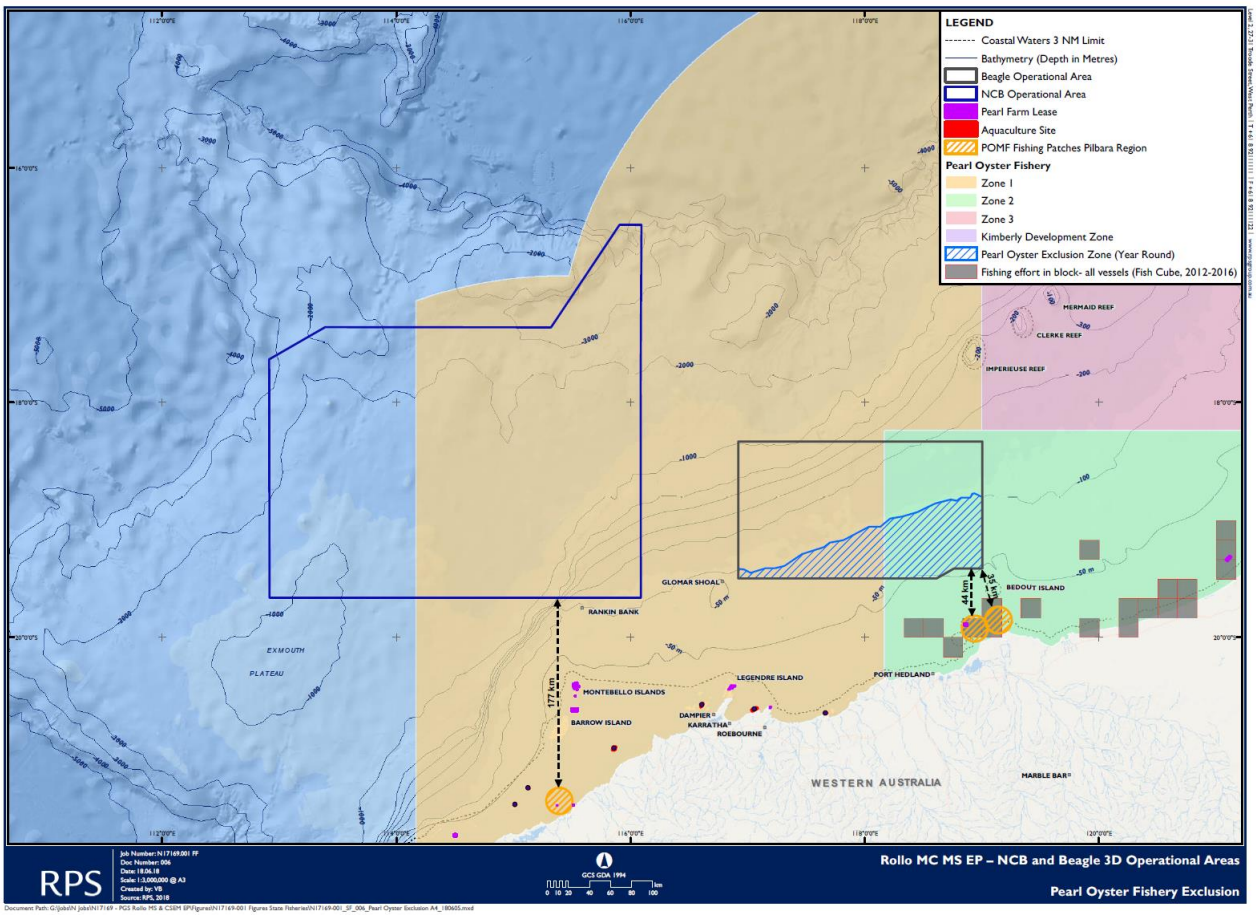


Figure 2-57 - NCB and Beagle OAs Pearl Oyster Managed Fishery (POMF)

2.5.5.1.8 North Coast Shark Fishery

The OAs overlap the WA North Coast Shark Fishery (WANCSF) (Figure 2-58) however, there has been no fishing in this fishery since the 2009/2010 season (DPIRD 2018a).

The OAs do not overlap the Northern Shark Fishery (NSF) which also is not operating.

2.5.5.1.9 West Coast Deep Sea Crab (Interim) Managed Fishery (WCDSCMF)

The NCB and Beagle OAs do not overlap the WCDSCMF fishing area based on information from Fish Cube (Figure 2-59).

While the boundaries of the WCDSCMF are from the 150 m isobath to the edge of the Australian EEZ, most fishing is concentrated in deeper waters on the continental slope between 500 – 800 m depths (How et al. 2015).

The West Coast Deep Sea Crab (Interim) Managed Fishery (WCDSCMF) targets crystal (snow) crabs (*Chaceon albus*), giant (king) crabs (*Pseudocarcinus gigas*) and champagne (spiny) crabs (*Hypothalassia acerba*) using baited pots operated in a long-line formation in the shelf edge waters (>150 m) of the West Coast and Gascoyne bioregions (Fletcher et al. 2017). Based on the following information the OAs do not overlap with these species habitat:

- The champagne crab is found southwards of Kalbarri. (Smith 2006).
- The crystal crab is found along the west coast of Australia ranging from just north of Carnarvon down around the south western cape to Bremer Bay on the south coast of WA. (Chaceon website).
- The king crab is found along the southern coast of Australia from Albany to the Tasmanian east coast. (Chaceon website).

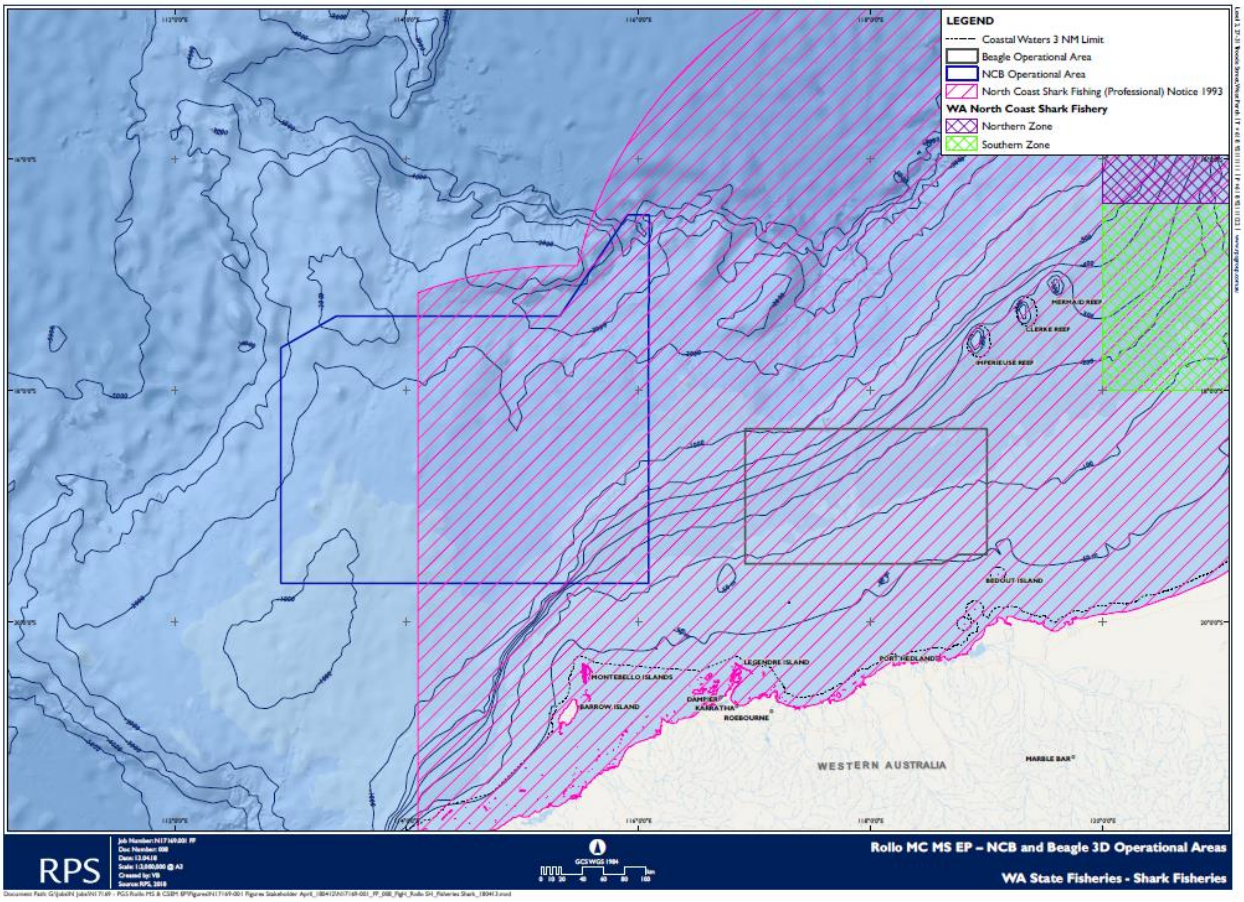


Figure 2-58 - NCB and Beagle OAs vs. Shark Fisheries

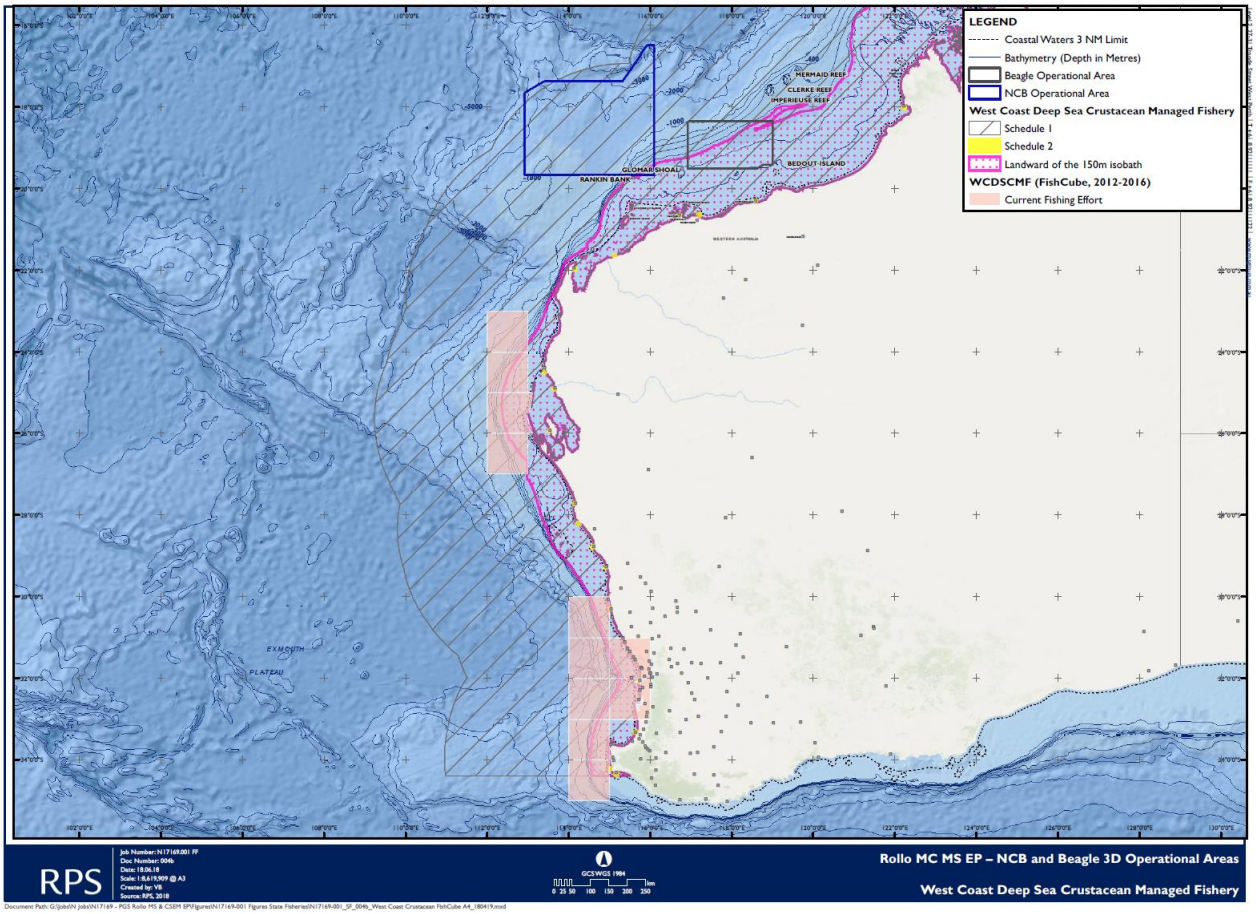


Figure 2-59 - NCB and Beagle OAs vs. West Coast Deep Sea Crab (Interim) Managed Fishery (WCDSCMF)

2.5.5.2 Commonwealth Administered Fisheries

Commonwealth fisheries managed by the Australian Fisheries Management Authority (AFMA) that the NCB and Beagle AMBAs overlap are:

- North West Slope Trawl Fishery (NWSTF)
- Southern Bluefin Tuna Fishery (SBTF)
- Western Deepwater Trawl Fishery (WDTF)
- Western Skipjack Tuna Fishery (WSTF)
- Western Tuna and Billfish Fishery (WTBF)

Based on the latest information from the 2016 ABARES Report (Patterson et al. 2017) it was identified that only the NWSTF has had any catch effort within the NCB and Beagle AMBAs from 2011 – 2016.

2.5.5.2.1 North West Slope Trawl Fishery (NWSTF)

The NCB and Beagle OAs overlap the NWSTF (Figure 2-60). Based on catch effort data from ABARES reports from 2011 to 2016 the area of catch effort within the NWSTF is 174,994 km^2 of which the NCB OA overlaps 39,476 km^2 (23%) and the Beagle OA overlaps 8,045 km^2 (5%).

The NWSTF operates off north-western Australia from the coast of the Prince Regent Park to Exmouth between the 200 m depth contour and the outer boundary of the AFZ (Figure 2-60). The key species targeted in the NWSTF in recent years is the Australian scampi (*Metanephrops australiensis*). However, smaller quantities of velvet scampi (*M. velutinus*) and Boschma's scampi (*M. boschmai*) are also harvested, and mixed snappers (Lutjanidae) have been an important component of the catch in some years. Scampi are found in deep waters off Australia's west coast, mainly off Port Hedland. Scampi are a benthic species that inhabits the continental shelf. They can usually be found on Globigerina ooze at depths of 420-500 m (AFMA 2018a).

Demersal trawl gear is used in the NWSTF and most of the effort and catch occurs over soft, muddy sediments or sandy habitats typically at depths of 350-600 m on the continental slope. Vessel numbers have decreased to stabilise at one or two vessels each year since 2008 – 2009 (Patterson *et al.* 2017).

There is no total allowable catch for this fishery. Total catch, fishing effort and number of vessels are shown in Table 2-21 which has been taken from Patterson et al. (2017, 2015) and Woodhams et al (2013). Information on seasonality is not available but Patterson et al. (2017) states that catch effort often increases when boats cease to operate in the Northern Prawn Fishery. The Northern Prawn Fishery is typically closed from 15 June to 1 August and 31 November to 1st April.

Table 2-21 - Fishing Data for the North West Slope Trawl Fishery 2011- 2016

Fishing Season	Scampi Catch (t)	Total Catch (t)	Fishing effort (days)	Vessels
2015 – 2016	33	49.1	115	2
2014- -2015	33.4	54.8	117	1
2013 – 2014	33.3	45.7	119	1
2012 – 2013	30	37.5	106	1
2011 - 2012	20.1	68.2	101	2

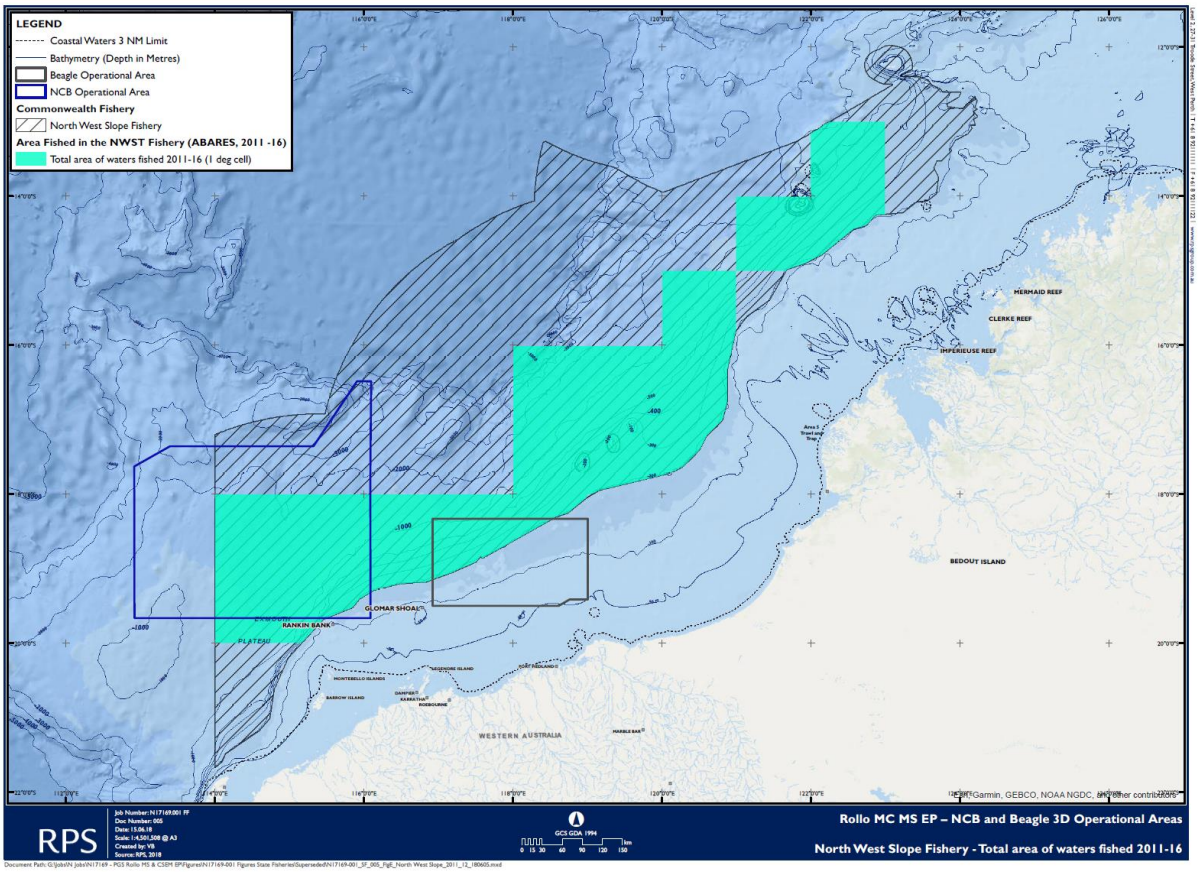


Figure 2-60 – NCB and Beagle OAs vs. North West Slope Trawl Fishery (NWSTF)

2.5.5.2.2 Southern Bluefin Tuna Fishery (SBTF)

The NCB and Beagle OAs overlap the SBTF fishery (Figure 2-61), however, there is no fishing effort in this area. This was confirmed by the Australian Southern Bluefin Tuna Industry Association (ASBTIA) who advised that the previous broader Rollo OA is not an area of key concern key for the purse-seine fishery operations for the ranching of Southern Bluefin Tuna.

Although the SBTF licence area overlaps the proposed OA the activities in the SBTF are primarily confined to the waters off South Australia (such as the GAB) with smaller areas along the south east coastline, such as northeast of Eden in New South Wales (Figure 2-62) Patterson *et al* (2017).

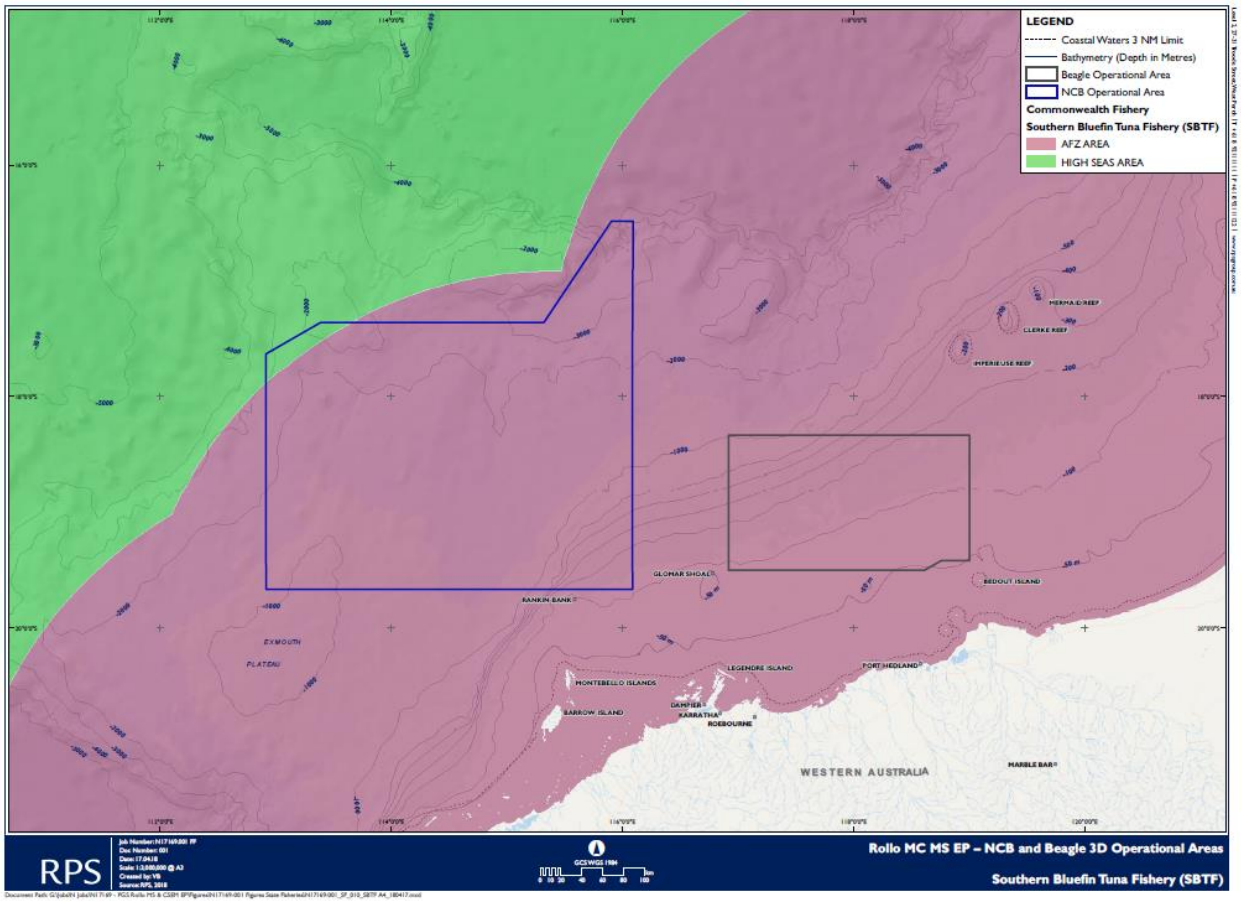
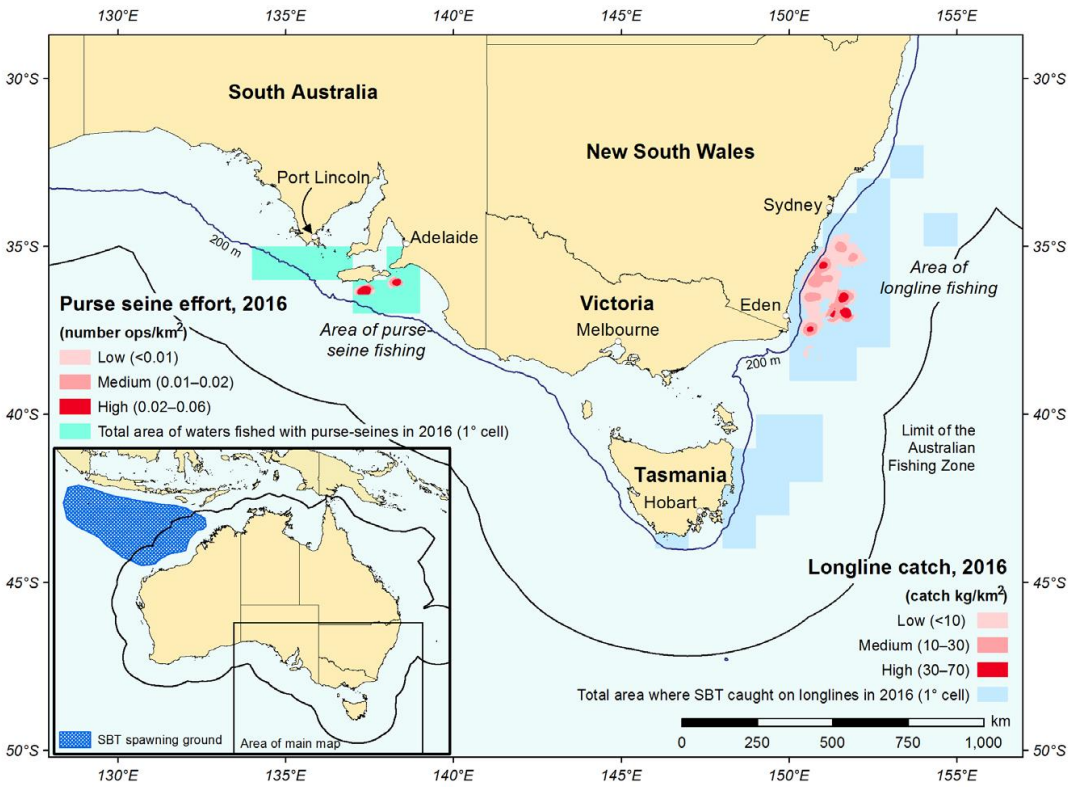


Figure 2-61 - NCB and Beagle OAs vs. Southern Bluefin Tuna Fishery (SBTF)



Source: modified from Patterson *et al* (2017).

Figure 2-62 - Area fished in the Southern Bluefin Tuna Fishery 2015-16

2.5.5.2.3 *Western Deepwater Trawl Fishery (WDTF)*

The NCB OA overlaps the WDTF Fishery within the Gascoyne Region. Based on the most recent publicly available data (Patterson et al. 2017) there has been no catch effort within the area of overlap since the 2008 -2009 fishing season (Wilson et al. 2010) (Figure 2-63). Negligible effort has occurred in the Gascoyne region since 2000 (AFMA 2017). Fishing effort in the fishery has historically been low with 3 vessels fishing for 13 days in the 2013 – 2014 season and no effort in the 2014 – 2015, 2015 – 2016 and 2016 – 2017 seasons (Figure 2-64).

The WDTF is open to fishing the entire year however, operators have generally chosen to access the fishery on a part time or opportunistic basis (AFMA 2017).

Feedback from WAFIC (WAFIC 01) was that the fishery had undertaken a trial for 6 weeks during 2018. Feedback from AFMA (AFMA 06) was that the fishery was open, there are licence holders within the fishery and there was currently no to low activity due to market forces. However, no data was available as to the trial catch values, location or dates. Considering that there has been no catch effort in the area of overlap with the NCB OA since the 2008 – 2009 fishing season (Wilson et al 2010) it is likely that any trial would be outside this area of overlap.

The fishery uses demersal (bottom) trawl and catches more than 50 species in habitats ranging from temperate-sub-tropical in the southern region to tropical in the north region. Catches in the WDTF are historically dominated by six main commercial finfish species including orange roughy (*Hoplostethus atlanticus*), oreos (Oreosomatidae), boarfish (Pentacerotidae), eteline snapper (Lutjanidae: Etelinae), apsiline snapper (Ludjanidae: Apsilinae) and sea bream (Lethrinidae). Between 2000 and 2005, deepwater bugs emerged as the most important target species. Total catch has been particularly low since 2010-11, consisting mostly of deepwater bugs, with minimal catch of finfish.

Orange roughy is a deepwater fish widely distributed in southern Australian waters from New South Wales, south around Tasmania and west to southern Western Australia (AFMA 2018c) thus is unlikely to be within the OA. Oreos are caught off the southern coast of Australia in cool to cold deeper continental slope waters (2018d) thus are unlikely to the within the OA.

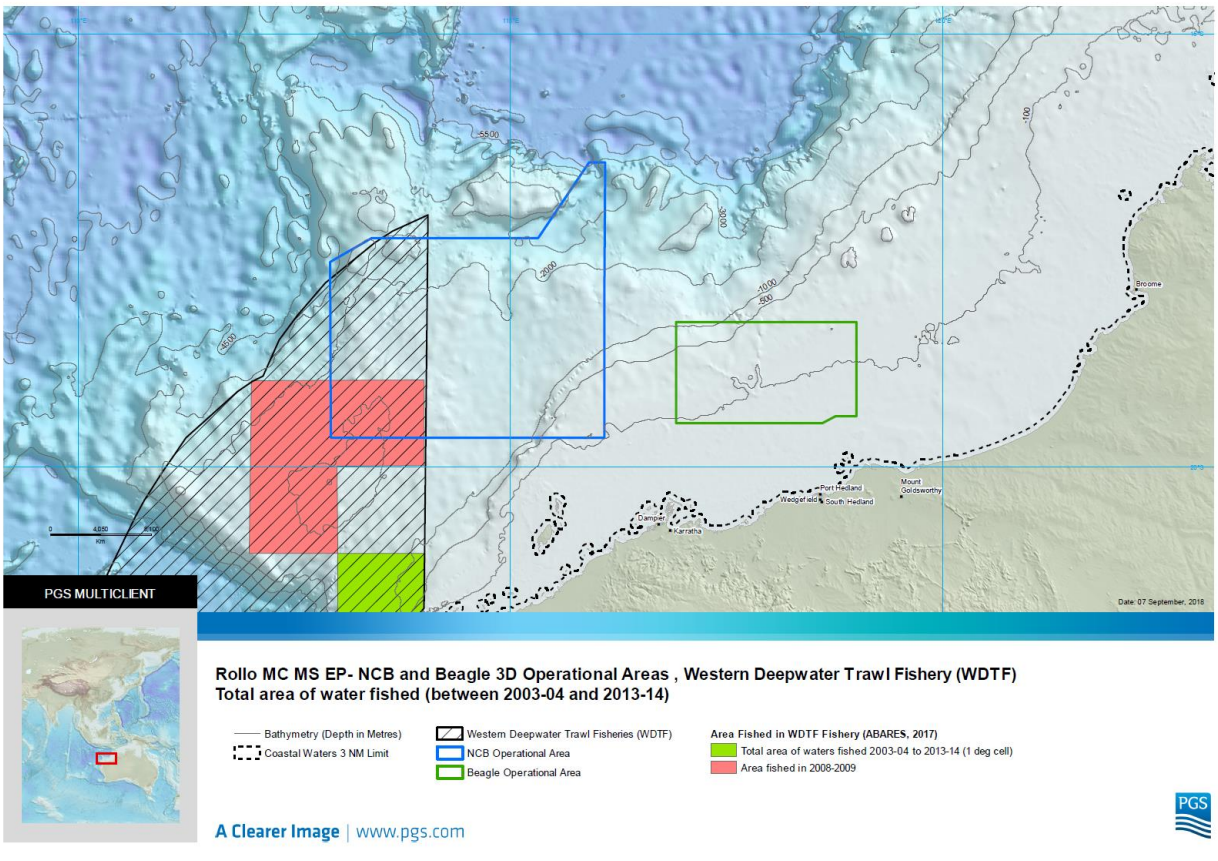


Figure 2-63 - NCB and Beagle OAs vs. Western Deepwater Trawl Fishery (WDTF)

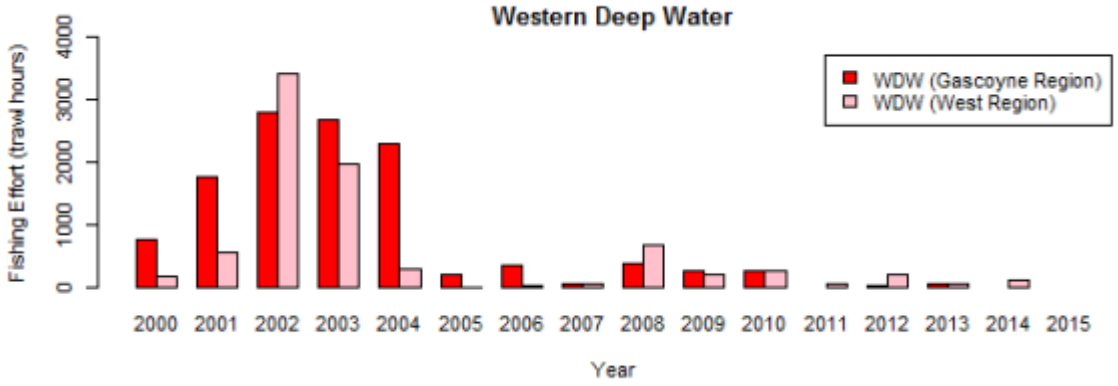


Figure 2-64 – Total Fishing Effort in the WDTF for 2000 – 2015 (Wilson et al. 2010)

2.5.5.2.4 Western Skipjack Tuna Fishery (WSTF)

The NCB and Beagle OAs overlap the WSTF (Figure 2-65), however, there has been no effort in the fishery since 2008 – 2009 (Patterson *et al.* 2015, Paterson *et al* 2017). When there was fishing in this fishery it was off South Australia (Figure 2-66).

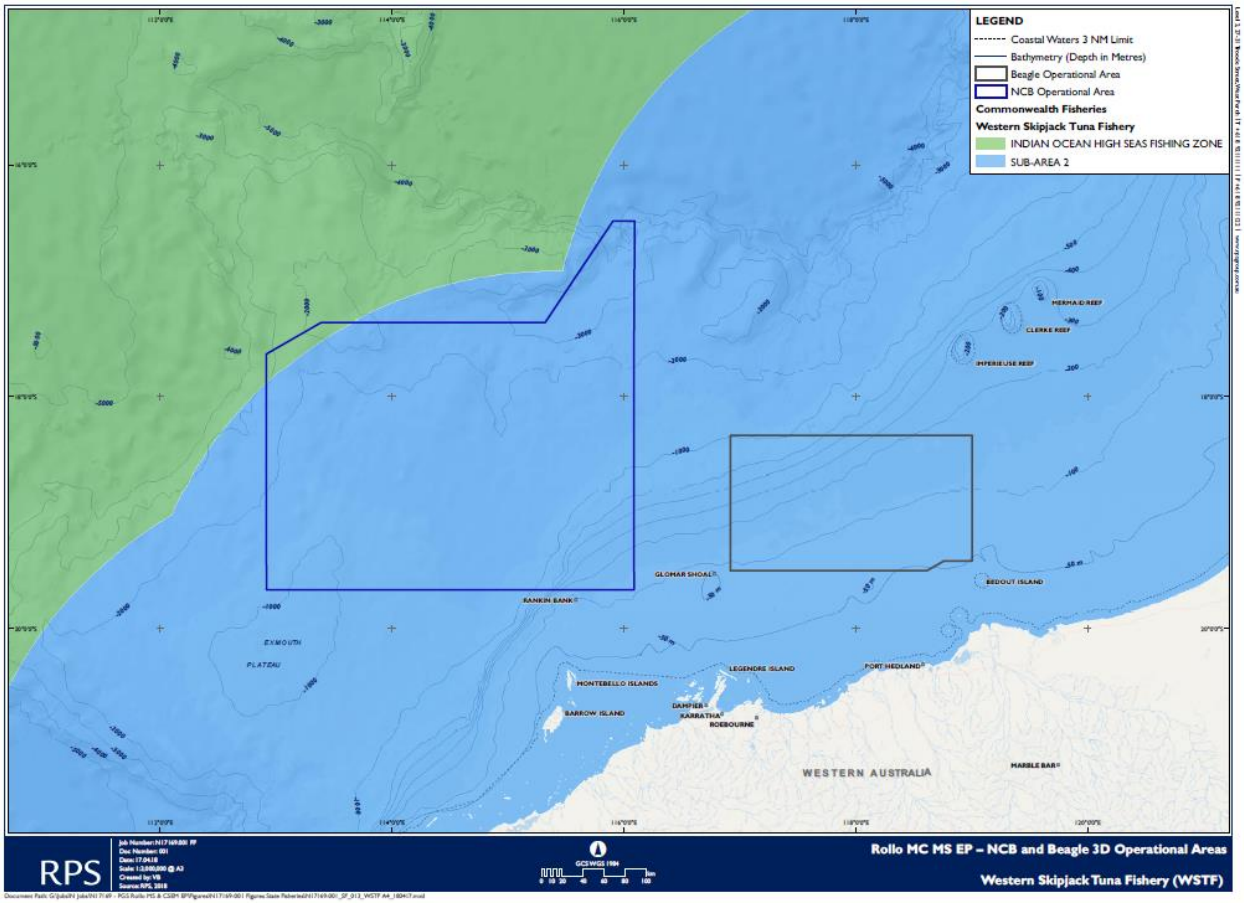
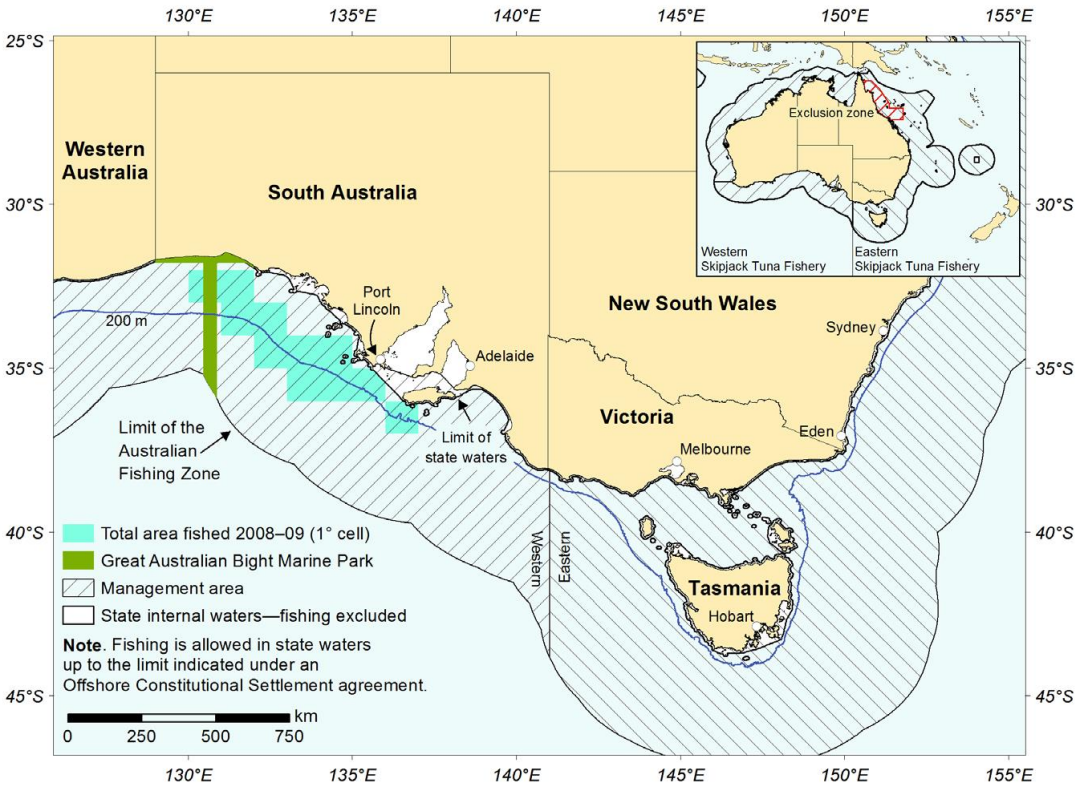


Figure 2-65 - NCB and Beagle OAs vs. Western Skipjack Tuna Fishery (WSTF)



Source: modified from Patterson *et al* (2017).

Figure 2-66 - Area fished in the Western Skipjack Tuna Fishery 2015-16

2.5.5.2.5 Western Tuna and Billfish Fishery (WTBF)

The NCB and Beagle OAs overlap the WTBF sub-area 1 (Figure 2-67), however, there is no fishing effort within these areas. Most of the fishing effort in this fishery is south of Geraldton to south of Albany (Patterson *et al.* 2015, Paterson *et al*. 2017) (Figure 2-68).

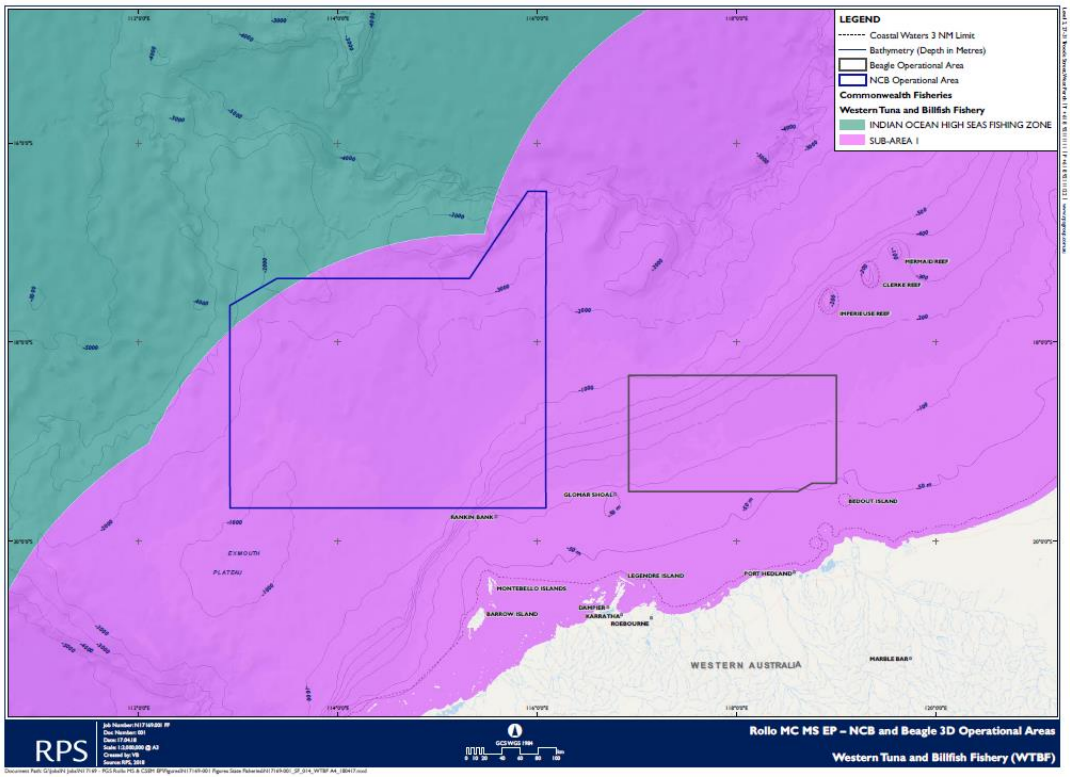
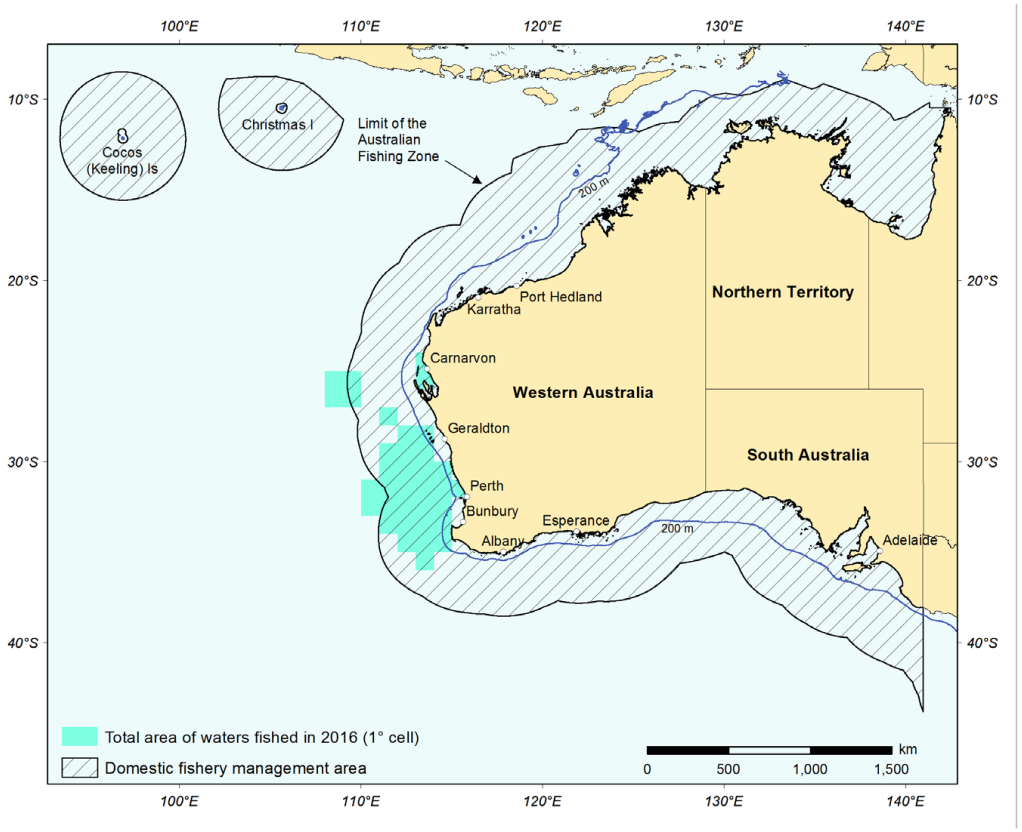


Figure 2-67 - NCB and Beagle OAs vs. Western Tuna and Billfish Fishery (WTBF)



Source: modified from Patterson *et al* (2017).

Figure 2-68 - Area fished in the Western Tuna and Billfish Fishery 2015-16

2.5.6 Exploration and Petroleum

The NWMR has been the target of significant petroleum exploration activity stretching back over the past 40 years. There have been many 2D and 3D seismic surveys conducted in the region, plus the drilling of both exploration and appraisal wells. Several production facilities are located within the NWMR including Floating Production Storage Offshore (FPSO) facilities, manned and unmanned monopods, and larger production platforms. Most of the wells and facilities are to the south of the OAs (Figure 2-69).

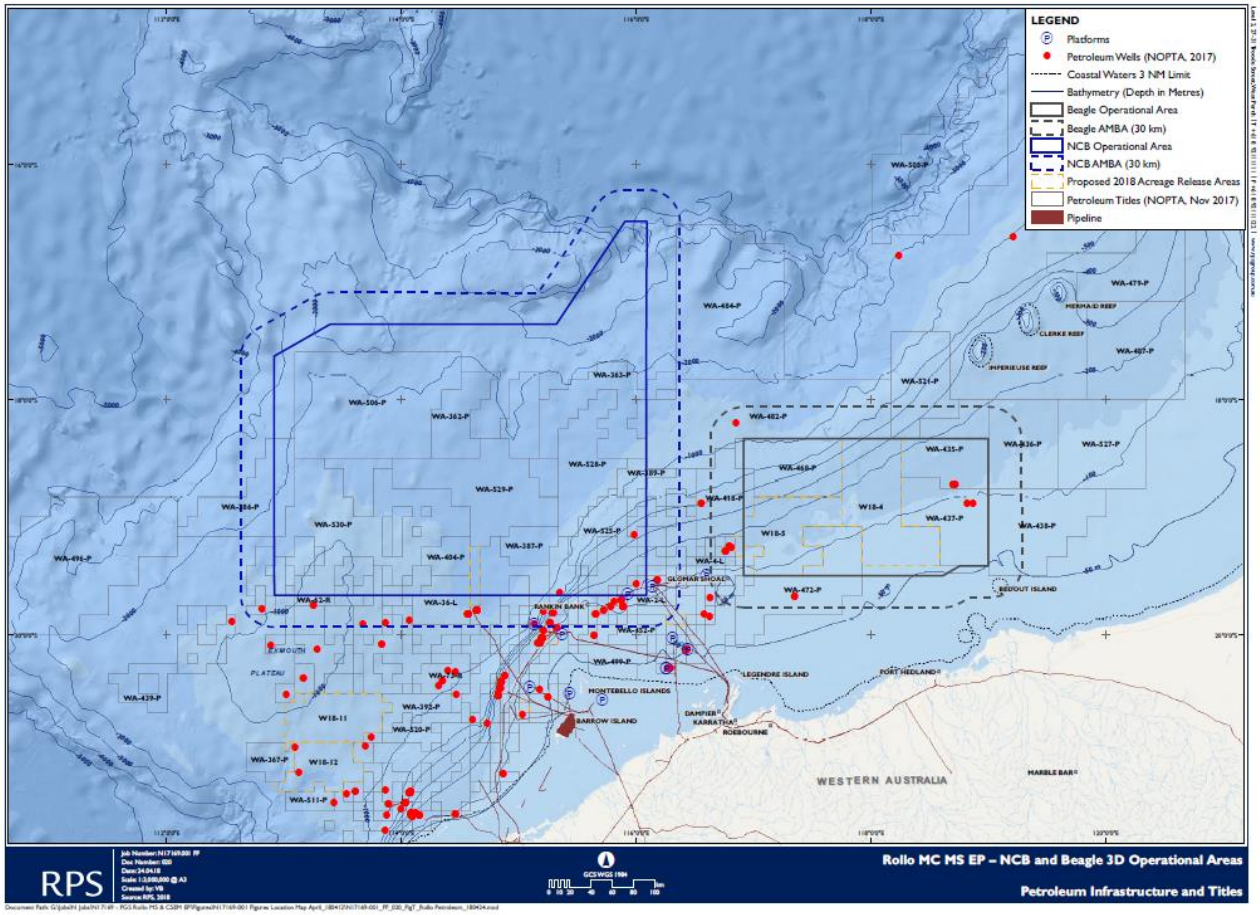


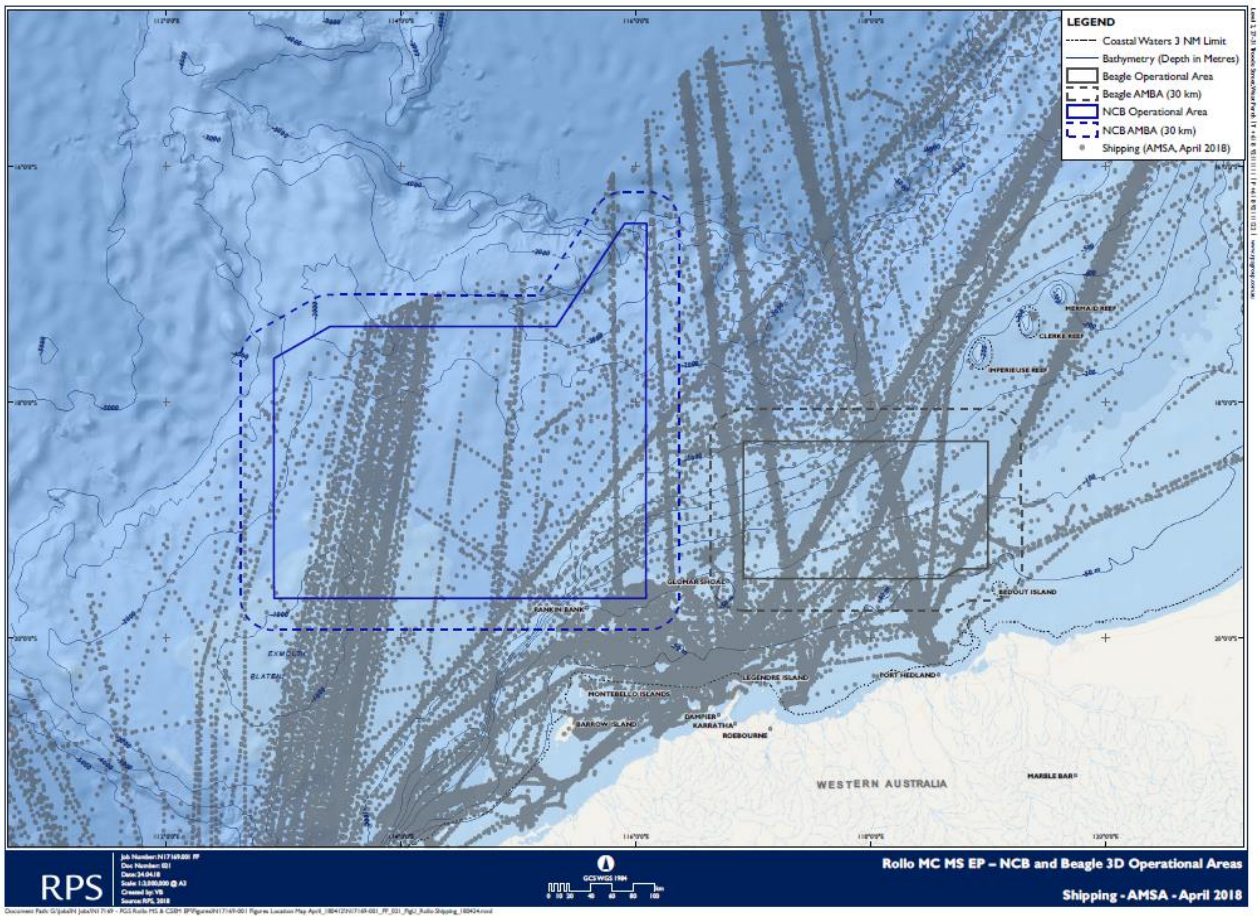
Figure 2-69 - Production facilities and pipelines within or adjacent to the NCB and Beagle AMBA

2.5.7 Commercial Shipping

Within the NWMR, there is significant commercial shipping activity, the majority of which is associated with the mining and oil and gas industry. The Australian Maritime Safety Authority (AMSA) has introduced a network of commercial shipping fairways on the NWS to reduce the risk of vessel collisions with offshore infrastructure. There are several commercial shipping lanes that exist in the proposed OAs, or in adjacent waters (Figure 2-70. AMSA was identified as a stakeholder and contacted regarding proposed surveys in the proposed OA (Chapter 1).

AMSA provided the following information (Stakeholder record AMSA 02):

In the Beagle sub-basin survey area, the majority of large commercial shipping navigates within the north-west shipping fairways. Outside of the fairways, Offshore Support Vessels are the most likely vessels to be encountered. In the North Carnarvon basin there are two major shipping routes. The first lies in the western section of the survey area and will include heavy concentrations of cargo ships and tankers transiting along Australia's west coast. There is also a secondary route heading in a north-east direction, with the majority of commercial traffic navigating within the shipping fairway.



Source: modified from AMSA (2018).

Figure 2-70 - Shipping lanes of the NWMR within, or adjacent to the NCB and Beagle AMBA

2.5.8 Defence Activities

The Australian Department of Defence (Defence)operates recognised training areas and special purpose military areas for training and exercises to ensure Australia's defence capabilities. Offshore areas may coincide with Defence Practice Areas (DPA) or Military Exercise Areas (MEA).

Defence confirmed (Stakeholder Record DoD 002) that the orange area depicted in the Figure 2-71 is consistent with the North West Exercise Area (NWXA) and the purple area is consistent with the Learmonth Air Weapons Range (LAWR). The NCB OA overlaps the North West Exercise Area.

Defence may conduct active training and practice activities within the NWXA and LAWR from time to time, however we are not able to provide further details at this time.

Defence also advised that unexploded ordnance (UXO) may be present on and in the sea floor within the area of the proposed activities.

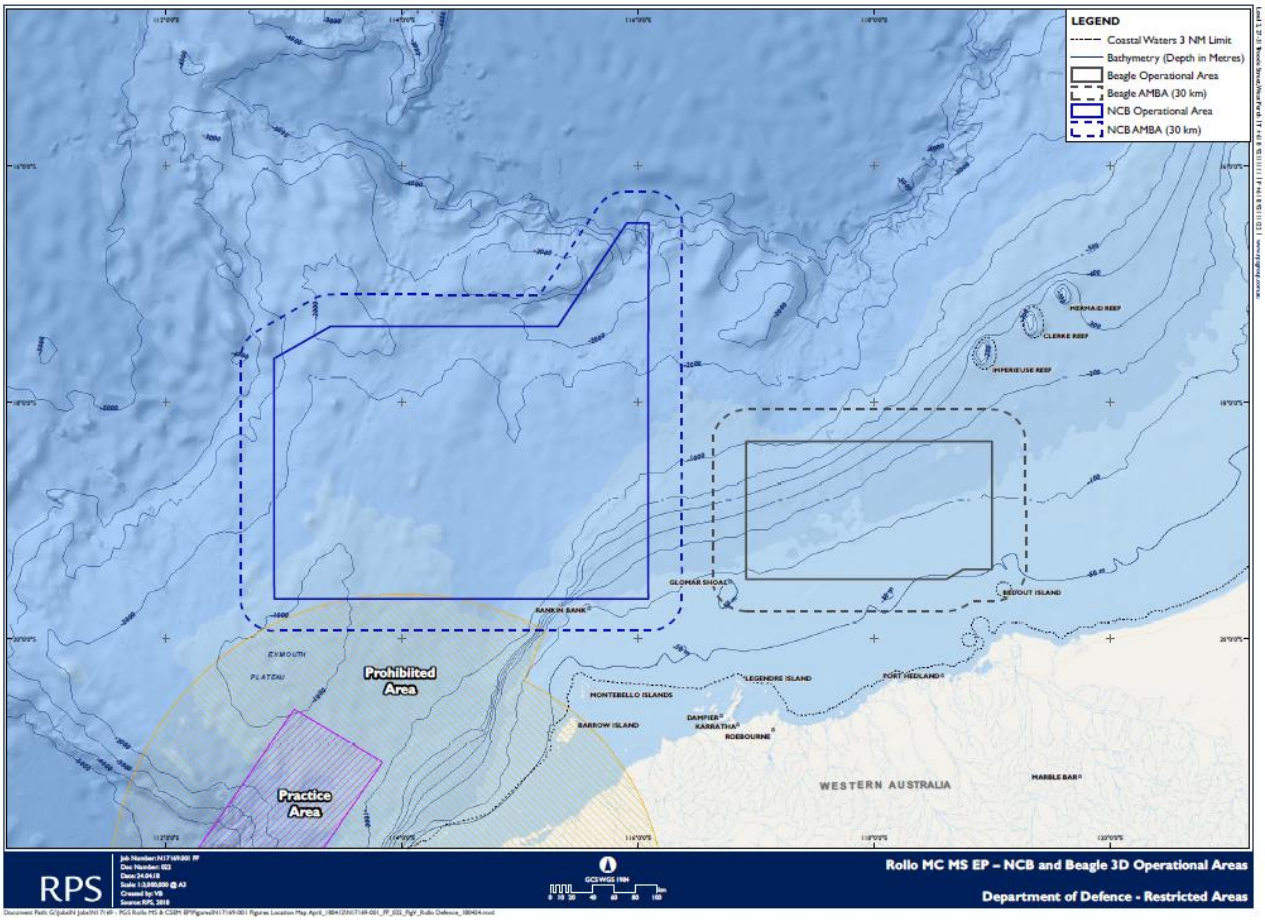


Figure 2-71 – Defence Areas within or adjacent to the NCB and Beagle AMBA

3. ENVIRONMENTAL RISK ASSESSMENT

An Environmental Risk Assessment (ERA) has been undertaken to understand and manage the environmental impacts and risks associated for the activities within the OAs. See Chapter 3 - Appendix 3C for the complete ERA methodology that was applied for the Rollo EP. The ERA is designed to provide:

- details of the environmental impacts and risks associated with survey activities;
- an evaluation of all the impacts and risks, appropriate to the nature and scale of each impact or risk; and
- details of the control measures that will be used to reduce the impacts and risks of the activity to ALARP and to an acceptable level.

The Chapter 2 ERA (this document) includes an assessment of six aspects associated with the 3D MSS surveys within the NCB and Beagle OAs that are variable i.e. location and timing of individual surveys.

1. Interactions with other mariners
2. Seismic acoustic emissions
3. Noise emissions (non-seismic)
4. Vessel light emissions
5. Physical presence of survey vessel, support vessel and towed array
6. Non-routine/ accidental hydrocarbon release

The Chapter 3 ERA includes an assessment of five aspects associated with the 3D MSS surveys within the NCB and Beagle OAs that are relatively constant by nature and relate to the management of the operating vessels.

1. Routine atmospheric emissions
2. Routine discharges
3. Physical presence of support vessel, survey vessel and towed array
4. Waste management
5. Non-routine/ accidental hydrocarbon release

The following Sections outline the results of the ERA for Chapter 2 (this document) only.

3.1 RISK EVALUATION SUMMARY

The Environmental Risk Assessment (ERA) for surveys within the proposed OAs indicates that the residual environmental impacts and risks associated with the activities will be reduced to ALARP and are of an acceptable level. The Chapter 2 ERA identified six sources of environmental risk four planned and two unplanned aspects, which are assessed as having a Low or Medium residual risk following implementation of identified control measures.

3.2 PERFORMANCE OUTCOMES, STANDARDS AND MEASUREMENT CRITERIA

Regulation 13(7) of the Environment Regulations requires that an EP include environmental performance outcomes (EPO), environmental performance standards (EPS) and measurement criteria (MC) that address legislative and other controls to manage the environmental impacts and risks of the activity.

EPO and EPS for surveys conducted within the proposed OAs have been identified for the environmental impacts and risks assessed via the detailed risk evaluation process. These EPS set the standards against which PGS will measure environmental performance and implementation of the control measures identified in this EP. For each EPS, appropriate MC for determining whether the EPO have been met have been identified. The EPO, EPS and MC specified are consistent with legislative requirements and PGS's policies, standards and procedures. They have been developed based on the decision tools outlined in Chapter 3- Appendix 3C, as part of the ALARP demonstration process. A breach of an EPO or EPS constitutes a 'Recordable Incident' under the Environment Regulations.

3.3 PLANNED ACTIVITIES (ROUTINE AND NON-ROUTINE)

3.3.1 Interactions with Other Mariners

3.3.1.1 Description of Risk

Interaction with other mariners includes commercial fisheries, shipping and defence training. There is the possibility that fishing, shipping and defence training activities may be disrupted by the physical presence of the seismic and support vessels, if they occur in the same location at the same time.

3.3.1.2 Area Potentially Affected

The area that maybe affected is restricted to the NCB and Beagle OAs where the seismic and support vessels will operate.

The survey vessel will be required to have an exclusion zone of 3 nm (5.5 km) around the vessel and streamers based on a worst-case vessel set up of 16 8 km streamers 150 m apart this would be a Safe Navigation Area of 14 km by 14 km.

3.3.1.3 Receptors within Area Potentially Affected

The following receptors have been identified as having the potential to occur within the NCB and Beagle OAs:

- Commercial Fisheries:
  - Mackerel Managed Fishery (MMF)
  - North West Slop Trawl Fishery (NWSTF)
  - Pilbara Fish Trawl Interim Managed Fishery (PFTIMF)
  - Pilbara Trap Managed Fishery (PTMF)
  - Pilbara Line Fishery (PLF)
  - Western Deepwater Trawl Fishery (WDTF)
- Defence
- Shipping

There are no charter boat locations identified within the NCB or Beagle OAs.

3.3.1.4 Potential Environmental Impacts

3.3.1.4.1 Commercial Fisheries

Disruption to commercial fisheries in an area proposed for an individual survey within the NCB and Beagle OAs could result from:

- Restriction of access to fishing grounds due to vessel movements and operations.
- Loss of fishing gear e.g. buoyed fish traps and recreational take of finfish species from the survey vessels.
- Seismic equipment loss and subsequent entanglement with fishing gear (covered in Section 3.4.1).
- Restriction of access due to diesel spill (covered in Section 3.4.3).

This could lead to temporary reduced catches and income for commercial fisheries due to loss of access to fishing grounds whilst the survey is being undertaken or loss of fishing gear.

PGS will undertake pre-survey planning to continue to manage impacts to fisheries license holders and to ensure that protocols of cooperation and interaction established during stakeholder consultation are upheld and put in force if a survey overlaps a respective fisher's license area.

Table 3-1 details the spatial analysis undertaken to determine the area of overlap between the active fisheries and the NCB and Beagle OAs. It also details the controls that will be implemented to ensure the

level of impacts to fisheries are acceptable. The calculations in Table 3-1 are based on the fishery areas of effort not the total area of the fishery which is a much larger area.

The outcomes of this spatial analysis were provided to fisheries stakeholders (relevant fishing companies, individual licence holders and/or appropriate peak fishing industry organisations) via stakeholder consultation as detailed in Chapter 1. This provided stakeholders an opportunity to assess the implications and potential impacts to their fishing activities—mainly the possible spatial overlap or extent. PGS provided maps and noted that there was a reduction in scope compared to prior advice. The spatial analysis focused on following key questions:

- Are the proposed levels of spatial overlap acceptable?
- Will there be multiple surveys in the fishing area – i.e. over two seasons?
- Measures to minimise or eliminate spatial or temporal overlap between seismic acquisition and fishing activity.

Where possible, PGS will avoid undertaking seismic surveys where it is known that fishers have a restricted fishing location and/or temporal constraints. As detailed in Chapter 1, PGS has consulted with fisheries licence holders and for licence holders that responded to meeting requests, protocols of interaction have been put in place.

Therefore, the additional operational restriction of 25,000 km^2 of acquisition per year and limiting acquisition to two vessels at a time, further refines and restricts operations within the fisheries licence areas.

While restricted fishing locations and timings may be avoided (as supported by industry data or literature), it is often not possible to avoid very large fishing areas; locations where fishing may occur year-round, or spawning areas that are often large with limited scientific evidence supporting specific locations/timings.

The main concern for interactions between seismic acquisition and commercial fisheries is those fisheries with relatively small licence areas. In the case of the PFTIMF and PTMF, PGS has discussed with stakeholders both spatial and/or temporal avoidance options to eliminate or minimise overlap with their fishing activities (see Table 3-1), and thereby to eliminate or minimise the likelihood of interactions and potential impacts.

Fishing from the seismic vessel and support vessels is prohibited thus impact to commercial fish catches from recreational catch will not occur.

3.3.1.4.2 Shipping

Within the NCB and Beagle OAs there is significant commercial shipping activity, including that associated with the oil and gas industry. Within the North West Shelf, the Australian Maritime Safety Authority (AMSA) has introduced a network of commercial shipping fairways to reduce the risk of vessel collisions with offshore infrastructure. A number of these shipping lanes are located within the proposed OA (Section 2.5.7; Figure 2-70), with increased activity out of Port Hedland and Karratha.

The survey vessel(s) and towed array represent a potential navigational hazard and other vessels will need to avoid the seismic vessel to prevent collisions, entanglement of streamers, and other incidents. Shipping vessels transiting through the area will not be restricted in their activities. Normal navigation at sea processes are undertaken whereby shipping vessels will move through the area using navigational aids to avoid the seismic vessel as they do any other vessels.

In the worst case a vessel may need to go around the survey vessel which may result in them having to go 14 km from their route. Thus, any potential impacts will be within a localised area that needs to be avoided (Safe Navigation Area 14 km) and short term (~ 1.5 hr) for vessel/streamer to pass.

3.3.1.4.3 Defence Activities

The Rollo OA intersects the North West Exercise Area (Figure 2-71). Impacts are unlikely due to the small area of overlap. Eight weeks prior to commencing any seismic survey PGS will provide further details of the survey area coordinates, timing and activity to ensure that no military activities will coincide with seismic operations in the area.

3.3.1.4.4 Definition of Negative Interaction

A negative interaction is defined within this EP as a situation whereby any other vessel intentionally does not respond to the survey/chase vessel warnings, to the point whereby the other vessel's CPA/Speed/Course poses a threat to the safety of the seismic vessel and/or towed equipment, resulting in the seismic vessel having no other option but to alter their own speed (if possible) and course to avoid the other vessel and/or defuse the situation. A negative interaction may also include verbal abuse by third party vessel operators, regardless of whether it results in alteration of course or activities; avoidance of fishing gear; or any other third-party interaction that means a survey line is unexpectedly delayed or altered. It does not include warnings or communications that are considered standard under maritime requirements such as alerting another vessel of the seismic vessels presence or CPA.

Table 3-1 - Fishery licence areas, agreed protocols of interaction, operational restrictions and acceptability to proposed survey activities

Fishery	OA overlap with fishery area of effort	Protocol of interaction in place?	Proposed operational restrictions / mitigation procedures	Acceptable level of Impact
MMF	Area of catch effort (2011 – 2016) Area 2: 31,977 km^2 NCB overlaps 332 km^2 (1%) of Area 2 effort Beagle overlaps 2,584 km^2 (8%) of Area 2 effort Maximum 2 vessels No seasonality in Pilbara MMF	No	• Only one survey will be undertaken at a time within the MMF area of effort. • Surveys within the MMF will only occur within May, June and July. • Pre-survey engagement.	Yes. A maximum of 2 vessels operate within the OAs and via stakeholder engagement with MMF licence holders in Area 2 no objections or claims have been raised. The area of effort overlap is relatively small in relation to the remaining area where fishing occurs (91%). For the largest area of overlap (Beagle) it would take less than 30 days to complete the area of 2,584 km^2 and this will only occur within the 3 months of May, June and July. Displacement of activities can be avoided by coordinating each party's activities to not restrict either party. This will be coordinated via pre-survey engagement.
NWSTF	Area of catch effort (2011 – 2016): 174,994 km^2 NCB OA overlaps 39,475 km^2 (23%) area of effort Beagle OA overlaps 8,045 km^2 (5%) area of effort Maximum 2 vessels No seasonality – though may fish in NWSTF when Northern Prawn Fishery (NPF) closed.	No	• No more than 25,000 km^2 of acquisition will be acquired within a 12-month period, for the five-year lifespan of the EP. • Only one survey will be undertaken at a time within the NWSTF area of effort. • Pre-survey engagement.	Yes A maximum of 2 vessels operate within the OAs and via stakeholder engagement with NWSTF licence holders no objections or claims have been raised. The implementation of a 25,000 km^2/year acquisition limit equates to 14% of the NWSTF area of effort in 1 year and 27% over the five-year lifespan of the EP. Fishing effort within the NWST area is low within a maximum of 2 vessels that can move to other areas as the fishery is not restricted. As there are only 2 vessels further temporal restrictions such as only undertaken surveys when the NPF is closed where not implemented as there have been no objections or claims raised by stakeholders and displacement of activities can be avoided by coordinating each party's activities to not restrict

Fishery	OA overlap with fishery area of effort	Protocol of interaction in place?	Proposed operational restrictions / mitigation procedures	Acceptable level of Impact
				either party. This will be coordinated via pre-survey engagement.
PFTIMF	Area of catch effort (2011 – 2016): 23,108 km^2 NCB OA – 0% Beagle OA overlaps 8,192 km^2 (35%) area of effort Maximum 2 vessels No seasonality	Yes – MG Kailis	• There will be <5% annual overlap with PFTIMF Zone 2 areas actively fished (based on the last 5 years of available data). The Zone 2 area open for fishing is ~ 23,141 km^2 this would equate to a maximum of 1,157 km^2 acquisition per year. • Only one survey will be undertaken at a time within the PFTIMF area of effort. • Surveys within the MMF will only occur within May, June and July. • Pre-survey engagement.	Yes. A maximum of 3 vessels operate within the OAs. Via stakeholder engagement concerns have been raised in relation to the restricted area open to the PFTIMF. PGS have implemented an operational restriction based on 5% overlap with the PFTIMF Zone 2 areas actively fished. As the fishery has an area of ~ 23,141 km^2 this would equate to 1,157 km^2/year which would take ~ 12 days to survey. This provides 95% of the areas actively fished available for fishing. The area of impact is less than the area of 2,531 km^2 communicated to stakeholders as it has been calculated on the Zone 2 areas open for fishing rather than the broader fishery area. Further restrictions have been put in place where surveys will only be undertaken within the PFTIMF during of May, June and July. Displacement of activities can be avoided by coordinating each party's activities to not restrict either party. This will be coordinated via pre-survey engagement.
PTMF	Area of catch effort (2011 – 2016): 84,112 km^2 NCB OA overlaps 1,221 km^2 (1.5%) area of effort Beagle OA overlaps 18,300 km^2 (22%) area of effort Typically 2 vessels No seasonality	Yes – Old Brown Dog	• There will be <5% overlap with PTMF Schedule 1 areas actively fished which equates to no more than 4,206 km^2 acquisition per year. • Surveys within the MMF will only occur within May, June and July. • Only one survey will be undertaken at a time within the PTMF area of effort. • Pre-survey engagement.	Yes. Typically, 2 vessels operate within the OAs. Via stakeholder engagement concerns have been raised in relation to the restricted area open to the PTMF. PGS have implemented an operational restriction based on 5% overlap with PTMF Schedule 1 areas actively fished. As the fishery has an area of ~ 84,112 km^2 this would equate to

Fishery	OA overlap with fishery area of effort	Protocol of interaction in place?	Proposed operational restrictions / mitigation procedures	Acceptable level of Impact
				4,206 km^2/year which would take ~ 42 days to survey. This provides 95% of the areas actively fished available for fishing. Further restrictions have been put in place where surveys will only be undertaken within the PTMF during of May, June and July. The area of impact is less than the area of 5,000 km^2 communicated to stakeholders as it has been calculated on the area where there is catch effort rather than the fishery area. Displacement of activities can be avoided by coordinating each party's activities to not restrict either party. This will be coordinated via pre-survey engagement.
PLF	Area of catch effort (2011 – 2016): 135,649 km^2 NCB OA overlaps 15,467 km^2 (11%) area of effort Beagle OA overlaps 11,771 km^2 (9%) area of effort Maximum 4 vessels in NCB Maximum of 2 vessels in Beagle No fishing in Jan and Feb	Yes – Fat Marine and RNR Fisheries	• No more than 25,000 km^2 of acquisition will be acquired within a 12-month period, for the five-year lifespan of the EP. • For the PLF area of effort that overlaps the PFTIMF Zone 2 areas actively fished the operational restriction for the PFTIMF will apply. There will be <5% annual overlap with PFTIMF Zone 2 areas actively fished which equates to no more than 1,155 km^2 acquisition per year. • For the PLF area of effort that overlaps the PTMF Schedule 1 areas actively fished the operational restriction for the PTMF will apply. PTMF Schedule 1 areas actively fished which equates to no more than 4,206 km^2 acquisition per year. • Only one survey will be undertaken at a time within the PLF area of effort. • Pre-survey engagement.	Yes. Maximum of 2 vessels in Beagle and 4 in NCB. PGS have implemented an operational restriction based on 5% overlap with the PTMF and PTIMF areas actively fished that overlap the PLF. This equates to 4% annual overlap for the PLF areas actively fish within the Beagle OA (See Figure 3-4 that shows area of overlap). The maximum area that would be impacted by a survey would be ~ 9,200 km^2 based on only one survey can be undertaken at a time within the PLF during the months of May, June and July. This equates to 92 days at ~ 100 km2/per day which is ~ 7% of the PLF area of effort per year. This provides 93% of the areas actively fished available for fishing and the fishery is not restricted in area as per the trap and trawl fishery. Displacement of activities can be avoided by coordinating each party's activities to not restrict

Fishery	OA overlap with fishery area of effort	Protocol of interaction in place?	Proposed operational restrictions / mitigation procedures	Acceptable level of Impact
				either party. This will be coordinated via pre-survey engagement.
WDTF	There has been no catch effort within the area of NCB OA overlap since the 2008 - 2009 fishing season.	No	• Only one survey will be undertaken at a time within the NWSTF area of effort. • Pre-survey engagement.	Yes. There has been no catch effort within the area of NCB OA overlap since the 2008 - 2009 fishing season. Fishing effort in the fishery has been historically been low with 3 vessels fishing for 13 days in the 2013 – 2014. No objections or claims have been raised by WDTF licence holders. Displacement of activities can be avoided by coordinating each party's activities to not restrict either party. This will be coordinated via pre-survey engagement.

3.3.1.5 Summary of Environmental Impacts

Potential Environmental Impacts	Environmental Values and Sensitivities Affected	Decision Type

• Restriction of access to fishing grounds due to:
  ○ vessel movements and/or operation
  ○ loss and/or damage to fishing equipment
• Temporary disruption/exclusion of shipping traffic
• Temporary disruption of defence activities
	Other marine users:
	• Commercial fisheries
	• Commercial shipping
	• Australian military
		B

3.3.1.6 Analysis of additional control measures

Risks classified as a Decision Type B are typically in areas of increased environmental sensitivity with some stakeholder concerns. As there are several fisheries that have catch effort within the operating areas and via consultation concerns were raised by some stakeholders regarding displacement from their fishing areas this risk is classified as Type B.

Table 3-2 - ALARP demonstration - analysis of additional control measures

Additional Control Measure	Practicable?	Will they be implemented?	Cost/Benefit Analysis
Surveys not undertaken within the areas of the fishery where there is catch effort	Yes	No	**Cost:** Not undertaking surveys within the areas within the fishery where there is catch effort would reduce the area available for surveys by up to 33% based on the maximum fishing area (39,441 km^2 for the NWSTF within the NCB Area and the total Rollo area being 117,833 km^2). This has the potential to restrict PGS from meeting the seismic data delivery requirements of clients. This could be a significant cost > $1-10M. Permit holders would be unable to meet their work commitments for the petroleum titles covered by the survey area. Limited data would be available for release areas covered by the survey. However, PGS have committed to a number of controls to ensure fishers have sufficient area to fish in and have applied operational restrictions per annum in those fisheries that have restricted area: • No more than 25,000 km^2 of 3D will be acquired within a 12-month period, for the five-year validity of the EP. • Seismic acquisition will not be undertaken over the same area within 12 months of previous acquisition. • No more than one PGS survey will be undertaken at one time within a fishery area where there is catch effort. • There will be <5% annual overlap with PFTIMF Zone 2 areas actively fished which equates to no more than 1,155 km^2 acquisition per year. • There will be <5% overlap with PTMF Schedule 1 areas actively fished which equates to no more than 4,206 km2 acquisition per year.

Additional Control Measure	Practicable?	Will they be implemented?	Cost/Benefit Analysis
			Benefit: Eliminate restrictions to fishers to move or not access areas while being surveyed.
Applying a <5% overlap to all fisheries	Yes	Partially	**Cost:** A <5% overlap has been applied to the PFTIMF and PTMF as via consultation it was identified that these fisheries had a restricted area and commercial fishing is undertaken within most of the fishery area (PFTIMF 2012-2015 fishery effort within 100% of the fishery area. PTMF 2012-2015 fishery effort within 96%). This control was agreed to for the broader Rollo OA and has been applied to the smaller areas of Beagle and NCB. Since this agreement PGS has applied a further restriction of only undertaken surveys within the MMF, PLF, PFTIMF and PTMF during May, June and July when spawning does not occur. This provides a 92 day period where these areas can be surveyed. Further restrictions on applying a 5% overlap to the MMF and PLF will substantially reduce the area that PGS can undertake within the southern portions of the OAs. This could result in not being able to meet titleholders survey requirements resulting in loss of work to PGS. Via stakeholder engagement with the MMF, NWST and PLF no further restrictions have been requested and as vessel numbers are low in the OAs PGS is confident that displacement of activities can be avoided by coordinating each party's activities to not restrict either party. This will be coordinated via pre-survey engagement. **Benefit:** Reduced area of overlap with commercial fishers. However, further reductions would have reduced benefits as area of survey per year is low and, in most cases, reduced to ~ 92 days of survey. This is seen as acceptable as not interfering with fishing to a greater extent than is necessary for the exercise of right conferred by the titles granted to gather geophysical information by carrying out seismic activities as per OPGGS Act, section 280.
Seismic acquisition will only occur outside key fishing seasons.	Yes	Partially	**Cost:** Only the Pilbara Line Fishery shows any seasonality with no fishing undertaken within January and February. However, based on information from DPIRD-Fisheries (Section 2.4.2.5.4 Spawning) goldband snapper spawn in this area in January and February and red emperor in January. As spawning is seen as critical for future fish stocks a control was put in place not to undertake seismic surveys during this time. **Benefit:** Only the Pilbara Line Fishery shows any seasonality with no fishing undertaken within January and February. Undertaking surveys only within these months for the Pilbara Line Fishery would eliminate any restrictions to these fishers to move or not access areas while being surveyed. However, due to the area of overlap it is likely that there would still be some overlap with months were the Pilbara Line Fishery fished. In the stakeholder engagement undertaken with the PLF licensees there was no request to not fish within these months.
Restrict surveys to one at a time within a fishery catch effort area	Yes	Yes	**Cost:** Potential loss of contract work if PGS cannot meet a client's timeframe for a survey as they have already contracted a survey within a fishery. This could be a significant cost > $1-10M. **Benefit:** Reduces the area of restriction to fishers and allows them a greater area to move to or access within their area of fishery effort.
Ongoing consultation with marine user including 6 monthly updates and notification of surveys 8 weeks prior to commencement	Yes	Yes	**Cost:** Increased costs of consultation, however, reduced costs from not having to stop survey due to defence exercise, fishers or equipment in the area. **Benefit:** Allows for planning by all parties to reduce areas of overlap. Allows for agreed protocols of interaction with commercial fishers to be revised or develop. Implementation of agreed protocols of interactions will ensure that the amount of time fishers are displaced is ALARP. Notification of surveys has been increased to 8 weeks from 4 weeks based on stakeholder feedback.

Additional Control Measure	Practicable?	Will they be implemented?	Cost/Benefit Analysis
Daily forecast of operations	Yes	Yes	**Cost:** Increased costs of consultation, however, reduced costs from not having to stop survey due to fishers or equipment in the area. **Benefit:** Allows fishers, particularly those with set fishing gear, to plan the location of where fishing gear will be set to minimise interaction. Reduces impact on fishers if they can know in advance where the seismic vessel will be.
Payment of compensation to fishers for loss of catch.	Yes	No	**Cost:** Increased costs for surveys. Difficulty of proving cause/effect relationship between seismic acquisition and any real/perceived loss of catch. **Benefit:** Fishers are not commercially disadvantage if they fishing area is restricted. This has not been raised by fishers and it is not seen as warranted based on the small area of overlap with fishing areas.

3.3.1.7 Justification for Implemented Control Measures

No.	Control Measures	Justification
1	Operations of the survey vessel must comply with the operational standards for navigation and safety in accordance with relevant legislation and conventions, including but not limited to: • standard maritime safety procedures (including radar watch, radio contact, display of navigational beacons and lights) • standards for watchkeeping.	• COLREGs include the rules that apply to all vessels in all navigable waters and the responsibilities of the vessel master, owner and crew for compliance. • The STCW Convention established basic requirements on training, certification and watchkeeping for seafarers on an international level, thus prescribing minimum standards that countries are obliged to meet or exceed. • The *Navigation Act 2012* and Marine Orders are regulations under Australian Commonwealth legislations and apply to Australian and foreign vessels. Marine Orders 21, 28 and 30 give effect to provisions of international conventions (e.g. COLREG, STCW Convention and SOLAS). • As such, PGS will uphold all relevant laws and procedures and is confident that these control measures are effective at reducing associated environmental impacts and risks.
2	Adherence to the prohibition of vessel entry into designated petroleum safety zones surrounding petroleum wells, structures or equipment.	As per the OPGGS Act, PGS will adhere to vessel entry prohibitions into designated petroleum safety zones.
3	AMSA JRCC will be advised of the survey details (vessel name, callsign and Maritime Mobile Service Identity (MMSI)), satellite communications details (including INMARSATC and satellite telephone), area of operation, requested clearance from other vessels and notification of when operations commence and are complete) 48 hours before operations commence.	Under the *Australian Maritime Safety Authority Act 1990*, AMSA is a statutory authority to promote maritime safety and marine environment protections, as well as search and rescue services. Thus, PGS will adhere to AMSA's nautical advice, particularly regarding clear and effective communication within a proposed survey area.

No.	Control Measures	Justification
	The Australian Hydrographic Service (AHS) will be advised of the survey details (survey vessel, location, timing, etc.) four weeks prior to mobilisation for the promulgation of a Notice to Mariners (NTM) broadcast.	Under the *Navigation Act of 2012*, AHS is the Commonwealth Government agency responsible for the publication and distribution of nautical charts and other information required for safety of ships navigating in Australian waters. NTMs provide the latest safety-critical information to mariners, and thus, PGS will inform AHS of all survey details to ensure safe navigation.
5	The Department of Defence (DoD) will be advised of the survey details (survey vessel, location, timing, etc.) 8 weeks prior to mobilisation if an individual survey is located within 40 km of the North West Exercise Area.	The Beagle OA overlaps the North West Exercise Area, PGS will advise the Department of Defence of surveys within 40 km of the North West Exercise Area to ensure no overlap with military activities.
6	• Fishing companies, individual license holders and/or appropriate peak fishing industry organisations that potentially overlap the proposed OA will be sent further correspondence with detailed information for the proposed activity (including timing, duration and locations etc.) eight weeks[6] prior to commencing an individual survey within the proposed OA. • More than eight weeks prior to commencing an individual survey, PGS will undertake pre-survey planning to review fisheries licence areas overlap with a proposed survey area. This is to ensure protocols of cooperation and interaction established during stakeholder consultation are upheld and put in force if a proposed survey overlaps a fisheries area of effort.	Notification of activity details has been increased from four to eight weeks prior to a survey commencing to inform marine users about the survey area, survey and support vessel specifications, timing of operations, contact phone numbers and details about seismic operations to ascertain if proposed operations overlaps any key fishing grounds. Fishers can provide more detailed information regarding their proposed fishing locations. This will also enable planning by all parties to reduce areas of overlap. An increase in the notification timing allows for a reasonable period for consultation.
7	• Forecasts of operations will be available for all fisheries license holders. • The method and frequency by which license holders receives notifications will be determined during stakeholder engagement meetings. • Method and frequency which license holders receives notifications will be determined during stakeholder engagement meetings and/or on a case-by-case basis.	• The OPGGS Environment Regulation 11A requires titleholders to give each relevant person sufficient information to make an informed assessment of the possible consequences of the activity on the functions, interests or activities of the relevant person. Also, the titleholder must allow a relevant person a reasonable period for the consultation. • Issuing a forecast to fisheries license holders will allow fishers, particularly those with set fishing gear, to plan the location of where fishing gear will be set to minimise interaction.
8	At approximately six (6) month intervals from the date of EP acceptance PGS shall ensure: • PGS Rollo EP website updated with information regarding all activities associated with the activity, including completed surveys and potential new locations for surveys (if known). • Check that identified stakeholders are still relevant and correct.	• The OPGGS Environment Regulation 11A requires titleholders to give each relevant person sufficient information to make an informed assessment of the possible consequences of the activity on the functions, interests or activities of the relevant person. Also, the

[6] Unless a prior agreement has been made with specific stakeholders for a longer notification period, see **Chapter 1**.

No.	Control Measures	Justification
	• Identify new stakeholders.	titleholder must allow a relevant person a reasonable period for the consultation. • To ensure transparent and effective engagement with all stakeholders, PGS created a Rollo EP-specific website, for which a login will be provided to all stakeholders (upon request). The website will provide access to the full Rollo EP as well as information about completed surveys and potential new surveys (if known). This approach was appreciated and well-received by stakeholders and regulators. • PGS believes that six-month updates will provide a satisfactory access level for updated information and reduce stakeholder fatigue, as unaffected stakeholders will not receive unnecessary notifications for the whole OA.
9	No more than 25,000 km^2 of 3D will be acquired within a 12 month period, for the five year validity of the EP.	Under the OPGGS Environment Regulation 13, the EP must describe the activity, including an outline of the operational details and proposed timetables. As there is no planned survey at this time, PGS set annual restrictions to further define the activity in accordance with this regulation and is confident that these control measures are effective at reducing uncertainty and associated environmental impacts and risks. The maximum area of acquisition each year has been reduced from 35,000 km^2 to 25,000 km^2 to further minimise impacts to other marine users.
10	No more than two PGS surveys will be undertaken at one time within the operational area.	
12	To prevent further impacts from the activity and commercial fishing: • Fishing from the survey and support vessels is prohibited. • Seismic acquisition will not be undertaken over the same area within 12 months of previous acquisition without gaining the prior consent of affected fishers. • No more than one PGS survey will be undertaken at one time within a fishery area where there is catch effort.	• Based on the spatial analysis of overlap with commercial fisheries (see above), and further consultation with fisheries stakeholders, PGS will implement a number of specific operational restrictions to eliminate or minimise interactions and potential impacts. • In accordance with the IAGC Guidelines, PGS will: ○ minimise disturbance to traditional native hunting and fishing areas by restricting operations in specific commercial fishery license areas ○ fishing and trapping of aquatic life by crewmembers are strictly forbidden to minimise impacts and risks to marine fauna. • In accordance with the APPEA Code of Environmental Practice, PGS will reduce disturbance to fishing operations or other marine users to ALARP and acceptable levels and demonstrate adherence to agreed procedures.
15	To reduce potential impacts to PFTIMF, there will be <5% annual overlap with PFTIMF Zone 2 areas actively fished which equates to no more than 1,155 km^2 acquisition per year. This is less than the area of 2,531 km^2 communicated to stakeholders.	
16	To reduce potential impacts to PTMF, there will be <5% overlap with PTMF Schedule 1 areas actively fished which equates to no more than 4,206 km^2 acquisition per year. This is less than the area of 5,000 km^2 per year communicated to stakeholders.	

No.	Control Measures	Justification
19	Fishermen and other mariners will be alerted of survey vessels' presence and extent of towed array and a closest point of approach (CPA) shall be established which will determine the SNA (Safe Navigation Area).	A SNA will ensure that the survey vessel(s) and towed array do not present potential navigational hazards which other vessels will need to avoid. An SNA will help to prevent collisions, entanglement of streamers, and other safety incidents at sea. Also, any equipment loss may interfere with other maritime activities.
20	The survey vessel will have an Automatic Identification System (AIS) tracking device installed and operating.	An AIS provides fast, automatic and accurate information to reduce the risk of collisions. It allows vessels and shore-based stations to send and received identifying information. Furthermore, under the Safety of Life at Sea (SOLAS) Convention, AIS Class A is required for vessels 300 gross tonnage and upwards that are engaged on international voyages (i.e. seismic vessels). The SOLAS regulations are also upheld under Marine Order 21 of the *Navigation Act of 2012*.
21	Tail buoys are visible to other mariners (e.g. reflective tape/strobes/radar reflector etc.) so they are aware of the towed extent and vessels restricted manoeuvrability.	Tail buoys are floating units that identify the end of the streamers and enable position monitoring and direction of streamers. They allow for handling, monitoring and controlling of the streamer cables. Furthermore, under Rule 24 of COLREG, all possible measures shall be taken to indicate the presence of a towed object. The COLREG regulations are also upheld under Marine Order 30 of the *Navigation Act of 2012*.

3.3.1.8 Summary of Environmental Risk Assessment

Residual Risk Assessment				
Potential Environmental Impact		**Consequence**	**Likelihood**	**Residual Risk**
Restriction of access to fishing grounds due to vessel movements and/or operation	Commercial fisheries	Minor	Unlikely	Medium
Restriction of access to fishing grounds due to loss and/or damage to seismic equipment				
Temporary disruption/exclusion of shipping traffic	Shipping Industry	Slight	Unlikely	Low
Temporary disruption of defence activities	Defence		Remote	

3.3.1.9 Demonstration of ALARP

Based on the ERA conducted, the use of relevant decision-making tools appropriate to the decision type and the application of the 'Hierarchy of Controls' philosophy (below), the control measures described above are appropriate to manage the risk of interactions with other mariners and to ensure that reasonable and practicable solutions have not been overlooked. Therefore, the residual risk ranking for this potential impact is considered Medium to Low, as good industry practice or comparable standards have been applied to control the risk, and any further effort towards risk reduction (e.g. additional, alternative or modified control measures) would not provide further environmental benefit and/or is not reasonably practicable without sacrifices that are grossly disproportionate to the benefit gained. The environmental impacts and risk are thus reduced to ALARP.	
Eliminate	Interactions between the survey vessel and other maritime users cannot be eliminated, as the proposed OA overlaps several commercial fisheries license areas and commercial shipping traffic.
Substitute	The use of a survey vessel to undertake the survey cannot be substituted.
Engineering	The surveys will implement effective, engineering solutions, including tail buoys, AIS and approved electronic navigation systems, radar on survey vessel and marine radio channels and other communication systems.
Isolation	The surveys will implement the isolation control measures (above) to further reduce impacts to other maritime users, including avoidance of petroleum safety zones and applying operational restrictions to minimise the area of overlap for fisheries. PGS have committed to a number of controls to ensure fishers have sufficient area to fish in and have applied operational restrictions per annum in those fisheries that have restricted area.
Administrative	In advance of a survey commencing, PGS will provide updated information of the survey operations to all stakeholders, e.g. AMSA RCC and NTM by AHS (for the issuance of NAVAREA X and AUSCOAST warnings), relevant fisheries, defence and other petroleum titleholders. Daily forecast of operations allows fishers, particularly those with set fishing gear, to plan the location of where fishing gear will be set to minimise interaction. Reduces impact on fishers if they can know in advance where the seismic vessel will be. All personnel will receive appropriate environmental induction and training (Chapter 3), including the relevant PGS shipboard safety procedures.

3.3.1.10 Demonstration of Acceptability

The potential impacts from interactions with other mariners are considered 'Acceptable' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		

Internal Context	Is the proposed management of the impact or risk aligned with the PGS Environment Policy and HSEQ Commitment Statement?	The control measures are consistent with the objectives of the PGS Environment Policy and HSEQ Commitment Statement (Chapter 3):
		• PGS Environment Policy
		  ○ Prevent harm to the environment by reducing risk related to the activity
		  ○ Comply with applicable legal and industry standard requirements associated with the activity
		  ○ Achieve continual improvement in environmental performance.
		• HSEQ Commitment Statement (such as):
		  ○ Increase HSEQ awareness and reduce unsafe behaviour
		  ○ Reduce total risk exposure
		  ○ Prevent incidents
		  ○ Minimise harm to the environment.
		Thus, the control measures are acceptable to achieve PGS's environmental management requirements for this survey.

External Context – Social Acceptability	Have stakeholders raised any concerns about activity's impacts or risks, and if so, are measures in place to address those concerns?	Chapter 1 included all stakeholder consultation, including PGS' assessment of merits and claims as required by Regulation 16(b). In relation to displacement of marine users consultation has been ongoing and either closed out or in the case of most commercial fishers a response has not been elicited from them. Concerned raised by AMSA (shipping) and the Department of Defence have been addressed to their satisfaction. In relation to commercial fishers, from in-person discussions and repeated consultation, PGS demonstrated social acceptability with the implementation of additional operational restrictions (e.g. size of acquisition area and cooperation protocols) to reduce interactions with commercial fisheries. Stakeholders who have requested to be kept up to date of potential surveys have been including in the ongoing consultation Chapter 1 Table 2.4.
Environmental context	Are the control measures providing appropriate protection to the receiving environment (e.g. sensitive or unique environmental features) from potential impacts and risks introduced by the activity?	• The ERA evaluated the overlap between Rollo OA and commercial fisheries that have had catch effort within the area from 2012 – 2016 which is the most current data available from DPIRD-Fisheries. Spatial analysis demonstrated that the overlap between potential 3D survey areas and the fisheries within the operating areas is in general small ranging from 5% to 14% per year of the area where there

The potential impacts from interactions with other mariners are considered 'Acceptable' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		
		is catch effort. The catch effort area is a significant smaller area than the fishery area. • The main concern for interactions between seismic acquisition and commercial fisheries includes fisheries with relatively small licence areas which is the PFTIMF and PTMF. In the case of these fisheries PGS discussed with stakeholders both spatial and/or temporal avoidance options to eliminate or minimise overlap with their fishing activities (see above) and thereby to minimise the annual area of acquisition a year to 5 % of the area of catch effort. • For other fisheries the area of overlap has been reduced to as low as possible to not interfere with fishing to a greater extent than is necessary for the exercise of right conferred by the titles granted. • Control measures to provide appropriate protection to shipping activities include (but are not limited to) establishment of a Safe Navigational Area around the survey vessel, issuance of all required navigational warnings, clear identification of survey gear while in the water and AIS tracking. • Clear and timely communications issued to the Department of Defence will ensure that military exercises and not impact by seismic operations in the area. • Based on the ERA of potential impacts and risks to other maritime users, all known control measures have been adopted, and additional or alternative control measures would not provide additional environmental protection or benefit. Thus, the control measures provide appropriate protection to the receiving environment form potential impacts and risks introduced by the activity.

Legislation and Conventions	Is the impact or risk being managed in compliance with relevant Australian or international environmental management laws or standards (e.g. EPBC Act and Policy Statements, MARPOL, Navigation Act, etc.)?	Control measures to reduce impacts to other maritime users are compliant with relevant legislations and conventions (see Justification above), such as:
		• IMO Conventions (COLREG, STCW & SOLAS)
		• Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations
		• *Navigation Act 2012*:
		  ○ Marine Order 21 (Safety of navigation and emergency procedures) 2012
		  ○ Marine Order 28 (Operations standards and procedures) 2012
		  ○ Marine Order 30 (Prevention of collisions) 2009.

Industry Standards and Best Practice	Is the impact or risk being managed in accordance with industry standards, guidelines and best practice (e.g. APPEA Code of Environmental Practice, IAGC guidelines, etc.)?	Control measures to reduce interactions with other maritime users are in accordance with industry standards and best practice, including: • IAGC Environmental Manual for Worldwide Geophysical Operations recommends offshore surveys to minimise disturbance to traditional native hunting and fishing

The potential impacts from interactions with other mariners are considered 'Acceptable' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		
		areas by restricting operations in specific commercial fishery license areas. • APPEA Code of Environmental Practice recommends that offshore surveys reduce disturbance to fishing operations or other marine users to ALARP and acceptable levels and demonstrate adherence to agreed procedures.
ESD Principles	Is the impact or risk being managed in accordance to the principles of ESD (as per the EPBC Act)?	The ERA presented in this EP demonstrated compliance with the principles of ESD: • decision-making processes integrated both long-term and short-term economic, environmental, social and equitable considerations (e.g. reducing impacts to other marine users). • no threats of serious or irreversible environmental damage were identified. • the principle of inter-generational equity is maintained for the benefit of future generations. • the conservation of biological diversity and ecological integrity were fundamental considerations in decision-making and development of control measures. • the approved control measures considered improved valuation, pricing and/or incentive mechanisms.

3.3.1.11 Summary of Environmental Performance

EPO	EPS	Control Measure No.	Measurement Criteria
Zero incidents of negative interactions with other mariners, including commercial fishers, sipping or Dept. of Defence	Operations of the survey vessel must comply with the operational standards for navigation and safety in accordance with relevant legislation and conventions, including but not limited to: • standard maritime safety procedures including radar watch, radio contact, display of navigational beacons and lights. • standards for watchkeeping. • survey vessel will have an Automatic Identification System (AIS) tracking device installed and operating. • tail buoys are visible to other mariners e.g. reflective tape/strobes/radar reflector etc.	1, 20, 21	• Pre-mobilisation audit confirm: ○ Radar watch, radio and navigational beacons and lighting in place and operating ○ AIS tracking device installed and operating ○ Tail buoy has adequate visibility components (e.g. reflective tape, strobes, radar reflectors, etc.)
	The seismic or support vessels will not enter a designated petroleum safety zone for petroleum wells, structures or equipment.	2	Vessel track logs

EPO	EPS	Control Measure No.	Measurement Criteria
	• AMSA JRCC will be advised of the survey details (vessel name, callsign and Maritime Mobile Service Identity (MMSI)), satellite communications details (including INMARSATC and satellite telephone), area of operation, requested clearance from other vessels and notification of when operations commence and are complete) 48 hours before operations commence. • The Australian Hydrographic Service (AHS) will be advised of the survey details (survey vessel, location, timing, etc.) 4 weeks prior to mobilisation for the promulgation of a Notice to Mariners (NTM) broadcast. • The Department of Defence (DoD) will be advised of the survey details (survey vessel, location, timing, etc.) 8 weeks prior to mobilisation if an individual survey is located within 40 km of the North West Exercise Area.	3, 5,	Stakeholder consultation records
	• At six monthly intervals from the date of EP acceptance PGS shall: o Update the PGS Rollo EP website with information on potential new locations for surveys (if known) and completed surveys. o Review stakeholders to identify any new stakeholders and ensue existing stakeholders are still relevant and correct. • More than eight weeks prior to commencing an individual survey, PGS will undertake pre-survey planning to identify relevant stakeholders. • Eight weeks prior to commencing an individual survey relevant stakeholders will be will be sent information for the proposed survey (including area of survey, timing and duration). • For individual surveys a daily communication will be provided for relevant stakeholders. At a minimum the daily report will include: o Current survey vessel position o 72 hour look ahead for survey activities and location o Support vessel activities and location o Contact details for the survey and support vessel. o Safe Navigation Area for the seismic vessel.	6, 7, 8, 19	PGS Rollo EP website update Stakeholder review Stakeholder consultation records Daily communication records.

EPO	EPS	Control Measure No.	Measurement Criteria
	PGS will implement the following survey operation restrictions: • No more than 25,000 km^2 of 3D will be acquired within a 12-month period, for the five-year validity of the EP. • No more than two PGS surveys will be undertaken at one time within the operational area. • No more than one PGS survey will be undertaken at one time within a fishery area where there is catch effort. • Seismic acquisition will not be undertaken within 40 km of another vessel that is also acquiring data. • Seismic acquisition will not be undertaken less than one year after a survey has been undertaken over the same area. • There will be <5% annual overlap with PFTIMF Zone 2 areas actively fished based on the lasted 5 years of data available. There will be <5% overlap with PTMF Schedule 1 areas actively fished based on the lasted 5 years of data available.	9, 10, 12, 15, 16,	Record of survey acquisition area Vessel track logs Record of location of other seismic vessels undertaking seismic activities Record of timing of planned and previous seismic surveys within an area
	Fishing from the survey and support vessels is prohibited.	12	• Vessel inductions detail no fishing from vessels.

3.3.2 Underwater Noise Emissions from Discharge of Acoustic Array

3.3.2.1 Description of Risk

PGS will utilise a 3260 in^3 acoustic source array to generate acoustic pulses by periodically discharging compressed air into the water column at intervals of 10 seconds. The primary environmental risk from seismic surveys is sound emissions caused by the discharge of underwater seismic pulses. The level of impact to marine fauna depends on multiple factors, such as sound intensity and duration, distance from the source, fauna species and the mitigation procedures employed. Potential impacts range from mortality or pathological damage from close exposure to high sound levels, to various behavioural responses such as area avoidance (McCauley, 1994). This risk assessment is based on a worst-case-scenario. The potential acoustic impact will be less if a smaller acoustic array is used. It should be noted that mortality and pathological damage has not been observed and the assessment is based on a theoretical worst-case scenario.

The term 'discharge of the acoustic source' is considered as any discharge of the array into the receiving environment, whether it be from a single acoustic source, source testing, soft start procedures or ramp up or the full array acquisition (full power). For the impact assessment the discharge of the acoustic source at full power has been used as this would determine the worst-case impact.

3.3.2.2 Underwater Sound Modelling of the Acoustic Source

PGS commissioned JASCO Applied Sciences (JASCO) to model the received sound fields associated with the 3,260 in^3 acoustic array at three locations (Figure 3-1). The acoustic modelling sites were chosen to represent a range of water depths over the NCB and Beagle OAs and based on the following criteria:

1. Proximity to sensitive habitats
2. Range of water depths represented
3. Variety of seabed types

Table 3-3 provides information regarding why the three acoustic monitoring sites were selected and the sensitives associated with the sites.

Table 3-3 - Acoustic modelling sites information

Site	1	2	3
Water Depth	119 m	181 m	350
Representative	Representative of locations within the NCB and Beagle OA along the ancient coastline.	Assess impacts to Rankin Bank and the Continental Slope Demersal Fish Communities	Representative of deeper waters. The location was selected on the slope as Jasco advised that noise would travel further on the slope than in the deeper water.
Sensitivities	Ancient coastline KEF Humpback whale migration BIA Whale shark BIA Marine turtle BIAs Marine bird BIAs Pearl oyster and fishery Commercial fisheries Glomar shoal KEF	Continental Slope Demersal Fish Communities KEF Whale shark BIA Commercial fisheries Rankin Bank	Exmouth Plateau KEF Marine turtle BIA Pygmy blue whale BIA North West Slope Fishery

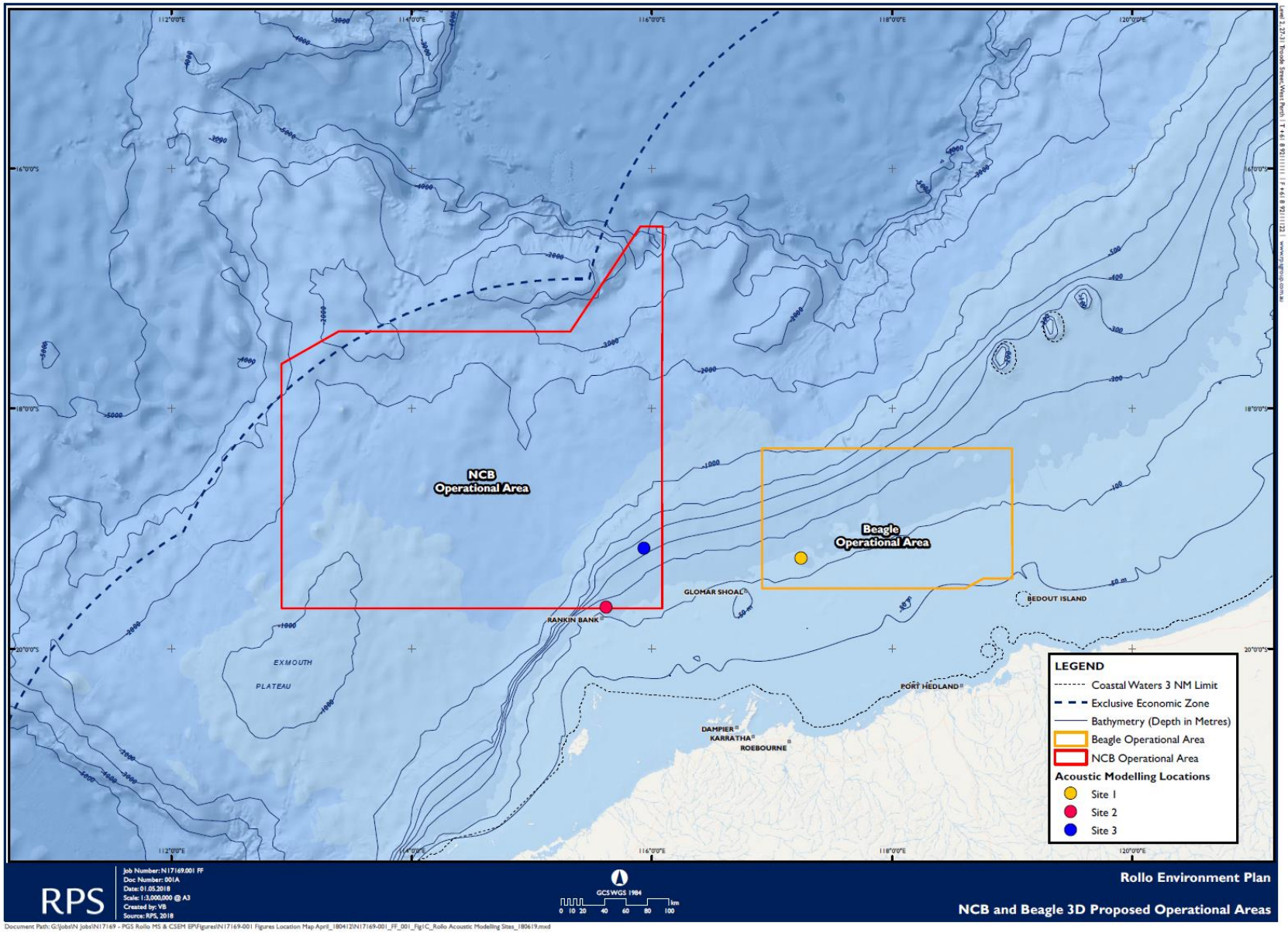


Figure 3-1 – Acoustic modelling sites for the Rollo OAs

The underwater acoustic signatures of the array were predicted with JASCO's specialised Airgun Array Source Model (AASM), which accounts for individual airgun volumes and array geometry criteria (Li & McPherson 2018). Complementary underwater acoustic propagation models were used in conjunction with the modelled array signature to estimate sound levels over a large area around the source. The models were used in combination to characterise the acoustic fields at near and long ranges in terms of sound exposure level (SEL), sound pressure level (SPL) and zero-to-peak pressure levels (PK) and peak-to-peak pressure levels (PK-PK).

A conservative sound speed profile that is most supportive of sound propagation conditions for the period of the survey was defined and applied at each of the modelling locations. The modelling methodology considered source directivity and range-dependent environmental properties in each of the areas assessed.

Single-impulse sound fields were predicted at each site, and accumulated sound exposure fields were predicted for one likely scenario of survey operations over 24 h at Site 1 at the ancient coastline.

Sound level contours were calculated based on the underwater sound fields predicted by the propagation models, sampled either at the seafloor or as the maximum value over all modelled depths indicated for each location in the modelled region. The predicted distances to specific levels were computed from these contours. Two distances relative to the source are reported for each sound level: 1) R_{max}, the maximum range to the given sound level over all azimuths; and 2) $R_{95\%}$, the range to the given sound level after the 5% farthest points were excluded. In some cases, a sound level contour might have small protrusions or anomalous isolated fringes. In cases such as this, where relatively few points are excluded in any given direction, R_{max} can misrepresent the area of the region exposed to such effects, and $R_{95\%}$ is considered more representative. In strongly asymmetric cases, $R_{95\%}$ neglects to account for significant protrusions in the footprint, and thus R_{max} might better represent the region of effect in specific directions. Cases such as this are usually associated with bathymetric features affecting propagation. The difference between R_{max} and $R_{95\%}$ depends on the source directivity and the non-uniformity of the acoustic environment. Nevertheless, for conservatism, PGS have used the R_{max} for the Rollo acoustic risk assessment.

During a seismic survey, new sound energy is introduced into the environment with each pulse from the acoustic source. While some impact criteria are based on the per-pulse energy released, others, account for the total acoustic energy marine fauna is subjected to over a specified period. An accurate assessment of the accumulated sound energy depends not only on the parameters of each seismic pulse impulse, but also on the number of impulses delivered in a period and the relative positions of the impulses. When there are many seismic pulses, it becomes computationally prohibitive to perform sound propagation modelling for every single event. The offset between the consecutive seismic impulses is small enough, however, that the environmental parameters that influence sound propagation are virtually the same for many impulse points. The acoustic fields can, therefore, be modelled for a subset of seismic pulses and estimated at several adjacent ones.

The time selected for modelling the cumulative sound exposure level was 24 hrs. This was based on the following best available scientific evidence and fauna specific guidelines.

For marine mammals NMFS (2018) recommends a baseline accumulation period of 24 hours but acknowledges that there may be specific exposure situations where this accumulation period requires adjustment (e.g., if activity lasts less than 24 hours or for situations where receivers are predicted to experience unusually long exposure durations such. For example, where a resident population could be found in a small and/or confined area and/or exposed to a long-duration activity with a large sound source, or where a continuous stationery activity is nearby an area where marine mammals congregate. Though the seismic activity will last for greater than 24 hours no areas where marine mammals congregate such as feeding, resting or calving areas where identified within the OAs or 30 km AMBA.

For fish the Popper et al. (2014) sound exposure guidelines for TTS effects in fish are based upon data from Popper et al. (2005) for exposure of several riverine species to a seismic airgun array. This study showed that exposure to an SEL_{cum} of 186 dB re 1 $\mu Pa_2 \cdot s$ accumulated over five seismic pulses within about five minutes resulted in about 20 dB of TTS in the lake chub (a hearing specialist) and northern pike (a hearing generalist). In all cases, fish that showed TTS recovered to normal hearing levels within 18–24 hours (Popper et al. 2005). This is the only study in the published literature that includes information on TTS recovery period in fish exposed to seismic airgun noise and is the basis for the fish TTS exposure thresholds included for seismic

airguns in Popper et al. (2014). The Popper et al. (2005) study was done using a static source (airgun array) and static receptors (fish in cages at 13-17 m from the array), and therefore is not representative of a marine seismic survey with a moving source. Hence, the Popper et al. (2005) experiment represents a worst-case scenario, as the source was fixed rather than moving – i.e. the five seismic pulses that were found to have caused TTS effects over five minutes would have all been of identical intensity. This would not be the case with a moving source.

Predicting the accumulated SEL was based on all sound exposure events along a representative survey track scenario at Site 1 along the ancient coastline. This site was selected as it is within an area where pygmy blue whales and whale sharks migrate and is the main area of commercial fishing within the OAs.

In-field Model Validation

JASCO completed more than 20 underwater acoustic measurement programs to validate their model predictions against experimental data collected during marine seismic surveys from around the world, including the Chukchi and Beaufort Seas in the Arctic Ocean, the North Pacific Ocean and Baffin Bay in the North Atlantic. In addition, JASCO completed a substantial number of in-field, sound source verification studies for various offshore projects, not only including marine seismic surveys but also exploratory drilling programs and pile driving, and the results of which have been used to conduct internal validation of the models used for this EP.

3.3.2.3 Underwater Acoustic Modelling Results

Acoustic Source Levels and Directivity

Most acoustic energy from the acoustic source is output at lower frequencies, in the tens to hundreds of hertz. Although there was little difference in the broadband source levels in the endfire and broadside directions, some directivity below a few hundred hertz led to slightly higher emissions in the broadside direction at those frequencies. Because the survey was modelled in shallow water, the low-frequency components associated with the highest spectral levels for the source attenuated rapidly compared to those at higher frequencies. Table 3-4 shows the PK and per-pulse SEL source levels for the 3260 in^3 acoustic source in the endfire, broadside, and vertical directions. The vertical source level that accounts for the surface ghost is also presented to make it easier to compare the output of other airgun array source models.

Table 3-4: PK and per-pulse SEL source levels for the 3260 in3 acoustic source

Direction	Peak source pressure level ($L_{S,pk}$) (dB re 1 µPa²m²)	Per-pulse source SEL ($L_{S,E}$) (dB 1 µPa²m²s)	
		10–2000 Hz	2000–25000 Hz
Broadside	249.3	224.7	186.8
Endfire	246.1	223.3	186.9
Vertical	255.5	228.5	194.5
Vertical (surface affected source level)	255.5	230.9	197.6

Per-pulse Sound Levels

Per-pulse results are presented for the three modelling sites for SEL (Table 3-5) and SPL (Table 3-6) and seafloor PK-PK Table 3-7). The tables list the estimated ranges and isopleths of interest for the 3260 in^3 acoustic source towed at 8 m. Additionally, the maximum sound level at the seafloor underneath the acoustic source was predicted, and determined to not reach the sound level of 226 dB re 1 µPa PK.

Table 3-5 - Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances from the 3260 in^3 array to modelled maximum-over-depth per-pulse SEL isopleths.

Per-pulse SEL (dB re 1 µPa²·s)	Site 1		Site 2		Site 3	
	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)
200	<0.02	<0.02	—	—	<0.02	<0.02
190	0.04	0.04	0.05	0.05	0.05	0.04
180	0.18	0.17	0.24	0.20	0.16	0.14
170	0.84	0.71	1.2	1.1	0.64	0.56
160	3.6	2.9	5.8	4.8	2.8	2.1
150	10.9	8.8	16.4	11.1	12.1	9.3
140	26.5	20.1	45.5	37.1	42.4	28.9
130	62.4	49.5	105.0	89.8	135.7	105.1
120	108.3	93.5	> 141.4*	NA	> 141.4*	NA

*Sound level contours reached maximum modelling extent.

Table 3-6 - Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances from the 3260 in^3 array to modelled maximum-over-depth SPL isopleths.

SPL (dB re 1 µPa)	Site 1		Site 2		Site 3	
	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)
200	0.04	0.04	0.04	0.04	0.04	0.04
190	0.16	0.14	0.14	0.13	0.15	0.13
180	0.76	0.67	1.1	0.84	0.51	0.46
170	2.9	2.5	3.0	2.8	2.2	1.9
166	5.6	4.1	5.7	4.7	4.0	3.0
160	9.4	7.6	11.5	7.9	8.8	6.5
155	14.2	11.6	20.1	15.1	16.8	12.0
150	20.2	16.8	34.8	28.5	26.8	20.8
140	55.1	41.2	100.8	77.2	91.2	61.4
130	106.0	89.9	> 141.4*	NA	> 141.4*	NA
120	> 141.4*	NA	> 141.4*	NA	> 141.4*	NA

* Sound level contours reached maximum modelling extent.

Table 3-7 - Maximum (R_{max}) horizontal distances from the 3260in³ array to modelled PK-PK at the seafloor

PK-PK (dB re 1 µPa)	Distance R_{max} (m)		
	Site 1	Site 2	Site 3
213	155	139	—
212	180	205	15
211	200	294	65
210	230	317	97
209	261	340	131
202	655	763	568

3.3.2.4 Potential Environmental Impacts

3.3.2.4.1 Background

The assessment of impacts and risks from discharge of underwater seismic pulses presented in this sub-section is based on information sourced from several scientific literature publications. It is important to note that it is sometimes difficult to interpret acoustic studies on the effects of underwater sound on marine fauna because authors often do not provide enough information to allow comparisons between studies; such as; inclusion of received sound levels, source sound levels, and specific characteristics of the sound, especially if incorrect units are compared.

Underwater sound levels are typically reported as dB with a reference level of 1 micro-Pascal (µPa). However, the dB number can represent multiple types of measurements, including zero-to-peak pressure (0-pk, or PK), peak-to-peak pressure (pk-pk), root-mean-square (rms) sound pressure level (SPL; dB re 1 µPa). It is not uncommon to find reports and even peer-reviewed papers on the effects of underwater noise sources that fail to specify if the sound levels values refer to the pk-pk, 0-pk or SPL measure of the waveform amplitude, or whether it is measured or estimated for the source or the receiver.

The assessment of impacts and risks presented in this sub-section is based on a rigorous and robust interpretation of the currently available science. Whilst every effort has been made to source papers and reports that relate, as far as possible, to the circumstances of this particular seismic survey, it is not possible to find examples that directly apply to the specific acoustic array parameters and environmental conditions (e.g. water depth range, seabed geo-acoustical properties, etc.) of the proposed OA. This process is further complicated by the uncertainties and shortcomings of the available literature, as outlined above.

Studies relating to the environmental effect of marine seismic surveys have largely focused on the potential effects to fish stocks and marine mammals from the sound waves associated with the seismic energy source. Concerns have included:

- pathological effects (lethal and sub-lethal injuries) – immediate and delayed mortality and physiological effects to nearby marine organisms.
- permanent or temporary effects on hearing – TTS and PTS.
- behavioural change to populations of marine organisms.
- disruptions to feeding, mating, breeding or nursery activities of marine organisms in such a way as to affect the vitality or abundance of populations.
- disruptions to the abundance and behaviour of prey species for marine mammals, seabirds and fish.
- altered behaviour or breeding patterns of commercially targeted marine species, either directly, or indirectly, in such a way that commercial or recreational fishing activities are compromised.

Pathological Effects

The response of marine fauna to marine seismic survey sounds will range from no effect to various behavioural changes. Immediate pathological effects are likely to be restricted to very short ranges and high sound intensities and are unlikely to occur for most species, as most free-swimming animals will practice avoidance manoeuvres well before they get within the ranges at which pathological effects may occur.

It is prudent to point out that there is presently confusion in some quarters caused by incorrectly associating the biological effects of high explosives with those of other types of underwater sound sources. High explosives produce a shock wave in the water that is subtly different to that of a sound wave, as produced by most underwater sources (including airguns), but vastly different in its biological implications. Shock waves produce severe pathological effects at considerable ranges, which vary depending on charge size, and physical or biological factors. Airguns do not produce shock waves and the effects described for high explosives do not apply to them. For example, Larson (1985) concluded from experiments with caged fish that mortality from shock waves only occurs when two criteria are met simultaneously:

- peak pressure is ≥ 2.75 x 10^5 Pa, and
- rise time and decay time is ≤ 1 ms.

Airguns do not meet these criteria and do not cause shock waves.

TTS and PTS Threshold Levels

"The softest sound that an animal can hear at a specific frequency is called the hearing threshold at that frequency. If an animal is exposed to sound below the threshold of hearing, the animal cannot hear the sound. The animal can hear sounds that are above its threshold without impairment until a certain combination of intensity and duration is reached. Above this limit, the animal's threshold of hearing may be temporarily or permanently worsened. When this happens, sounds must be louder in order to be detected. If the threshold returns to near normal levels after some period of time, this condition is called a temporary threshold shift or TTS. If the threshold does not return to near normal levels, the effect is called a permanent threshold shift or PTS. PTS can occur as a result of repeated occurrences of TTS, or it can occur as a result of a single exposure to a very intense sound."[7]

TTS occurs when an animal's hearing threshold is temporarily increased during and immediately after an exposure event to a loud sound source (Richardson *et al.* 1995). PTS occurs when an animal experiences a shift in their hearing threshold from permanent and irreversible damage caused by prolonged or repeated exposure to high sound levels (Richardson *et al.* 1995). Scientifically measuring PTS is difficult and not always possible, and thus TTS measurements over time are used to predict likely occurrences of PTS.

By definition hearing recovers after TTS, and hearing loss is temporary and acceptable. The extent (how many dB of hearing loss) and duration of the TTS may continue from minutes to days after the exposure.

3.3.2.5 Sound Source Justification

A 3,260 in^3 array is the maximum sized acoustic source that will be utilised for surveys conducted under the Rollo EP. This sound source will ensure that reservoir targets are correctly imaged, and that the most meaningful data can be acquired. Target depths can only be truly understood once acquisition commences and data can be analysed. If it was identified that target depths in shallow waters were shallower than anticipated, to physically change a source size during a survey would entail a complete rebuild of the air-gun arrays which can take over two days at a cost of up to $400,000/day (down time) and involve additional safety risks. Furthermore, although the design phase has not been completed, seismic lines will likely run both perpendicular and parallel with the shoreline and so vessels will very quickly move from shallow waters to deeper waters, and back again. This leaves very little opportunity to change the source and it is impractical to do it for every run.

A recent study published by the IAGC (2014) discussed how source volumes do not actually correspond linearly with source output levels, but rather that it is a cube-root relationship. In fact, a reduction in source air volume has a relatively minimal influence on source level, and the modelled or theoretical source levels often quoted for seismic source arrays are not directly predictive of the received levels at distance in the water column because of the effect of the element separation in the array. The sound pressure (i.e. peak

[7] http://www.dosits.org/animals/effectsofsound/marinemammals/hearingloss/

amplitude) is proportional to the cube root of the ratio between two source volumes. For example, an 8,000 in^3 array only produces about twice the loudness of a 1,000 in^3 array, all things being equal (e.g. number of elements and spatial dimensions of the array; IAGC, 2014).

"The idea of a simple universal solution to limit or reduce array output without loss of data quality and that would yield any measureable benefit to the marine environment is impracticable and not supported by current best available scientific data" (IAGC, 2014).

Based on stakeholder consultation and engagement (September 2017; Chapter 1) with the then Department of Fisheries (DoF), PGS assessed the merits of their claims and objections regarding the proposed acoustic source and comparisons with recent published reports (e.g. Richardson *et al.* 2017). DoF's concerns contributed significantly to defining PGS's acceptable level of impacts and risks, and thus PGS revised their survey parameters to include a reduced sound source with a maximum volume of 3,260 in^3 from a 4,130 in^3 source.

3.3.2.6 Disturbance to Planktonic Organisms

Receptors

Plankton is a diverse group of organisms defined by their pelagic habitat and inability to swim actively against a current. Some organisms form part of the plankton for only part of their life cycle, e.g. as eggs and larvae. Currently, there is little understanding of spawning areas and durations for most key indicator species in the NWMR.

Glomar Shoal, 11 km from the Beagle OA and 50 km from the NCB OA, has been identified as a potential area important for spawning events, due to its high species diversity and supposed productivity. However, this has not been confirmed and there are currently no fishing exclusion zones around this area.

Rankin Bank, 7 km from the NCB OA and > 100 km from the Beagle OA, has been identified as a potential area for spawning events as it supports a diversity of fish species including those of commercial value.

The Rollo OA overlaps the whale shark migration foraging BIA, and whale sharks may opportunistically forage whilst on migration as they leave the Ningaloo aggregation area and head north along the 200 m isobath within the foraging / migration BIA, from March to November.

No specific areas within the NCB or Rollo OAs have been identified as fish spawning areas. Consultation with DPIRD-Fisheries (Stakeholder Record DPIRD 0009) advised that the spawning grounds for most species occurs throughout their distribution. Fishers typically target areas of higher fish densities, which may include spawning individuals, and/or spawning aggregations. As it is difficult to identify spawning areas one way to undertake seismic surveys during time periods when there is the least overlap with spawning periods. Based on the current Departmental Seismic Guidance Statement (DoF 2013) the period of least overlap is June and July.

Feedback from PPA (PPA 005) and DPIRD-Fisheries (Stakeholder Record DPIRD 0009) is that pearl oyster broodstock may be present out to 100 m water depths. However, this is not support by available research by Condie et al. (2006) as discussed in Section 2.4.2.3.

Overview

Plankton includes fish eggs and larvae which are transported by currents and winds and hence cannot take evasive behaviour to avoid seismic sources.

Except for fish eggs, larvae and other minute planktonic organisms within a few metres of an airgun, no planktonic organisms are likely to be affected significantly by acoustic array discharges (McCauley, 1994). Larval stages are often considered more sensitive to stressors than adult stages, but exposure to seismic sound reveals no differences in larval mortality or abundance for fish, crabs or scallops (Carroll et al., 2017).

Table 3-8, Table 3-9 and Table 3-10 detail the sound exposure thresholds selected for the assessment of impacts to plankton and distance to those thresholds.

Table 3-8 - Maximum (R_{max}) horizontal distances (in m) from the 3260 in^3 array to modelled PK at the seafloor

Receptor	PK Threshold (*L*pk; dB re 1 µPa)	Distance R_{max} (m)		
		Site 1	Site 2	Site 3
Fish eggs and larvae	207	160	160	Not reached-

Table 3-9 - Distances to seafloor SEL_{24h} based criteria for the scenario within the Beagle MSS acquisition area

Receptor	Threshold for SEL24h (*LE*,24h; dB re 1 µPa^2·s)	Distance R_{max} (m)	
		Maximum-over-depth	At seafloor
Fish eggs and larvae	210	< 100 m	Not reached

Table 3-10 - Maximum (R_{max}) horizontal distances (in km) from the 3260 in^3 array to modelled maximum-over-depth PK-PK

Receptor	PK-PK (Lpk-pk; dB re 1 µPa)	Distance R_{max} (km)		
		Site 1	Site 2	Site 3
Plankton	178	6.9	10.3	14

Mortality/potential mortal injury

The majority of data presented in Table 3-11 indicates that the range of pathological effect on fish eggs and larvae is likely to be restricted to less than approximately 2 m. Calculations indicate that less than 0.02% of plankton in an area would be affected[8]. Data presented in Popper *et al.* (2014) cites the references and studies outlined in Table 3-11 and determined that eggs and larvae in very close proximity (<5 m) are likely to suffer mortality and tissue damage. Even with this increased radius, percentage of plankton affected would still be very minor and the effects from the seismic discharge is insignificant compared with the size of the planktonic population in a survey area or natural mortality rates for planktonic organisms.

In western USA, trials of seismic air-gun emissions as a method to reduce the survival of non-native lake trout embryos produced high mortalities (of up to 100%), but only at close range (0.1 m). At distances of 2.7 m, mortalities did not differ from those of controls (Cox *et al.* 2012 as cited in NSW DPI 2014).

Sætre and Ona (1996) calculated that under the 'worst case' scenario, the number of larvae killed during a typical seismic survey was 0.45% of the total population. For a number of fish species, natural mortality is estimated at 5-15% per day. Consequently, seismic-created mortality is so low compared to natural mortality that it can be considered to have inconsequential impact on recruitment to fish stock populations.

Day *et al.* (2016) looked at the effects of a simulated seismic survey on spiny lobsters and found that "seismic exposure did not result in a decrease in fecundity, either through a reduction in the average number of hatched larvae or as a result of high larval mortality; compromised larvae or morphological abnormalities. These results support the suggestion that early life stage crustaceans may be more resilient to seismic air gun exposure than other marine organisms (Pearson *et al.* 1994 as cited in Day *et al.* 2016)". Received levels were ~211 dB re 1 µPa (PK-PK; approximately 205 dB re 1 µPa PK) and similar to those proposed by Popper *et al.* (2014).

Gausland (2000) in his paper on the impacts of seismic surveys on marine life, noted several studies which confirmed that that signal levels exceeding 230-240 dB re 1 µPa (PK-PK) are necessary for harm to occur and so therefore massive physical damage can only occur within a few metres from the air guns. Consequently, seismic-created mortality is so low that it can be considered to have inconsequential impact on recruitment to the populations.

[8] This assumes plankton are uniformly distributed, single gun array, 18.75 m shot point interval, maximum range of pathological effect 2 m.

Table 3-11 - Observed seismic noise pathological effects on fish eggs and larvae

Year	Title	Type[9]	Species	Source(s)	Exposure	Results – Main findings	Effect?	Reference
2017	Widely used marine seismic survey air gun operations negatively impact zooplankton	F	Various	1 x Sercel G Gun II (150 in^3)	178 dB PK-PK	Experimental air gun signal exposure decreased zooplankton abundance when compared with controls, as measured by sonar (~3–4 dB drop within 15–30 min) and net tows (median 64% decrease within 1 h) and caused a two- to threefold increase in dead adult and larval zooplankton. Impacts were observed out to the maximum 1.2 km range sampled. *INCREASED ZOOPLANKTON MORTALITY OUT TO 1.2 KM.*	**YES < 1.2 km**	McCauley *et al.* 2017
2017	Potential impacts on zooplankton of seismic surveys	M	Various	n/a	n/a	Impact of the seismic survey on zooplankton biomass was greatest in the Survey Region (0.78, i.e., 22% of the zooplankton biomass was removed) and declines moving to the Survey Region + 15 km (0.86), and the Survey Region + 150 km regions (0.98, see Table for values); there was no discernible effect on the entire Northwest Shelf Bioregion. *TEMPORARY IMPACT ON ZOOPLANKTON WITHIN SURVEY AREA +15 KM.*	**YES < 1.2 km**	Richardson *et al.* 2017
2016	Seismic air gun exposure during early-stage embryonic development does not negatively affect spiny lobster larvae	F	Spiny Lobster *Jasus edwardsii*	1 x Sercel G Gun II (45 and 150 in^3)	209 – 212 dB PK-PK, 192 – 199 dB SEL_{CUM}	Overall there were no differences in the quantity or quality of hatched larvae, indicating that the condition and development of spiny lobster embryos were not adversely affected by air gun exposure. No mortality up to a year after airgun exposure *NO INCREASED MORTALITY OR INJURIES COMPARED TO CONTROL GROUP*	**NO**	Day *et al.* 2016
2012	Common Sole Larvae Survive High Levels of Pile-Driving Sound in Controlled Exposure Experiments	L	Common Sole *Solea solea*	Projector playing pile driving sounds.	≤ 210 dB PK ≤ 206 dB SEL_{CUM}	No clear differences between the exposure groups and the control group were observed for any of the larval stages. *NO INCREASED MORTALITY OR INJURIES COMPARED TO CONTROL GROUP*	**NO**	Bolle, 2012

[9] F – Field, L, Laboratory, M – Modelling, U – Unknown.

Year	Title	Type[9]	Species	Source(s)	Exposure	Results – Main findings	Effect?	Reference
2011	Use of Seismic Air Guns to Reduce Survival of Salmonid Eggs and Embryos	F	Lake trout *Salvelinus namaycush*	1 x Unknown Airgun (40 in^3).	207 – 232 dB SPL.	Mortality in lake trout embryos treated at 0.1 m from the air gun at 207 and 267 TU°C appeared higher than controls at the 15 m depth. Mortality at the 2.7 m distance did not appear to differ from controls at any developmental stage or either depth. *NO INCREASE IN EGG MORTALITY OR LARVAE SURVIVAL*	**NO**	Cox, 2011
2009	Potential Effects of Seismic Airgun Discharges on Monkfish Eggs (Lophius americanus) and Larvae	L	Monkfish *Lophius americanus* Capelin *Mallotus villosus*	1 x Sleeve gun (20 in^3), 1 x GI gun (? In^3)	~205 dB PK-PK, ~199 dB PK-PK	No significant differences were observed between control and exposed larvae or eggs. *NO INCREASED MORTALITY OR INJURIES COMPARED TO CONTROL GROUP.*	**NO**	Jerry, 2009
2009	Potential Impacts of Seismic Energy on Snow Crab	F	Snow Crab *Chionoecetes opilio*	1,310 in3 air-gun array	Unknown	Survival of embryos being carried by female crabs, and locomotion of the resulting larvae after hatch, were unaffected by the seismic survey. *NO INCREASE IN EGG MORTALITY OR LARVAE SURVIVAL.*	**NO**	DFO, 2004
2007	Pilot study on the effects of seismic air gun noise on lobster (Homarus americanus)	F L	Lobster (*Homarus americanus*)*	L - 10 in^3 F – 40 in^3	Field: 227 dB PK-PK (estimated) Lab: 202 PK-PK (measured)	No effects on mortality up to 8 months after seismic survey completed *NO INCREASE IN EGG MORTALITY OR LARVAE SURVIVAL.*	**NO**	Payne *et al.* 2007
2003	Effect of Seismic Energy on Snow Crab	L	Snow Crab *Chionoecetes opilio*	2 x Sleeve gun (10 in3), 1 x Sleeve gun (20 in3) and 4 x Sleeve gun (40 in^3). Used individually or combined in an array (200 in^3).	201 – 207 dB PK 40 in^3, 197 – 237 dB PK, 200 in^3	The eggs of one female showed significant effects on development when exposed at a very close range of 2-m. The exposed eggs were much slower to develop than were the unexposed controls. *EGG DEVELOPMENT RETARDED AFTER HIGH (221 dB) EXPOSURE AT CLOSE (2 M) RANGE.*	**YES < 2 m**	Christian *et al.* 2003
1996	Effects of airguns on eggs, larvae and fry (EN)	F	Atlantic Cod *Gadus morhua* Pollock *Pollachius pollachius* Atlantic Herring *Clupea harengus*	Airgun array consisting of 3 x Bolt 1500 C (585 in^3), 1 x Bolt 1500 C (290 in^3) and 1 x Bolt 1500 C (155 in^3)	220 – 242 dB SPL	Highest mortality rates and most frequent injuries were observed out to 1.4 m distance, while low and no mortality rate and more infrequent injuries were observed out to 5 m distance. *INCREASED MORTALITY AND INJURY WITHIN 5 M OF THE ARRAY*	**YES < 5 m**	Booman, 1996

Year	Title	Type[9]	Species	Source(s)	Exposure	Results – Main findings	Effect?	Reference
			Turbot *Scophthalmus maximus* European Plaice *Pleuronectes platessa*					
1994	Effects of seismic energy releases on the survival and development of zoeal larvae of dungeness crab (Cancer magister)	F	Dungeness Crab *Cancer magister*	1 x Unknown Array (13.9 L / 842 in^3).	244 (estimated dB SPL	For immediate and long-term survival and time to molt, the field experiment revealed no statistically significant ($\alpha > 0{\cdot}05$) effects on zoeae for exposures as close as 1 m from the array, nor for mean sound pressure as high as 231 dB. *NO SIGNIFICANT EFFECTS FOR EXPOSURES AS CLOSE AS 1 M FROM THE ARRAY*	**NO**	Pearson *et al.* 1994
1992	The Reaction of Bottom Fish Larvae to airgun pulses in the context of the vulnerable Barent Sea Ecosystem	U	Atlantic Cod *Gadus Morhua*	1 x Single airgun.	Estimated at 214 – 220 dB SPL	Injuries to larvae were reported for the closest (1 m) exposure range.	**YES < 1 m**	Matishov, 1992
1988	Effects of air gun energy releases on northern anchovy	U	Northern Anchovy *Engraulis mordax*	Unknown	Unknown	Extrapolation of the survival and histology data suggests that noticeable impacts on eggs and larvae of this fish would result only from multiple, close exposures to seismic arrays.	**YES < 1 m**	Greenlaw and Holliday, 1988
1987	Scaring effects in fish and harmful effects on eggs, larvae and fry by offshore seismic explorations.	F	Atlantic Cod *Gadus morhua*	1 x Bolt 600 B (640 cm3), 1 x Bolt 1500 C (8610 cm3) and 1 x Water gun (8610 cm3)	Not reported.	No effect following exposure to airguns. Increased mortality after close range exposure to a water gun. *NO EFFECT FROM AIRGUNS. INCREASED MORTALITY FROM WATER GUN AT CLOSE RANGE.*	**NO**	Dalen and Knutsen, 1987
1973	Effect of elastic waves generated in marine seismic prospecting on fish eggs in the Black Sea	U	Various Species	1 x Unknown Airgun (200 in3).	210 dB SPL (estimated at 10 m)	Pathological effects and effects on survivability were found for the closest (0, 5 m) exposure. No effects were present at the 10 m exposure. *PATHOLOGICAL EFFECTS AND REDUCED SURVIVABILITY AT DISTANCES < 5 M.*	**YES < 5 m**	Kostyvchenko, 1973

The recently published study by McCauley *et al.* (2017), conducted in temperate waters of south-east Tasmania, is the first large-scale field experiment on the impact of seismic activity on zooplankton. This study measured zooplankton abundance and the proportion of the population that was dead at three distances from a single 150 in^3 airgun—0, 200 and 800 m. The experiment estimated the proportion of the zooplankton that was dead, both before and after exposure to airgun noise, using net samples to measure zooplankton abundance, and bioacoustics to identify the distribution of zooplankton. In this study, copepods dominated the mesozooplankton (0.2-20 mm), and impacts were not assessed on microzooplankton (0.02-0.2 mm) or macrozooplankton (>20 mm). There was movement of water through the experimental area, which made interpreting their results more difficult (Richardson *et al.* 2017).

McCauley *et al.* (2017) provide three findings from the experiment to show that zooplankton were affected by the seismic source:

i) the proportion of the mesozooplankton community that was dead increased two- to three-fold;
ii) the abundance of zooplankton estimated by net samples declined by 64%; and
iii) the opening of a "hole" in the zooplankton backscatter observed via acoustics.

They found that exposure to airgun noise significantly decreased zooplankton abundance and increased the mortality rate from a natural level of 19% per day to 45% per day (on the day of exposure, and that these impacts were observed out to the maximum range assessed (1.2 km).

Scientists from CSIRO's Oceans and Atmosphere Business Units were contracted by APPEA to undertake a desktop study that: a) critically reviewed the methodologies and findings of the McCauley *et al.* (2017) experiment; and b) simulated the large scale impact of a seismic survey on zooplankton in the Northwest Shelf region, based on the mortality rate associated with airgun noise exposure reported by McCauley *et al.* (2017).

The CSIRO review of the McCauley *et al.* (2017) study found that there were three primary questions raised by the results of the experiment, all of which warrant further investigation (Richardson *et al.* 2017):

1) Why was there no attenuation of the impact with distance?

There is no consistent decline in the proportion of zooplankton that are dead with increasing distance away from the airgun. The energy of the sound waves at a distance of 1.2 km is substantially lower than at the source.

2) Why was there an immediate decline in abundance?

It is unclear why there would be a near immediate drop in zooplankton abundance as measured by net samples and acoustic data. If zooplankton were killed, they would not immediately sink from the surface layers, or be rapidly eaten. A drop in abundance would be more likely once the dead zooplankton either sunk to the bottom or were removed by predation. Richardson *et al* (2017) conclude it is difficult to explain this immediate decline in zooplankton abundance.

3) Was there sufficient replication to be confident in the study findings?

The conclusions were based on a relatively small number of zooplankton samples. A total of 24 samples were collected – 2 tows each sampling time x 3 distances from the gun (0 m, 200 m, 800 m) x 2 levels (Control, Exposed) x 2 replicate experiments (Day 1, Day 2). This means that there were only 12 samples collected under conditions exposed to the airgun, six on each day of the two experiments. The main potential confounding explanation in the study would be that a different water mass entered the area on each day of the experiment and had lower abundance and higher quantities of dead zooplankton. Richardson *et al.* (2017) conclude that:

> "*although this is relatively unlikely it cannot be discounted because of the relatively few samples collected and only two replicate experiments conducted*."

Independently of the APPEA/CSIRO study, the International Association of Geophysical Contractors (IAGC) conducted its own review of the McCauley *et al.* (2017) paper. This review came to the following conclusion:

> "*While we found the study interesting, we are also troubled by the small sample sizes, the large day-to-day variability in both the baseline and experimental data, and the large number of speculative conclusions that appear inconsistent with the data collected over a two-day period. Both statistically and methodologically, this project falls short of what would be needed to provide a convincing case for adverse effects from geophysical survey operations*." (IAGC, 2017).

The second component of the CSIRO study was to estimate the spatial and temporal impact of seismic activity on zooplankton on the Northwest Shelf from a large-scale seismic survey, considering mortality estimates of McCauley *et al.* (2017), and accounting for typical growth rates, natural mortality rates, and the ocean circulation in the region The approach modelled a hypothetical 3D survey (2,900 km^2 in size, over a 35-day period, in water depths of 300-800 m) on the edge of the Northwest Shelf during summer.

To simulate the movement of zooplankton by currents, the researchers used a hydrodynamic model that seeded 0.5 million particles into CSIRO's Ocean Forecast Australia Model. Zooplankton particles could be hit multiple times by airgun pulses if they were carried by currents into the future survey path. The greatest limitation in this approach was accurate knowledge of the natural growth and mortality rates of zooplankton, and to address this the CSIRO researchers tested the sensitivity of the model to different recovery (growth-mortality) rates, and also the sensitivity of the results to ocean circulation by undertaking simulations with and without water motion (Richardson *et al.* 2017).

The results of the simulations that included ocean circulation showed that the impact of the seismic survey on zooplankton biomass was greatest in the *Survey Region* (defined as the survey acquisition area with a 2.5 km impact zone around it) (22% of the zooplankton biomass was removed) and declines as one moves beyond it to the *Survey Region + 15 km* (14% of biomass removed), and the *Survey Region + 150 km* (2% of biomass removed). The time to recovery (to 95% of the original level) for the *Survey Region* and *Survey Region + 15 km* recovery was 39 days (38-42 days) after the start of the survey and three days (2-6 days) after the end of the survey (Richardson *et al.* 2017).

The major findings of the CSIRO study were that there was substantial impact of seismic activity on zooplankton populations on a local scale within or close to the survey area, however, on a regional scale the impacts were minimal and were not discernible over the entire Northwest Shelf Bioregion. Additionally, the study found that the time for the zooplankton biomass to recover to pre-seismic levels inside the survey area, and within 15 km of the area, was only three days following the completion of the survey. This relatively quick recovery was due to the fast growth rates of zooplankton, and the dispersal and mixing of zooplankton from both inside and outside of the impacted region (Richardson *et al.* 2017).

Received sound levels exceed the mortal injury impact threshold criterion for fish eggs and larvae i.e. SPL PK 207 dB re 1 µPa (Popper 2014) at a maximum distance of 160 m from the sound source (Site 1 and 2, Table 3-8). This distance is used as it is the furthest between the dual criteria from Popper 2014). Received levels above the criterion would:

- Not be received at Glomar Shoal as the closest distance to Glomar shoal is 11 km.
- Not be reached at areas where POMF broodstock areas are likely (20 m water depth (Condie et al. 2007) based on no acquisition within 100 m water depth of POMF Zone 1 and 2.
- Would not have significant impact on fish spawning within the survey area as there is a 5% to 15% overlap of areas where there is catch effort which based on advice from DPIRD-Fisheries corresponds with areas of spawning.

Using the received level at which McCauley *et al.* (2017) measured an impact, as this is the latest research to show an impact at this low a level, 178 dB PK-PK is reached at the maximum distance at Site 3 at 14 km (Table 3-10). This corresponds with the CSIRO finding that predicted that at the Survey Region + 15 km 14% of the biomass was removed.

Though the CSIRO model was based on a hypothetical 3D survey of 2,900 km^2 in size and over a 35-day period it is seen as being applicable for this impact assessment based on the following:

- Plankton is not evenly distributed spatially or temporally within the water column due to the water movement, spawning and nutrient availability.

- Not all plankton within an area where a seismic source is active will be affected and thus they will be available to commence recovering. Not all plankton will be impacted as the plankton is moving as is the seismic source. Richardson *et al.* (2017) identified that within the survey region, ~1-2% of the total number of particles are impacted in any 12-hour period, the time required to survey one line. This would not change if a line was longer for a larger survey.
- Based on the noise modelling the maximum distance to the McCauley *et al.* (2017) 178 dB PK-PK is 14 km thus once the seismic source is further than 14 km from an area the plankton population would commence to recover. As seismic surveys are undertaken in a racetrack methodology to allow sufficient area for the seismic vessel with streamers to turn with every line the seismic source gets further away from its previous position (Figure 3-2). A worse case would be a survey that went across the NCB OA (360 km wide at 8 km/hr would take 1.9 days thus to get 14 km from the starting line would be 23 lines (each line is 600 m apart) which would take 44 days. This is not significantly more than the survey duration used by CSIRO (35 days).
- Richardson et al. (2017) showed that zooplankton communities can begin to recover during the survey period during periods of good oceanic circulation, or "bottom out" at a maximum impact level (presumably where growth rates and/or zooplankton entering the survey area roughly approximate mortality rates) after 23 - 30 days of commencement of survey operations, and therefore a continuous decline is zooplankton throughout the survey period is not anticipated and parts of the survey are would progressively recover during the survey.

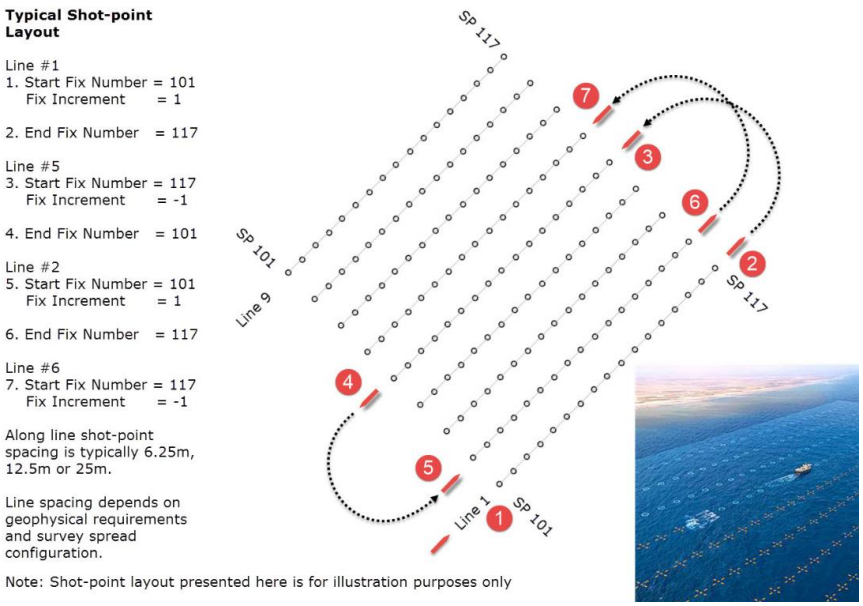


Figure 3-2 - Seismic Racetrack Layout

Summary

Thus, based on the application of the CSIRO study 14% of the plankton biomass may be potentially removed up to 15 km. Though impacts based on the noise levels are predicted out to 14 km the 15 km distance used by Richardson et al. (2017) has been used to be conservative.

Glomar Shoal

Glomar Shoal which is 11 km from the Beagle OA has been identified as a potential area important for spawning events, due to its high species diversity and supposed productivity mainly for commercial fish species rather than coral spawning (DEWHA 2008a). Potential impacts to plankton, including fish eggs and larvae and coral spawn at Glomar Shoal are within an acceptable level and would not impact on recruitment and hence ecology of the shoal based on:

- Any mortality or mortal injury effects to fish eggs and larvae resulting from seismic noise emissions are likely to be inconsequential compared to natural mortality rates of fish eggs and larvae, which are very high (exceeding 50% per day in some species and commonly exceeding 10% per day). For

example, in a review of mortality estimates (Houde and Zastrow 1993), the mean mortality rate for marine fish larvae was M = 0.24, a rate equivalent to a loss of 21.3% per day.

- In the experiment undertaken by McCauley et al. (2017) zooplankton mortality rate background levels were 19% thus impacts to zooplankton are likely to be within natural mortality rates.
- To reduce potential impacts to commercial fish spawn seismic surveys will only be undertaken within the Mackerel and Pilbara line, trap and trawl fisheries catch effort areas during May, June and July which is outside of known spawning timing for these fisheries major catch species.
- Hard and soft coral cover at Glomar Shoal is 0.4% and 1.3%, respectively (AIMS 2014) thus coral cover is low and therefore coral spawning is likely to be at low levels.

Rankin Bank

Rankin Bank which is 7 km from the NCB OA has been identified as a potential area for spawning events as it supports a diversity of fish species. Potential impacts to plankton, including fish eggs and larvae at Rankin Bank are within an acceptable level and would not impact on recruitment and hence ecology of the bank based on:

- Any mortality or mortal injury effects to fish eggs and larvae resulting from seismic noise emissions are likely to be inconsequential compared to natural mortality rates of fish eggs and larvae, which are very high (exceeding 50% per day in some species and commonly exceeding 10% per day). For example, in a review of mortality estimates (Houde and Zastrow 1993), the mean mortality rate for marine fish larvae was M = 0.24, a rate equivalent to a loss of 21.3% per day.
- In the experiment undertaken by McCauley et al. (2017) zooplankton mortality rate background levels were 19% thus impacts to zooplankton are likely to be within natural mortality rates.
- To reduce potential impacts to commercial fish spawn seismic surveys will only be undertaken within the Mackerel and Pilbara line, trap and trawl fisheries catch effort areas during May, June and July which is outside of known spawning timing for these fisheries major catch species.

Whale Sharks

The Rollo OA overlaps the whale shark migration foraging BIA, and whale sharks may opportunistically forage whilst on migration as they leave the Ningaloo aggregation area and head north along the 200 m isobath within the migration / foraging BIA, from July to November (DoE, 2015j). The whale shark feeds on a variety of planktonic and nektonic prey, including small crustaceans, small schooling fishes such as sardines, anchovies and mackerel and, to a lesser extent, on small tuna and squid (Compagno 1984; Last & Stevens 1994 in DoEE 2018a). Potential impacts to plankton are within an acceptable level and would not impact on whale shark foraging based on:

- The whale shark seasonally aggregates in coastal waters off Ningaloo Reef between March and July, at Christmas Island between December and January, and in the Coral Sea between November and December. These seasonal aggregations are thought to be linked to localised seasonal ‘pulses’ of food productivity (DoE (2016j). If whale sharks are moving between these areas to feed it could be assumed that they are not reliant on feeding while migrating and that feeding is opportunistic.
- As detailed predicated impacts to plankton, fish eggs and larvae of 14% are within natural mortality rates.
- Mortality or mortal injury effects to plankton, fish eggs and larvae do not impact on whale sharks being able to feed on them as they will still be available within the water column.
- Whale sharks congregate at Ningaloo Reef from March to July and then migrate along the 200 m isobath mainly between July and November (DoE 2015j). Though migration can occur during July it would be expected that numbers would be low as it is the start of the migration period. There will be no seismic activity within the whale shark migration / foraging BIA from August to November further reducing potential impacts.

Commercial Fish Species

No specific areas within the NCB or Rollo OAs have been identified as fish spawning areas. Consultation with DPIRD-Fisheries (Stakeholder Record DPIRD 0009) advised that the spawning grounds for most species occurs throughout their distribution. Fishers typically target areas of higher fish densities, which may include

spawning individuals, and/or spawning aggregations. Fishers typically target areas of higher fish densities, which may include spawning individuals, and/or spawning aggregations. Potential impacts to commercial fish species fish eggs and larvae are within an acceptable level and would not impact on recruitment and hence the fisheries biomass based on:

- Any mortality or mortal injury effects to fish eggs and larvae resulting from seismic noise emissions are likely to be inconsequential compared to natural mortality rates of fish eggs and larvae, which are very high (exceeding 50% per day in some species and commonly exceeding 10% per day). For example, in a review of mortality estimates (Houde and Zastrow 1993), the mean mortality rate for marine fish larvae was M = 0.24, a rate equivalent to a loss of 21.3% per day.
- In the experiment undertaken by McCauley et al. (2017) zooplankton mortality rate background levels were 19% this impacts to zooplankton are likely to be within natural mortality rates.
- The area of overlap with fisher's target areas (area of catch effort) range from 5 to 15%. Thus, in the worst case 85% of the target areas are not impacted and available to provide spawn for commercial species.
- To reduce potential impacts to commercial fish spawn seismic surveys will only be undertaken within the Mackerel and Pilbara line, trap and trawl fisheries catch effort areas during May, June and July which is outside of known spawning timing for these fisheries major catch species.
- For the Mackerel Managed Fishery, the three indicator species for assessment and stock status are Spanish mackerel, grey mackerel and samson fish. The spawning biomass and breeding stock for these species has been assessed as adequate (Fletcher et al. 2017).
- For the Pilbara line, trap and trawl fisheries the three indicator species for assessment and stock status are red emperor, bluespotted emperor and Rankin cod. A 2016 assessment of the three indicator species estimated the spawning biomass of red emperor stock to be currently above the threshold level and the stocks of bluespotted emperor and Rankin cod are well above the target spawning biomass levels (Fletcher et al. 2017).
- For the North West Slope Trawl Fishery scampi is assessed as a single stock. Information on spawning biomass was not available for this species (Patterson et al. 2017).

Feedback from PPA (PPA 005) and DPIRD-Fisheries (Stakeholder Record DPIRD 0009) is that pearl oyster broodstock may be present out to 100 m water depths. However, this is not support by available research by Condie *et al.*(2006) as discussed in Section 2.4.2.3.

In the NWMR spawning of *P. maxima* occurs all year round, with a peak in September to November (Southgate and Lucas, 2008). *P. maxima* then metamorphose, settling into a benthic, filter feeder within 3-4 weeks. *P. maxima* are therefore less likely to be impacted by seismic surveys once they have settled on the seabed. Losses in the water column during the planktonic stage are extremely high, and <1% of the fertilised eggs actually survive the veliger stage (Southgate and Lucas, 2008).

P. maxima is known to occur out to 100 m water depth, but the vast majority of the *P. maxima* brood stock responsible for spat recruitment into the fishery adjacent to Eighty Mile Beach are located in much shallower waters (Condie et al. 2006):

- Mother of pearl (MOP) distribution in the Eighty Mile Beach region is concentrated around the 8-15 m water depths.
- Brood stock responsible for stock recruitment into the fishery located in water depths less than 20 m.
- Deeper 'unfished' stock are not a brood stock source for the fishery.
- MOP inshore stock appears to be self-sustaining and may even be providing larvae to deeper stock in irregular recruitment events.

In 2014, PGS commissioned Dr Andrew Levings (a former head diver in the pearl shell fishery, pearl farm manager, and PPA trusted Pearl Oyster expert) to undertake a review of the PGS Titan MC3D MSS and the potential impacts on the POMF at Eighty Mile Beach (Attachment 2F). His recommendations were:

- To avoid surveys inside of 80 m during the peak of the spawning season from October to mid-December.
- To commit resources to understand the response of *P. maxima* to geophysical surveys so that the range of effect on adults and larvae can be established.

PGS has committed to not undertake seismic acquisition (seismic source would not be activated) within water depths to 100 m within POMF Zone 1 and Zone 2 pending research outcomes that are acceptable to the PPA. Thus, impacts to pearl oyster spawn that would impact recruitment and hence broodstock are within an acceptable level based on:

- Impacts are predicted out to 15 km from the source, however, the seismic source will not be activated within the water depths to 100 m within POMF Zone 1 and Zone 2 providing over 60 km to water depths of 50 m providing a significant buffer between water depths where brood stock responsible for stock recruitment into the fishery are located (20 m).
- 14% of the plankton biomass may be potentially removed which is less than the natural losses during the planktonic stage of <1% of fertilised eggs surviving to the veliger stage (Southgate and Lucas, 2008).
- Dr Andrew Levings advised to avoid surveys inside of 80 m during the peak of the spawning season from October to mid-December. PGS has implemented the control of no seismic surveys inside 100 m throughout the year minimising potential impacts both spatially and temporally.

Impairment

Based on the Popper *et al.* (2014) semi-quantitative exposure criteria there is a moderate risk of potential impairment (recoverable injury and TTS) effects to fish eggs and larvae within tens of metres of the source (Table 3-12).

Table 3-12 – Exposure guidelines sound levels for mortality, impairment and behaviour in eggs and larvae

Type of animal	Mortality or potential mortal injury	Impairment		Behaviour
		Recoverable injury	TTS	
Eggs and larvae	>210 dB SEL_{24h} or >207 dB PK	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low

Behavioural

Similarly, based on the Popper *et al.* (2014) semi-quantitative exposure criteria there is a moderate risk of behavioural effects to fish eggs and larvae within tens of metres of the source (Table 3-12). It is not clear what these behavioural impacts could be, but it is possible that zooplankton, including free-swimming larvae, could move either vertically or horizontally within the water column in response to a stimulus such as underwater noise. These impacts are unlikely to be significant, especially as they will be constrained to a range of a few tens of metres from the source.

3.3.2.7 Disturbance to Benthic Invertebrates

Receptors

Crustaceans

The NCB and Beagle Operating Areas overlap the North West Slope Trawl Fishery (NWSTF) area of effort (2011 – 2016) by 23% and 5%, respectively. It is likely that the area of effort is where more scampi are present and hence would represent the worst-case scenario. AFMA (2018) state that Scampi are a benthic species that inhabits the continental shelf. They can usually be found on Globigerina ooze at depths of 420-500 m.

The NCB OA overlaps the Western Deepwater Trawl Fishery (WDTF) fishery but there has been no catch effort within the area of overlap since the 2008 -2009 fishing season (Wilson et al 2010). One of the species targeted by the WDTF is deepwater bugs.

Crustaceans are likely to be present at the KEF Ancient coastline at 125 m depth contour which is overlapped by both the NCB and Beagle OAs, Exmouth Plateau (overlapped by the NCB OA), Glomar Shoal (11 km from the Beagle OA) and Rankin Bank (7 km from the NCB OA. Though crustaceans are likely to be present within the whole of the operating area it is likely that these areas are representative of where crustaceans would be present in higher numbers and hence would represent the worst-case scenario.

Molluscs

The NCB and Beagle Operating Areas overlap Zone 1 of the Pearl Oyster Managed Fishery (POMF) and the Beagle Operating Area overlaps the Zone 2 of the POMF. Fishing for pearl oyster occurs in 10 -35 m water depths with the closest fishing area 35 km from the Beagle OA and the nearest pearl farm 49 km from the Beagle OA (Figure 2-57).

Pinctada maxima typically occurs in water depths up to 70 m though has been recorded up to 120 m. Feedback from PPA (PPA 005) and DPIRD-Fisheries (Stakeholder Record DPIRD 0009) is that pearl oyster broodstock may be present out to 100 m water depths. However, this is not support by available research by Condie *et al.* (2006) as discussed in Section 2.4.2.3.

Molluscs are likely to be present at the KEF Ancient coastline at 125 m depth contour which is overlapped by both the NCB and Beagle OAs, Exmouth Plateau (overlapped by the NCB OA), Glomar Shoal (11 km from the Beagle OA) and Rankin Bank (7 km from the NCB OA. Though molluscs are likely to be present within the whole of the operating area it is likely that these areas are representative of where molluscs would be present in higher numbers and hence would represent the worst-case scenario.

Coral

Corals have been identified as a feature at the KEF Ancient coastline at 125 m depth contour which is overlapped by both the NCB and Beagle OAs, Glomar Shoal (11 km from the Beagle OA) and Rankin Bank (7 km from the NCB OA.

Receptor sensitivity

Few marine invertebrates have sensory organs that can perceive sound pressure (such as a gas-filled bladder), but many have a statocyst and/or elaborate arrays of tactile 'hairs' that are sensitive to hydro-acoustic disturbances (Carroll *et al.* 2017 and McCauley, 1994). These sensory hairs or organs are collectively known as mechanoreceptors, and crustaceans are particularly well endowed with them.

The statocyst organs, found in a wide range of invertebrates, are utilised by animals to maintain their equilibrium and orientation and to direct their movements through the water. Their functions include the detection of gravitational forces and linear accelerations. Although there is little information available on the functioning of these sensory organs, it has been suggested that marine invertebrates are sensitive to low-frequency sounds and that this sensitivity is not directly linked to sound pressure but to particle motion detection (André *et al.* 2016, Roberts and Breithaupt 2016, Edmonds *et al.* 2016).

Decapod crustaceans have a variety of external and internal sensory receptors that are potentially responsive to sound and vibration. Many of these resemble vertebrate receptors that respond to hydrodynamic stimulation, particle motion and possibly pressure. However, the exoskeleton and body plan of aquatic decapods are more capable of responding to particle displacement components of an impinging sound field than pressure changes. The limited acoustic sensitivity of decapods is also related to their absence of gas-filled organs such as those associated with pressure detection in fishes (e.g. swim bladders). However, sound detection in decapods is believed to occur through the extensive arrays of sensilla that sense mechanical disturbances in the surrounding water and sediment; known as the particle motion component of the sound field (Edmonds *et al*. 2016).

A recent critical review of the potential impacts of marine seismic surveys on fish and invertebrates by Carroll *et al.* (2017) summarises the impacts of low-frequency sound on marine invertebrates based on a literature review of 70 studies, which comprised a total of 68 species of fish and 35 species of invertebrates, including several studies that were not differentiated (Carroll *et al.* 2017).

Carroll *et al.* (2017) conclude that:

"Our review has identified scientific evidence for high-intensity and low-frequency sound-induced physical trauma and other negative effects on some fish and invertebrates; however, the sound exposure scenarios in some cases are not realistic to those encountered by marine organisms during routine seismic operations. Indeed, there has been no evidence of reduced catch or abundance following seismic activities for invertebrates, and there is conflicting evidence for fish with catch observed to increase, decrease or remain the same."

This review (Carroll *et al.* 2017) concluded that there were no significant differences detected in any of these studies for marine invertebrates exposed to a seismic source, either between sites exposed and not exposed to the acoustic source (Figure 3-3).

Crustaceans

There has recently been several comprehensive reviews of seismic noise impacts to invertebrates—e.g. Carroll *et al.* (2017), Edmonds *et al.* (2016) and Salgado Kent *et al.* (2016). Studies specific to scampi/prawn species are limited, however, several studies have been undertaken on decapods with a range of effects to no effects identified. Crustaceans were the most studied group in terms of the range of metrics investigated, including catch rates and physical, behavioural, and physiological effects (Carroll *et al.* 2017).

The review by Edmonds *et al.* (2016) also included a critical evaluation of crustacean sensitivity to high amplitude underwater noise. Sensitivity to underwater noise is shown by the Norway lobster and closely related crustacean species, including juvenile stages. They concluded that current evidence supports physiological sensitivity to local, particle motion effects of sound production. These reviews summarise that a range of physiological response have been identified in some studies, however, the received sound levels are typically at levels that would be received within a few hundred meters from the sound source or have been from repeated exposure at the same sound levels which is not realistic in an actual survey. Several researchers (including Edmonds *et al.* 2016 and Christian *et al.* 2003) have commented that current stock assessment methodologies do not have the resolution to show statistically significant changes in distribution or abundance from the seismic survey operations above that of natural variation.

<u>Mortality/potential mortal injury</u>

The review by Salgado Kent *et al.* (2016) supported a finding that there was no evidence in the current literature of direct mortality of crustaceans from seismic exposure. A range of physiological responses have been identified in some studies, however, the received sound levels are typically at levels that would be received within a few hundred metres from the sound source or have been from repeated exposure at the same sound levels which is not realistic in an actual survey.

As summarised by Carroll *et al.* (2017) "*Previous field-based studies on adult populations revealed no evidence of increased mortality due to airgun exposure in …..lobsters up to eight months after exposure (Payne et al. 2007; Day et al.,2016a). Similarly, there was no evidence of mortality-associated population effects such as reduced abundance or catch rates in …… reef-associated invertebrates four days after exposure (Wardle et al. 2001), snow crabs up to 12 days after exposure (Christian et al. 2003), shrimp two days after exposure (Andriguetto-Filho et al. 2005), or lobsters weeks or years after exposure (Parry and Gason, 2006)*."

To examine the effects on adult lobsters, Day *et al.* (2016) maintained them in modified lobster pots while a vessel with the airgun acoustic source passed within close proximity to the animals. Measurements from the sea noise loggers were used to build relationships of received level (PK-PK and SEL) for the air gun with range and to use this relationship to estimate all fired air gun signal levels at each lobster pot. The estimated received per-pulse SEL ranged from 186 - 190 dB re 1 μPa^2.s, maximum accumulated SEL from 192 – 199 dB re 1 μPa^2.s and PK-PK from 209-212 dB re 1 µPa. The results contained no evidence of lobster mortality for any experiment, as well as no evidence of impact to lobster embryos, which were described as resilient to the acoustic exposure. Therefore, mortality in direct response to seismic airgun exposure is unlikely. However, concern was expressed over lobster health and ecology over the long term, although the experiment did not assess how this translates to long-term, ecological implications at the population level.

A pilot study on snow crabs (Christian et al., 2003; 2004) exposed captive adult male snow crabs, egg-carrying female snow crabs, and fertilised snow crab eggs to variable SPLs (191–221 dB re 1 µPa PK) and SELs (<130–187 dB re 1 µPa2·s) under controlled field experimental conditions. The crabs were exposed to 200 discharges over a 33-minute period. Neither acute nor chronic (12 weeks post-exposure) mortality was observed for the adult crabs.

No exposure criteria currently exist to enable an evaluation of potential mortality/potential mortal injury effects in crustaceans. However, based on the research findings to date these effects are likely to be confined to extremely close ranges (i.e. <10 m) from the source.

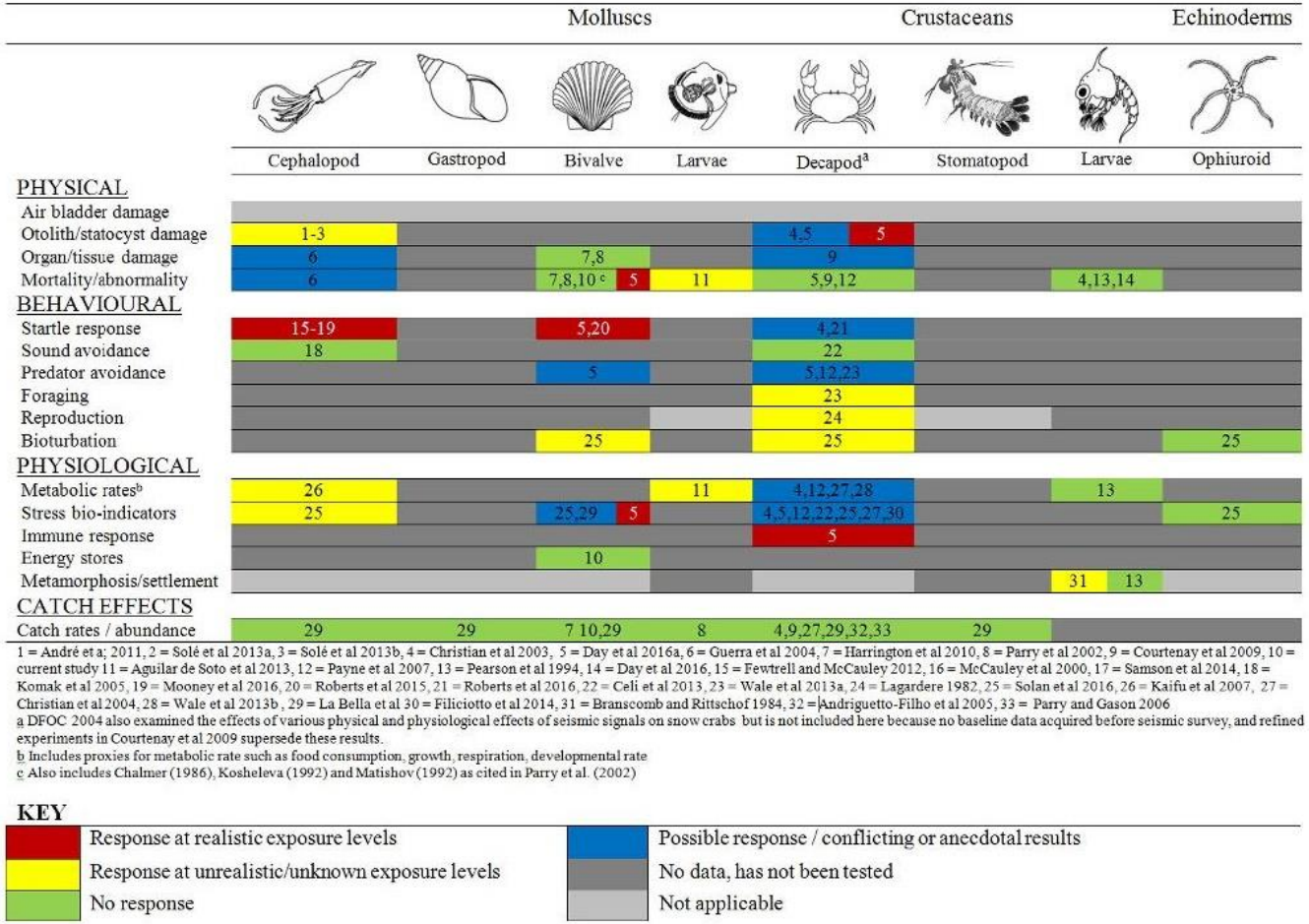


Figure 3-3 - A summary of potential impacts of low-frequency sound on various responses of marine invertebrates[10]

[10] Impacts are classified according to the sound exposure treatments as realistic for seismic surveys (i.e. few short bursts of low-frequency sound at N1–2m) or unknown/unrealistic (i.e. continuous sound exposure, N100 bursts of nearfield sound exposure, in aquaria). There are significant differences between seismic studies regarding sound exposure and the environment in which studies were conducted (Carroll *et al.* 2017).

Impairment / behavioural

Edmonds *et al.* (2016) undertook a review and critical evaluation of crustacean sensitivity to loud impulsive, low frequency underwater noise typically produced by seismic surveys. They identified that sensitivity to underwater noise is shown by the Norway lobster and closely related crustacean species, including juvenile stages. They concluded that current evidence supports physiological sensitivity to local, particle motion effects of sound production.

Christian *et al.* (2003) examined a series of morphological and physiological characteristics, i.e. haemolymph, hepatopancreas, heart, heads (statocysts, green glands, and brains), gills and gonads. They did not find significant effects on the physiological components of tested animals, but they noted that embryonic development of external eggs may be delayed after being exposed to seismic airguns (Christian *et al.* 2003; as cited in Moriyasu *et al.* 2004).

From 2013–2015, a long-term study evaluated the acoustic impacts from seismic exposure on southern rock lobsters (*Jasus edwardsii*) in Australia (Day *et al.* 2016a). The Day et al. (2016a) study is the most recent that has recorded negative effects on commercially important shellfish species from seismic sound. The study investigated the effects of seismic sound on southern rock lobsters (*Jasus edwardsii*) and the Australian scallops (*Pecten fumatus*). Rock lobster experiments consisted of four sampling times between days 0 and 120 post-exposure, as well as over the longer term of 365 days post-exposure. Each lobster experiment comprised two treatments; a control pass of the airgun where it was deployed but not operated, and an active pass of the airgun (Day et al. 2016a). Following exposure, a total of 302 lobsters, were sampled and assessed for mortality, two behavioural reflex tests, statocyst damage (balance and gravity sensing organ), condition, haemolymph biochemistry, the number of circulating haemocytes and embryonic development. The maximum measured exposures were 209 to 212 dB re 1 µPa SPL PK-PK and 186 to 190 dB re 1 μPa^2.s SEL. The maximum cumulative SEL received from multiple shots was between 192 and 199 dB re 1 µPa2.s (Day et al. 2016a). The study found that sub-lethal effects, relating to impairment of reflexes, damage to the statocysts and reduction in numbers of haemocytes (possibly indicative of decreased immune response function), were observed after exposure to sound levels at levels of SEL 186 dB re 1 μPa^2.s and PK-PK 209 dB re 1 µPa (Day et al. 2016a).

Payne et al. (2007), in a preliminary study into the impacts of seismic to the American lobster (*H. Americanus*), exposed animals to received sound levels of 202 dB re 1µPa (PK-PK) and used 'turnover rates' to establish damage to statocyst organs. The study reported no difference in turnover rates between control and exposed animals 9, 65 and 142 days after airgun exposure.

As Payne et al. (2007) identified no effects on righting time in lobster at 202 dB re 1 µPa (PK-PK), and Day et al. (2016a) found effects at 209 dB re 1 µPa (PK-PK), the level of 202 dB re 1 µPa (PK-PK) has been applied in this assessment as a precautionary threshold to determine potential impacts. Table 3-13 details the noise modelling for these assessment levels.

Table 3-13 - Maximum horizontal distances from the 3260 in^3 array to modelled PK-PK at the seafloor

Receptor	PK-PK (Lpk-pk; dB re 1 µPa)	Distance R_{max} (m)		
		Site 1	Site 2	Site 3
Crustaceans	202	655	763	568
Crustaceans	209	261	340	131

Summary

Exmouth Plateau

The Exmouth Plateau is in water depths ranging from ~800 - 4,000 m hence noise levels at which sub-lethal impacts to lobsters were observed (209 PK-PK) and where no impacts where observed (202 PK-PK) are not reached.

Western Deepwater Trawl Fishery

The area of overlap with the WDTF is in water depths greater than 1,000 m and the fishery undertakes demersal (bottom) trawl. Hence noise levels at which sub-lethal impacts to lobsters were observed (209 PK-PK) and where no impacts where observed (202 PK-PK) are not reached within the depth area that the NCB operating area overlaps the fishery.

North West Slope Trawl

The NCB and Beagle Operating Areas overlap the North West Slope Trawl Fishery (NWSTF) which targets scampi. As this fishery fishes in water depths > 200 m water depth the Site 3 modelling site is used as this site was selected to represent noise propagation within the deeper water depths of the operating areas. The Site 3 location was selected on the slope as Jasco advised that noise would travel further on the slope than in the deeper water, thus the use of this location is a conservative assessment ((Li & McPherson 2018).

The noise level at which sub-lethal impacts to lobsters were observed (209 PK-PK) is reached at 131 m at Site 3 and where no impacts where observed (202 PK-PK) is reached at 568 m at Site 3.

Potential impacts to scampi within the NWSTF are within an acceptable level based on:

- The conservative use of fisheries areas to represent the presence of scampi rather than the known habitat area that supports the scampi population.
- The noise level at which sub-lethal impacts to lobsters were observed (209 PK-PK) is reached at a distance of 131 m at Site 3 and hence noise levels at which sub-lethal impacts to lobsters were observed is not reached at water depths where scampi is likely to be present and fished for (> 200 m).
- The noise level at which no impacts to lobsters were observed (202 PK-PK) is reached at a distance of 568 m. As the fishery is a bottom trawl fishery scampi below 568 m will not be affected. For this assessment a water depth of < 570 m has been used to identify the area within the NWST fishery area of effort where scampi could receive noise levels will be above the no observed impact level of 202 PK-PK (200 – 570 m water depth as the fishery starts at the 200 m water depth and if scampi are in water deeper than 570 m they will not be affected). Based on this, the area of impact (200 – 570 m water depth) within the NWST fishery area of effort within the Rollo and NCB OAs is 3,732 km^2 and 6,658 km^2 giving a total of 10,390 km^2. The area of the fishery where there has been catch effort and therefore scampi are present is 174,994 km^2 which equates to a potential impact on up to 6% of the fishery area (Table 3-14). This would be a conservative assessment and is based on that scampi are evenly distributed within the seabed within the area of fishing effort.
- Lethal effects were not observed at these noise levels.
- Sub-lethal effects, relating to impairment of reflexes, damage to the statocysts and reduction in numbers of haemocytes were observed at these noise levels, however, impacts would not occur to all invertebrates and if impacts did occur though there is a possibility of reduced fitness it is unlikely that it would occur to all invertebrates. Thus, impacts at a population level due to reduced fitness would be unlikely as there would be enough unaffected crustaceans to maintain the population.
- At the received noise levels impacts to embryonic development were not observed with hatched larvae found to be unaffected in terms of egg development, the number of hatch larvae, larval dry mass and energy content and larval competency (i.e. survival in adverse conditions) thus recruitment should be unaffected. (Day et al. 2016a).

- Scampi in the NWSTF are classified as not overfished and not subject to overfishing. (Patterson et al. 2017) and as there is a low take in this fishery impacts at a population level due to reduced fitness would be unlikely as there would be enough unaffected crustaceans to maintain the population.

Table 3-14 - Area of overlap with NWSTF Area of Effort for received noise above the level where no impacts were observed (202 PK-PK)

NWSTF Area of Effort (2011 – 2016) km^2	NCB Area of overlap with NWSTF Area of Effort < 570 m water		Beagle Area of overlap with NWSTF Area of Effort < 570 m water	
	km^2	%	km^2	%
174,994	3,732	2	6,658	4

Ancient Coastline KEF

Crustaceans are likely to be present at the KEF Ancient coastline at 125 m depth contour which is overlapped by both the NCB and Beagle OAs. Site 1 modelling site was selected to represent noise propagation at the Ancient Coastline KEF (Table 3-3). The noise level at which sub-lethal impacts to lobsters were observed (209 PK-PK) is reached at 261 m at Site 1 and where no impacts were observed (202 PK-PK) is reached at 655 m at Site 3.

Potential impacts to crustacean are within an acceptable level based on:

- Based on the noise level at which no impacts where observed (202 PK-PK) this would equate to 20% of the Ancient Coastline (NCB – 2.3% and Beagle 17.8%). This is highly conservative as is based on the whole area of overlap being populated by crustaceans. No information could be found regarding invertebrate associations with the Ancient Coastline. The SPRAT profile states “Little is known about fauna associated with the hard substrate of the escarpment, but it is likely to include sponges, corals, crinoids, molluscs, echinoderms and other benthic invertebrates representative of hard substrate fauna in the North West Shelf bioregion (DoEE 2018d). The closest relevant information available for an area with hard substrate would be the recent studies by AIMS at Glomar Shoal. Benthic studies indicated that ~ 9.5 % of the shoal was covered by biota (North West Atlas 2018). Thus, impacts are more likely to be to an area of 10% of the Ancient Coastline (where biota present) which based on the area of overlap is ~ 2%.
- Lethal effects were not observed at these noise levels.
- Sub-lethal effects, relating to impairment of reflexes, damage to the statocysts and reduction in numbers of haemocytes were observed at these noise levels, however, impacts would not occur to all invertebrates and if impacts did occur though there is a possibility of reduced fitness it is unlikely that it would occur to all invertebrates. Thus, impacts at a population level due to reduced fitness would be unlikely as there would be sufficient unaffected population crustaceans to maintain the population.
- At the received noise levels impacts to embryonic development were not observed with hatched larvae found to be unaffected in terms of egg development, the number of hatch larvae, larval dry mass and energy content and larval competency (i.e. survival in adverse conditions) thus recruitment should be unaffected. (Day et al. 2016a).

Invertebrate species are likely to be present at Glomar Shoal (11 km from the Beagle OA) and Rankin Bank (7 km from the NCB OA), however, noise levels at which sub-lethal impacts to lobsters were observed is not reached at these distances.

Catch rates

Brown shrimp (*Crangon crangon*) in the Wadden Sea were exposed by Webb *et al.* (1998) to an acoustic array (volume 480 cubic inches with source levels of 190 dB re 1 µPa at 1 m depth). There was no evidence of mortality or reduced catch rates for the shrimp. The authors attributed the lack of effects to the absence of gas-filled organs and a rigid exoskeleton (Webb *et al.* 1998).

Christian et al. (2003) identified that post-seismic snow crab catches were higher than pre-seismic catches, but this was likely due to physical, biological or behavioral factors unrelated to the seismic source. They concluded that there was no significant relationship between catch and distance from the seismic source (received levels 197-237 dB re 1 µPa (PK-PK)).

Andriguetto-Filho et al. (2005) examined bottom trawl yields of a non-selective Brazilian shrimp fishery before and after exposure to seismic sources (196 dB) and did not identify any statistically significant changes to the catch yield after exposure to seismic survey activity. It was stated that the limited dispersal capacities of shrimp (compared to migratory fish species) suggested any attempted movement out of the survey area was not detectable.

Parry and Gason (2006) investigated the effect of seismic airgun discharges on southern rock lobster (*Jasus edwardsii*) via statistical analysis of the coincidence between seismic surveys and changes in commercial catch rates in western Victoria between 1978 and 2004. There was no evidence that catch rates of rock lobsters in western Victoria were affected by seismic surveys in the weeks or years following the surveys. However, most seismic surveys occurred in deep water, where impacts would be expected to be minimal. The apparent lack of impact of seismic surveys on catch rates of rock lobsters is consistent with the limited information available on the physiological effects of seismic surveys on invertebrates, including rock lobsters (Parry and Gason, 2006; Edmunds *et al.* 2016).

Morris et al. (2017) investigated impacts of 2D seismic on snow crab catch rates in Canada. Results did not support the contention that seismic activity negatively affects catch rates in shorter term (i.e. within days) or longer time frames (weeks). However, significant differences in catches were observed across study areas and years. While the inherent variability of the CPUE data limited the statistical power of this study, the results do suggest that if seismic effects on snow crab harvests do exist, they are smaller than changes related to natural spatial and temporal variation. Sound levels for this study were; horizontal zero-to-peak sound pressure level was 251 dB re 1 µPa @ 1 m and the source sound exposure level was 229 dB re 1 $\mu Pa^2 \cdot s$ @ 1m.

A recent critical review of the potential impacts of marine seismic surveys on fish and invertebrates (Carroll *et al.* 2017) concluded that:

"*For marine invertebrates, the potential effects of seismic signals on catch rates or abundances have been tested on cephalopods, bivalves, gastropods, decapods, stomatopods, and ophiuroids with no significant differences detected in any of these studies between sites exposed to seismic operations and those not exposed*".

Summary

Potential impacts to crustacean (Scampi) catch rates are within an acceptable level based on:

- The noise level at which sub-lethal impacts to lobsters were observed (209 PK-PK) is reached at 131 m at Site 3 and hence noise levels at which sub-lethal impacts to lobsters were observed is not reached at water depths where scampi is likely to be present and fished for (> 200 m).
- The noise level at which no impacts to lobsters were observed (202 PK-PK) is reached at a distance of 568 m. As the fishery is a bottom trawl fishery scampi below 568 m will not be affected. For this assessment a water depth of < 570 m has been used to identify the area within the NWST fishery area of effort where scampi could receive noise levels will be above the no observed impact level of 202 PK-PK (200 – 570 m water depth as the fishery starts at the 200 m water depth and if scampi are in water deeper than 570 m they will not be affected). Based on this, the area of impact (200 – 570 m water depth) within the NWST fishery area of effort within the Rollo and NCB OAs is 3,732 km^2 and 6,658 km^2 giving a total of 10,390 km^2. The area of the fishery where there has been catch effort and therefore scampi are present is 174,994 km^2 which equates to a potential impact on up to 6% of

the fishery area (Table 3-14). This would be a conservative assessment and is based on that scampi are evenly distributed within the seabed within the area of fishing effort.

- Lethal effects were not observed at these noise levels.
- Sub-lethal effects, relating to impairment of reflexes, damage to the statocysts and reduction in numbers of haemocytes were observed at these noise levels, however, impacts would not occur to all invertebrates and if impacts did occur though there is a possibility of reduced fitness it is unlikely that it would occur to all invertebrates. Thus, impacts at a population level due to reduced fitness would be unlikely as there would be enough unaffected population crustaceans to maintain the population.
- At the received noise levels impacts to embryonic development were not observed with hatched larvae found to be unaffected in terms of egg development, the number of hatch larvae, larval dry mass and energy content and larval competency (i.e. survival in adverse conditions) thus recruitment should be unaffected. (Day et al. 2016a).
- Trawl effort is low within the fishery with one or two vessels catching a maximum of 33 tonnes/year since 2012 (Patterson et al. 2017). There is no set total allowable catch for this fishery due to the low level of take which is below the catch rates from 2000 to 2010 which are used as the basis for triggers for further management actions, if fishing activity increases (Patterson et al. 2017).
- Scampi in the NWSTF are classified as not overfished and not subject to overfishing. (Patterson et al. 2017) and as there is a low take in this fishery impacts at a population level due to reduced fitness would be unlikely as there would be enough unaffected crustaceans to maintain the population.

Molluscs

Sound detection capabilities of bivalve molluscs

Little is known about sound detection in invertebrates; however, many species have mechano-sensory structures that have some resemblance to vertebrate ears. Many molluscs, including bivalves, possess statocysts (described above), which are organs that assist the organism in maintaining balance and orientation in its immediate environment (Carroll *et al.* 2017).

Statocysts are fluid-filled, capsule-like sensory organs, usually including ciliated hair cells and containing a single dense body (statolith) or a number of smaller ones (statoconia). The statolith and/or statoconia interact with the cilia lining the capsule, probably (as has been shown in gastropods and cephalopods) conveying information about orientation to the organism. They may also enable the animals to detect low-frequency pressure waves in sediment—either in the porewater or as vibrational signals associated with movements of sediment particles (Wethey and Woodin, 2005). Additionally, proprioception (the sensing of movement of bodily tissue by acoustic energy) may be involved in the detection of sound in invertebrates, including bivalves (McCauley and Kent, 2008).

It has been postulated that statocyst organs may be receptive to the particle acceleration component of a sound wave, possibly in the far-field (Hawkins and Myrberg, 1983; cited in McCauley, 1994). Franzen (1995) showed that tellinid bivalves (*Macoma balthica*) are sensitive to frequencies in the minimum range of 50-200 Hz, which corresponds to shear-wave vibrations that propagate along the sediment surface. A study on the ox-heart clam (*Glossus humanus*) has demonstrated sensitivity to vibrations and hypothesized that the sensitivity was related to sensing breaking waves on the incoming tide, to move with the tide (Frings, 1964; cited in McCauley and Kent 2008). *Donax variabilis*, a coquina clam, responds to pressure signals in the range of 20 Pa, or a sound pressure level of 140 dB SPL (rms; Ellers, 1995).

In at least one other bivalve species, response to sound has been evident by changes in aggregations. Low frequency sound (30 to 130 Hz) has been demonstrated as an effective control measure for zebra mussel fouling (Donskoy and Ludyanskiy, 1996).

Beyond the zones of impact outlined by McCauley (1994), no information is available concerning the distances over which bivalve molluscs may be able to detect either the pressure or particle motion components of a sound wave, particularly for animals suspended in mid-water. Wethey and Woodin (2005)

concluded that coquina clams could probably detect defecation signals generated by a polychaete worm at a distance of 60 cm in sediment.

Mortality/potential mortal injury and impairment

There are only a handful of studies that examined the potential effects of seismic airgun noise on bivalve molluscs. A summary of the results of these studies, which involved the blue mussel (*Mytilus edulis*), the Iceland scallop (*Chlamys islandicus*), a venerid clam (*Paphia aurea*), the arc clam (*Anadara inaequivalvis*), the commercial scallop (*Pecten fumatus*), and the sea scallop (*Placopecten magellanicus*), is presented in Table 3-15. As for other invertebrates the studies show mixed results of impacts and no impacts. Typically impacts are seen in laboratory or in filed studies where there has been repeated exposure.

A review of recent studies (Parry *et al.* 2002) suggested that molluscs are at risk of damage from seismic airgun noise only when they are closer than 1-2 m. However, previous studies have also suggested that most effects on invertebrates without gas-filled cavities are likely to be too subtle to be measured in the field (Parry and Gason, 2006).

A study conducted by the Tasmanian Aquaculture and Fisheries Institute (TAFI) assessed the immediate impact of seismic surveys on adult commercial scallops (*P. fumatus*) in the Bass Strait in 2010 (Harrington *et al*. 2010). Participants in the Bass Strait Central Zone Scallop Fishery (BSCZSF) were concerned that the seismic survey may have a negative impact on the commercially important adult scallops within the region. The study concluded that no short-term (<2 months) impacts on the survival or health of adult commercial scallops were detected after the seismic survey (Harrington *et al*. 2010). There had been no change in the abundance of live scallops (or related change in dead scallop categories) or macroscopic gonad and meat condition after seismic surveying within either the control, impacted or semi-impacted strata. There was also no observable change in the size frequency distribution of scallops in the impacted and semi-impacted strata following the survey.

In response to the lack of discernible results from the 2010 before and after study and the concerns from fisheries groups that seismic operations negatively affect catch rates, the Gippsland Marine Environmental Monitoring (GMEM) project was developed (Przeslawski et al. 2016). This study aimed at modelling and measuring sound at various depths before and during a seismic survey in 2015 to quantify potential impacts of seismic surveys on scallops and other benthic organisms. Sound exposure was assessed using both field monitoring and desktop modelling. The underwater sound model predicted SELs of 170 dB re 1µPa^2.s within 250 m of the source and sound levels exceeding 150 dB re 1µPa^2.s out to 4 km from the source. However, the highest SEL measured by hydrophones during the survey was 146 dB re 1µPa^2.s at 51 m depth when the airguns were operating 1.4 km away. There was no evidence of increased scallop mortality, or effects on scallop shell size, adductor muscle diameter, gonad size, or gonad stage due to the seismic sound (Przeslawski et al. 2016). The authors concluded that the GMEM study provided no clear evidence of adverse effects on scallops, fish, or commercial catch rates due to the 2015 seismic survey undertaken in the Gippsland Basin. Przeslawski et al. (2016) further concluded that the GMEN study provides a robust and evidence-based assessment of the potential effects of a seismic survey on some fish and scallops, however these results should be interpreted in the context of other studies such as Day et al. (2016a, 2016b), and should not be generalised to include other animals due to the vast range of different physiology and sensory systems.

From 2013–2015, a long-term study evaluated the acoustic impacts from seismic exposure on scallops (*P. fumatus*) in Australia (Day et al. 2016b). The experimental field research maintained the scallops in mesh enclosures while a vessel with the acoustic source passed close to the animals. Scallop experiments comprised four treatments, a control pass of the airgun deployed but not operated, one pass of the airgun, two passes of the airgun or four passes of the airgun. A total of 560 scallops were sampled at three times between days 0 and 120 post-exposure for mortality, haemolymph (blood analogue) biochemistry, the number of circulating haemocytes (blood cell analogues), righting reflex, recessing behaviour and other condition indices. Seismic sound exposure did not cause mass mortality of scallops during the experiment; however, repeated exposure (i.e. more than one pass of the airgun) where maximum exposure levels were in the range of 181 to 188 dB re 1µPa^2.s SEL (191 to 213 dB re 1µPa peak-peak SPL) was considered to possibly increase the risk of mortality (Day et al. 2016a, 2016b).

Though Day et al. (2016b, 2017) recorded increased mortality with repeated exposure to a seismic source, it has not been established as to whether this was due to the seismic source exposure or other mechanism related to the study design (Przeslawski et al. 2016a). Using a precautionary approach, if the increased mortality was due to the seismic source then the increased mortality identified translates to an annual increase of between 9.4% and 20%. These fall towards the low end of what might be expected when compared with natural mortality rates in wild scallop populations, which range from 11-51% with a six year mean of 38% (Day et al. 2016b,2017).

Scallops exposed to repeated seismic sound suffered physiological damage with no signs of recovery over the four-month period; suggesting potentially reduced tolerance to subsequent stressors. In addition, changes in behaviour and reflexes during and following seismic exposure were observed. Day et al. (2016a, 2016b) however cautioned that it was unclear from the study whether the observed physiological (and behavioural) impairments would result in mortality beyond the timeframes considered in their study.

Although studies have not necessarily looked at the effects of seismic sources on pearl oysters directly, it is apparent that several species of bivalve, including two oyster species, are remarkably resilient to the shock waves created by the detonation of high explosives underwater. The one study that examined the effects of underwater explosions on the pearl oyster (LeProvost et al. 1986) found that no mortality occurred in the exposed animals over a 13-week period and at a minimum exposure range of 1 m from the blast centre.

Seismic sources cause less impacts on benthic invertebrates than explosives, hence it is likely that bivalves, would have to be within a very close range of a seismic source to experience pathological damage or mortality: available evidence would suggest ~ 1–2 m. It is more difficult to determine the distances at which sub-lethal effects (such as morphological, biochemical and physiological changes being indicators of some level of stress in an animal) could occur. Only one study (La Bella *et al.* 1996) examined biochemical indicators of stress in bivalves exposed to seismic airgun noise. In this study, they found that hydrocortisone, glucose and lactate levels between test and control animals were significantly different (P >0.05) in the venerid clam *Paphia aurea*, showing an evidence of stress caused by acoustic noise. This was at a minimum exposure range of 7.5 m.

Based on the research to date, immediate mass mortality of mollusc species has not been reported to occur in experiments relating to seismic surveys. Though Day et al. (2016b, 2017) recorded increased mortality with repeated exposure to a seismic source, it has not been established as to whether this was due to the seismic source exposure or other mechanism related to the study design (Przeslawski et al. 2016a). Using a precautionary approach, if the increased mortality was due to the seismic source then the increased mortality identified translates to an annual increase of between 9.4% and 20%. These fall towards the low end of what might be expected when compared with natural mortality rates in wild scallop populations, which range from 11-51% with a six year mean of 38% (Day et al. 2016b, 2017).

Summary

Based on the research to date, mortality and mortal injury effects in molluscs that have been reported to occur in experiments relating to seismic surveys are only likely to occur at very close ranges to the source (<10 m).

Potential impacts to pearl oysters (*P. maxima)* are within an acceptable level based on:

- Fishing for pearl oyster occurs in 10 -35 m water depths with the closest fishing area 35 km from the Beagle OA and the nearest pearl farm 49 km from the Beagle OA.
- *P. maxima* typically occurs in water depths up to 70 m though has been recorded up to 120 m. Feedback from PPA (PPA 005) and DPIRD-Fisheries (Stakeholder Record DPIRD 0009) is that pearl oyster broodstock may be present out to 100 m water depths. However, this is not support by available research by Condie *et al.* (2006). PGS has committed to not undertake seismic acquisition (seismic source would not be activated) within water depths to 100 m within POMF Zone 1 and Zone 2 pending research outcomes that are acceptable to the PPA.
- If mortality impacts did occur to site attached molluscs, it would be within natural mortality rates and unlikely to have long term or population effects.

Potential impact to molluscs at the KEF Ancient coastline at 125 m depth contour are within an acceptable level based on:

- The research to date, impacts are only likely to occur at very close ranges to the source (<10 m).
- If mortality impacts did occur to site attached molluscs, it would be within natural mortality rates and unlikely to have long term or population effects.

The Exmouth Plateau is in water depths ranging from ~800 - 4,000 m and hence impacts are not predicted at these water depths.

Impacts to Glomar Shoal (11 km from the Beagle OA) and Rankin Bank (7 km from the NCB OA) are not predicted at these distances.

Coral

There is currently no peer-reviewed acoustic criteria against which potential noise impacts to coral could be assessed.

A literature review conducted for Woodside by Dr Mardi Hastings stated that the primary mechanisms for injury of hermatypic corals from seismic airgun noise are: (1) breaking of the external coral skeleton which could also damage the polyp tissue, and (2) rupture or tearing of polyp tissues inside the corallites (Hastings 2008).

Although injury to corals is theoretically possible as described by Hastings (2008), studies on the actual impacts were very limited prior to the Maxima and Gigas studies at Scott Reef (see below). A survey of coral reefs in Brunei that were subjected to seismic noise did not detect any damage to hard or soft corals, sponges or other sessile benthic organisms (IEC 2003).

The most relevant data currently available are results from exposure studies that Woodside conducted during the Maxima 3D and Gigas 2D Pilot OBC (ocean bottom cable) marine seismic surveys at Scott Reef in Western Australia.

In the Maxima 3D experiments corals in and around the lagoon were exposed to seismic signals (both experimental seismic lines and a full seismic survey) using a 2,055 in3 source over a 59-day period. The experimental lines passed directly over the coral communities (source at 7 m depth, corals at ~60 m depth) whereas the full seismic survey passed within tens to 100s of metres (horizontal offset). The maximum estimated received seismic signal levels at coral impact sites were 226–232 dB re 1 µPa (PK-PK), 214–220 dB re 1 µPa (SPL rms), 197–203 dB re 1 µPa2.s (single pulse SEL), and a maximum cumulative SEL of 197–203 dB re 1 µPa2.s (Salgado Kent et al. 2016).

For plate corals, *Lobophytum* spp., and various soft corals including *Sarcophytum* spp., the proportion of dead and bare coral cover and the % cover of red algae were documented, and no detectable effect was found from one or multiple passes of the seismic airgun array (Battershill et al. 2008). Further, there was no evidence of coral breakage, no signs of physiological impairment in the corals (polyp withdrawal or reduction in soft coral rigidity) and no long-term change in coral community structure related to the experimental or full seismic survey activities (Battershill et al. 2008).

The Gigas 2D Pilot OBC MSS coral monitoring study (SKM 2008) examined the potential for physical damage to a range of shallow water corals in north Scott Reef lagoon from seismic airgun emissions. This study also used a number of sub-lethal indicators of stress and mortality (partial and whole colony mortality) to determine the effects of airgun emissions on corals. The summary conclusion from this study was that emissions from the airgun array did not cause significant injury, tissue damage, sublethal stress or mortality to coral colonies, even when colonies are within a few metres of shots fired from the seismic array (SKM 2008). This survey had a measured at source SEL of 206 dB re 1 µPa2.s (McCauley 2008).

Heyward et al. (2018) reviews the research undertaken at Scott Reef and the analysis detected no effect of seismic activity measured as coral mortality, skeletal damage or visible signs of stress immediately after and up to four months following the 3D marine seismic survey. Maximum received levels were 226 dB re 1 µPa PK. Based on the noise modelling this sound level was not reached at the seafloor below the array for any of the three modelling sites.

Summary

Potential impacts to coral are within an acceptable level based on:

No impacts to corals are predicted as received sound level are below levels predicted to cause coral damage.

Table 3-15 – Studies of impacts of seismic airguns on molluscs

Species	Noise Source	Source Level (dB re 1µPa at 1 m)	Distance from source (m)	Estimated Exposure Level (dB re 1µPa)	Observed Effects	Reference
Blue mussel (*Mytilus edulis*)	Single airgun, 60-80 cui	223 (assumed)	0.5 -2.0	229	No detectable effect over 30 days at distance of 0.5 m.	Kosheleva (1992)
Icelandic scallop (*Chlamys islandicus*)	Single airgun	223 (assumed)	2.0	217	Shell split in one of three animals exposed at 2.0 m.	Matishov (1992)
Venerid clam (*Paphia* aurea) Arc clam (*Anadara inaequivalvis*)	16 airgun array	210	7.5	N/A	No difference in *P. aurea* and *A. inaequivalvis* catch levels caught by hydraulic dredge. Hydrocortisone, glucose and lactate levels between test and control animals were significantly different (P >0.05) in *P. aurea*, showing an evidence of stress caused by acoustic noise.	La Bella *et al.* (1996)
Scallop	Airgun array	N/A	N/A	N/A	No evidence that seismic surveys had affected CPUE of scallops and attributed a decline in scallop CPUE coincident with a 3D seismic survey to two years of poor recruitment prior to the seismic survey.	Brand and Wilson (1996); cited in Parry and Gason (2006)
Commercial scallop (*Pecten fumatus*)	24 airgun array	255	11.7	230	No increase in mortality over 17 days when compared to controls. No difference in adductor muscle strength between exposed and control animals. No major difference in the abundance of plankton (including bivalve larvae) behind the seismic survey vessel from their abundance before the passage of the vessel or 2 km distant from the vessel.	Parry *et al.* (2002)
Sea scallop (*Placopecten magellanicus*)	Single airgun, 8 cui	N/A	1.0	N/A	No immediate mortality within 48 hours.	Payne and Christian (unpublished); cited in Moriyasu *et al.* (2004)
Commercial scallop (*Pecten fumatus*)	Airgun array, 4,130 cui	264	N/A	N/A	No change in the abundance of live scallops (or related change in dead scallop categories) or macroscopic gonad and meat condition was detected after seismic surveying within either the control, impacted or semi-impacted strata. No observable change in the size frequency distribution of scallops in the impacted and semi-impacted strata following seismic surveying. The conclusion was that no short-term (<2 months impacts on the survival or health of adult commercial scallops were detected post the seismic survey.	Harrington *et al.* (2010)

Source: Galaxia Marine Environmental Consulting (2013)

3.3.2.8 Disturbance to Fish

Receptors

The following fish types have been identified for this assessment:

- Site attached species including syngnathid species such as pipefish; pipehorses and seahorses.
- Demersal fish species including commercial fish species such as tropical snappers (*Lutjanus* spp. and *Pristipomoides* spp.).
- Pelagic fish species including commercial fish species such as mackerel.

The following receptors associated with fish species have been identified:

- Pilbara trap, line and trawl fisheries which target goldband snapper, bluespotted emperor, and crimson snapper
- Mackerel Managed Fishery which target mackerel species
- Western Deepwater Trawl Fishery which target deep water fish species
- Rankin Bank which is 7 km from NCB OA
- Glomar Shoal which is 11 km from Beagle OA
- Bedout Island which is 14 km from Beagle OA
- KEF Continental Slope Demersal Fish Communities
- KEF Ancient coastline at 125 m depth contour

3.3.2.8.1 Acceptable levels of impact

Before making a prediction of the sound impacts to fish and fisheries catch rates the following has been defined as the acceptable level of impact from seismic surveys within the NCB and Beagle OAs.

- *No effect to the sustainability of the of the fish populations, habitats and fisheries in the Gascoyne and North Coast fishing marine bioregions.*

This level of acceptable impact has been derived from the information on the DPRID website about the sustainability of fisheries in Western Australia. A sustainable fishery has sufficient spawning fish to produce the next generation, while allowing fishing to take place. Sustainability in this context means ensuring the habitat and ecosystem supporting the fishery are in good condition (DPIRD, 2018b). The acceptable level also includes the key ecological features, Ancient Coastline, Continental Slope Demersal Fish Communities and Glomar Shoals as well as ecological features, Bedout Island and Rankin Bank that would provide habitats and ecosystems for fish populations. In context of the fish populations which are the natural and physical resources of the environment (described in section 2.4.2.5) this is considered reasonable because DPIRD, as the fishing regulator, has identified two broad bioregions in their management of the fisheries.

Further, in Western Australia 95% of fish stocks are not at risk from fishing. This is an internationally recognised sustainability benchmark based on Eco-system Based Fisheries Management (EBFM). EBFM is a holistic approach considering all ecological resources, as well as economic and social factors in deciding how to manage fisheries (DPIRD 2018b). Seismic surveys are considered by DPIRD in their assessment of the sustainability of the fisheries they regulate. Oil and gas activities have been assessed as have a low risk of measurably altering the overall ecosystem (Gaughan and Santoro, 2018). Therefore, this statement of an acceptable level is considered highly applicable to this impact assessment.

3.3.2.8.2 Predicting levels of impact to fish

Receptor Sensitivity

Fishes like other vertebrates have two inner ears within similar structure. The basic mechanism for transduction of sound into electrical signals is the sensory hair cell. Significantly, high intensity sounds are able to fatigue, damage or kill these cells resulting in temporary or permanent haring loss. Fish however, unlike other tetrapods, are able to keep adding sensory hair cells throughout their lives. In addition, there is evidence (Popper and Hastings, 2009) that damaged cells, as a result of exposure to sound that causes a shift in auditory thresholds, can be replaced.

The majority of fish species detect sounds from below 50 Hz up to 500-1,500 Hz. A smaller number of species can detect sounds to over 3 kHz, while a very few species can detect sounds to well over 100 kHz. The critical issue for understanding whether an anthropogenic sound affects hearing is whether it is within the hearing frequency range of a fish and loud enough to be detectable above threshold. For the sake of this EP, it is assumed that all fishes have hearing within the 0-200 Hz and so can 'hear' the seismic source.

Receptor Effects – Extent (Presence/Absence)

The Working Group on the Effects of Sound on Fish and Turtles undertook a review of experimental findings of sound on fishes. In their American National Standards Institute (ANSI) accredited report (Popper et al. 2014) they presented sound exposure guidelines for different levels of effects for different groups of species (Table 3-16), for three types of immediate effects:

- Mortality, including injury leading to death.
- Recoverable injury, including injuries unlikely to result in mortality, such as hair cell damage and minor haematoma.
- Temporary threshold shift (TTS).

Masking and behavioural effects are assessed qualitatively, by assessing relative risk rather than by specific sound level thresholds.

The presence or absence of a swim bladder has a role in fish's susceptibility to injury from sound exposure. Therefore, effects vary depending on the species and the presence and possible role of a swim bladder in hearing. Thus, different exposure guidelines are proposed for fish without a swim bladder, fish with a swim bladder not used for hearing, and fish that use their swim bladders for hearing (Table 3-16). The fish receptors identified for this assessment such as site attached species, including syngnathids, and demersal fish species are included in the category of fish having a swim bladder while mackerel, a pelagic fish species, do not have a swim bladder.

Table 3-16 – Exposure guidelines sound levels for mortality, impairment and behaviour in fishes

Type of animal	Mortality or potential mortal injury	Impairment		Behaviour
		Recoverable injury	TTS	
Fish: no swim bladder	>219 dB SEL_{cum} or >213 dB PK	>216 dB SEL_{cum} or >213 dB PK	>186 dB SEL_{cum}	(N) High[1] (I) Moderate (F) Low
Fish: swim bladder but not involved in hearing	>210 dB SEL_{cum} or >207 dB PK	>203 dB SEL_{cum} or >207 dB PK	>186 dB SEL_{cum}	(N) High[1] (I) Moderate (F) Low
Fish: swim bladder involved in hearing	>207 dB SEL_{cum} or >207 dB PK	>203 dB SEL_{cum} or >207 dB PK	>186 dB SEL_{cum}	(N) High[1] (I) Moderate (F) Low

Source: modified from Popper *et al.* (2014).

Table 3-17 provides a summary of the presence/absence of a cause-effect pathway based on the literature review and sound modelling undertaken and detailed in the following sections. An assessment of the level of impact, duration and severity, in the context of the NCB and Beagle OAs, has been undertaken where a

possible effect has been identified by examining conservative literature thresholds against noise modelling predictions of sonification.
The transient nature of a seismic survey and the soft-start ramp up practices mean that the for all fishes that have a large home range and are mobile the possible effects are predicted to commence with there being a behavioural effect. As the proximity to the sound source increased the effect is anticipated to increase.

Table 3-17 - Summary of presence/absence of effects from increased sound levels

Receptor	Possible Effects			
	Behavioural	Temporary Threshold Shift	Mortality/Recoverable Injury	Impact to Catch Rates
Rankin Bank - site attached, pelagic, demersal fish	Unlikely	Not Predicted	Not Predicted	Not Predicted
Glomar Shoal - site attached, pelagic, demersal fish	Unlikely	Not Predicted	Not Predicted	Not Predicted
Bedout Island - site attached, pelagic, demersal fish	Unlikely	Not Predicted	Not Predicted	Not Predicted
KEF Continental Slope Demersal Fish Communities - demersal fish	Possible	Possible	Not Predicted	Unlikely
KEF Ancient coastline at 125 m – pelagic fish	Possible	Possible	Not Predicted	Unlikely
KEF Ancient coastline at 125 m – site attached fish	Possible	Possible	Unlikely	NA
Commercial pelagic fish - Mackerel	Possible	Possible	Unlikely	Unlikely
Commercial demersal fish - Snapper, emperor, cod	Possible	Possible	Unlikely	Unlikely
Commercial deep water fish	Possible	Possible	Not Predicted	Not Predicted

Behavioural Effects – Duration and Severity

Behavioural responses to sounds are variable but include:

- Leaving the area of the noise source (avoidance; Streever *et al.* 2016).
- Startle/alarm response: changes in depth distribution (Pearson *et al.* 1994; Slotte *et al.* 2004; Woodside, 2007a).
- Changes in swimming patterns (including change in swimming speed and direction): spatial changes in schooling behaviour (Slotte *et al.* 2004; Woodside, 2007a).
- Startle responses (Pearson *et al.* 1994; Wardle *et al.* 2001): changes in vertical distribution.

For some fish, strong 'startle' responses have been observed at sound levels of 200 to 205 dB re 1 µPa, indicating that sounds at or above this level may cause fish to move away from the vessel. Sound levels of this intensity are likely to occur ~100 to 300 m from an acoustic array. Based on this, an approximate range of 200 m is given as the minimum distance at which fish may move away from an operating array and below which physical effects may occur (McCauley, 1994). However, a study by Wardle *et al.* (2001) found that only when the air gun bubble oscillations were visible to the fish, did the fish react directionally to the gun. In

addition, they found that schooling reef fish swam past the gun rack, apparently undamaged, at an equivalent pressure and rise that would be received at about 20 m below a survey array of 30 airguns.

The most recent relevant study on how the behaviour of fish exposed to seismic signals changed is the Woodside's Maxima 3D survey at Scott Reef. A summary of results relevant to how the behaviour of fish exposed to seismic signals changed is as follows (Woodside 2011a, 2011b; Miller and Cripps 2013):

- Behavioural observations of free-swimming fish:
  - Airgun noise emissions did not cause lethal or sub-lethal effects on fish near the operating array.
  - At close range, airgun noise emissions appeared to have caused prominent, short term, effects on fish behaviour. As the vessel approached, fish ceased normal behaviours and moved downward from the water column towards the seabed.
  - Fish began to feed and behave normally again within 20 minutes after the passage of the survey vessel. Once the vessel had travelled beyond ~1.5 km fish numbers and behaviour had returned to normal, baseline levels.
- Behavioural observations of caged fish:
  - Alarm responses were too infrequent to analyse.
  - Agitation levels increased with increasing received sound exposure level for the three holocentrid (squirrelfishes and soldierfishes) species but were not detectable for the bluestripe seaperch.
- Sonar observations of free-swimming fish:
  - Individual fish tended to move lower in the water column towards the seabed on approach of the operating airgun array, consistently out to 400 m either side of the survey test line.
  - Within 200 m of the survey test line, fish schools moved to the seabed after passage of the operating airgun array and stayed significantly closer to the seabed out to 63 minutes postexposure.
- Fish choruses:
  - For the period overlapping the survey, fish choruses followed predictable and relatively smooth trends with regards to timing and chorus level (at daily, lunar and seasonal scales), suggesting that in the long term the survey had little effect on the fish which produced the choruses.
- Fish diversity and abundance:
  - Shallow-slope fish surveys using underwater visual census:
    - No significant decreases were detected in the diversity and abundance of both Pomacentridae (damselfishes and clownfishes) and non-Pomacentridae fish species after the seismic survey compared to the long-term temporal trend before the survey.
  - Analysis of baited remote underwater video stations:
    - There were no detectable effects of the seismic survey on the diversity and abundance of deeper water fish communities at the spatial and temporal scales examined.
    - There were no signs of loss of individuals or of systematic re-distribution of individuals and species at any of the time scales examined.

The findings from the research at Scott Reef support those by Wardle et al. (2001), who exposed free ranging marine fish inhabiting an inshore reef to sounds from a seismic source (195-218 dB re 1 µPa PK). The study found:

- Fish exhibited a startle response to all received levels, but no avoidance behaviour were observed.
- Fish showed no signs of moving away from the reef.
- Exposure to the seismic noise did not interrupt a diurnal rhythm of fish gathering at dusk.

- Slight changes were recorded to the long-term day-to-night movements of two tagged pollack, particularly when positioned within 10 m of their normal living positions.
- The seismic sound had little effect on the day-to-day behaviour of the resident fish and invertebrates.

Fewtrell and McCauley (2012) identified that fishes tended to remain lower in the water column and/or swim faster and form tighter schools during periods of close air-gun emissions.

Masking impairs an animal's hearing impairment with respect to the relevant biological sounds normally detected within the environment and can have long lasting effects on survival, reproduction and population dynamics of fishes. The consequences of masking for fishes, however, have not been fully examined. Popper et al. (2014) surmised that "*It is likely that increments in background sound within the hearing bandwidth of fishes and sea turtles may render the weakest sounds undetectable, render some sounds less detectable, and reduce the distance at which sound sources can be detected. Energetic and informational masking may increase as sound levels increase, so that the higher the sound level of the masker, the greater the masking*." If impulsive sounds are generated repeatedly by many sources over a wide geographic area there is a possibility that the separate sounds might merge and that the overall background noise be raised (Nieukirk et al. 2004). However, masking only occurs while the interfering sound is present, and therefore, masking resulting from a single pulse of sound (such as an airgun shot) or widely separated pulses would be infrequent and not likely affect an individual's overall fitness and survival.

There are currently no quantitative guideline/criteria for fish behaviour as Popper *et al.* (2014) found that there was insufficient data available to establish sound level thresholds for behaviour and instead suggested general distances to assess potential behavioural impacts. In their review the expert working group of Popper *et al.* (2014) did not find sufficient trends to recommend behavioural thresholds. Instead, they assessed masking and behavioural effects qualitatively by assessing relative risk, being the distance of a fish from the source, rather than by a specific threshold. Based on the application of the Popper *et al.* (2014) semi-quantitative exposure criteria, there could be a high risk of behavioural impacts in fish species near (tens of metres) from the seismic source with the level of risk declining to low at thousands of metres from the seismic source.

Fish populations can be further impacted if behavioural responses result in deflection from migration paths, feeding grounds or disturbance of spawning, thereby affecting recruitment of fish stocks. Considering the distribution range of key species in the area, adequate spawning biomass levels, and that migratory routes are not restricted, the impact on fish populations is considered to be low. Available evidence suggested that behavioural changes for some fish species may be no more than a nuisance factor, and that within a few seconds they continue their previous activity. The temporary, short range displacement of pelagic or migratory fish populations may have insignificant repercussions at a population level (McCauley, 1994); and for site-attached reef fish, spatial patterns of richness, abundance and diversity does not change after airgun noise emissions (Woodside, 2007a; Miller and Cripps, 2013).

These effects are expected to be short-lived, with duration of effect less than or equal to the duration of exposure, are expected to vary between species and individuals, and be dependent on the properties of received sound (DFO 2004). The ecological significance of such effects is expected to be low, except where they may influence reproductive activity. However, researchers have observed that once acoustic disturbances are removed, fish return to normal behaviour within about an hour (McCauley *et al.* 2000; Pearson *et al.* 1992; Wardle *et al.* 2001).

Behavioural impacts to fish are within the acceptable level based on:

- Behavioural effects are assessed as high within 10s of metres of the seismic source of which pelagic and demersal fish can avoid and site attached species are not within that distance.
- Impacts to site attached species that maybe associated with the KEF Ancient Coastline at 125 m water depth are likely to be short lived and fish would return to normal behaviours once the vessel has moved away based on research by Woodside (2011a, 2011b), Miller and Cripps (2013) and Wardle et al. (2001).

- Impacts to demersal fish at the KEF Continental Slope Demersal Fish Communities are likely to be short lived and fish would return to normal behaviours once the vessel has moved away based on research by Woodside (2011a, 2011b), Miller and Cripps (2013) and Wardle et al. (2001).
- Impacts to commercial fish species are likely to be short lived short lived and fish would return to normal behaviours once the vessel has moved away based on research by Woodside (2011a, 2011b), Miller and Cripps (2013) and Wardle et al. (2001).
- The are no known spawning aggregation areas within the operating area with spawning likely to be in areas where fishing occurs based on feedback from DPIRD-Fisheries. Impacts to spawning fish are likely to be short lived and fish would return to normal behaviour once the vessel has passed. Seismic surveys will not be undertaken within Pilbara line, trap and trawl fisheries and the Mackerel Managed Fishery during key spawning periods thus impacts to spawning fish are not likely.
- Behavioural impacts to fish are unlikely at Rankin Bank, Glomar Shoal and Bedout Island due to the distance from the OAs (7 – 14 km). Behavioural impacts at locations within the OAs including the commercial fisheries area of effort, KEF Continental Slope Demersal Fish Communities and KEF Ancient coastline at 125 m depth contour are possible but would be temporary, localised and unlikely to impact at a population level.

Temporary Threshold Shift – Duration and Severity

The following is sourced from Popper et al. (2014):

> *"Temporary threshold shift (TTS) is a temporary reduction in hearing sensitivity caused by exposure to intense sound. TTS has been demonstrated in some fishes, and its extent is of variable duration and magnitude. TTS results from temporary changes in sensory hair cells of the inner ear and/or damage to auditory nerves innervating the ear (Smith et al. 2006; Liberman 2015). However, sensory hair cells are constantly added in fishes (e.g., Corwin 1981, 1983; Popper and Hoxter 1984; Lombarte and Popper 1994) and also replaced when damaged (Lombarte et al. 1993; Smith et al. 2006; Schuck and Smith 2009), unlike in the auditory receptors of mammals. When sound-induced hair cell death occurs in fishes, its effects may be mitigated over time by the addition of new hair cells (Smith et al. 2006, 2011; Smith 2012, 2015).*
>
> *After termination of a sound that causes TTS, normal hearing ability returns over a period that is variable, depending on many factors, including the intensity and duration of sound exposure (e.g., Popper and Clarke 1976; Scholik and Yan2001, 2002a, b; Amoser and Ladich 2003; Smith et al. 2004a, b, 2006, 2011; Popper et al. 2005, 2007). While experiencing TTS, fishes may have a decrease in fitness in terms of communication, detecting predators or prey, and/or assessing their environment."*

Popper et al. (2014) recommends a sound exposure guideline for TTS for fish with no swim bladder or a swim bladder not involved in hearing of >> 186 dB SELcum and 186 dB SELcum for fish with a swim bladder involved in hearing (Table 3-16).

The results from a study on goldband snapper (McCauley and Kent 2007), support the 186 dB re 1 μPa^2.s TTS threshold from Popper et al. (2014), despite the limited sample size. These results show an apparent increasing trend of damage above ~ 190 dB re 1 μPa^2.s. However, this trend of damaged hair cells immediately after air gun exposure is limited to positive results derived from a limited number of samples and should be treated with caution, as stated in the report itself (McCauley and Salgado Kent 2007).

Another study by McCauley et al. (2003) demonstrated that exposure to repeated emissions of a single airgun (source level at 1 m of 222.6 dB re 1µPa PK-PK) from 5 to 15 m at the closest approach caused extensive damage to the sensory hair cells in the inner ear of caged pink snapper (*Pagrus auratus*). Although no mortality was observed, the damage was severe with no evidence of repair or replacement of damaged sensory cells up to 58 days post-exposure. The study did not look at if this damage has any effects on fish hearing. The study acknowledged that the fish were caged and therefore not able to swim away from sound

source, and that the monitoring video suggested the fish would have fled the sound source if possible. The study also acknowledged that the impact of exposure on ultimate survival of the fish was not clear.

As part of Woodside's Maxima 3D MSS, an extensive field study was undertaken at Scott Reef. A component of this study investigated three potential impacts with regards to fish assemblages:

1) if resident fish species were physically damaged by the seismic signals;

2) if seismic signals damaged fish ears; and

3) how the behavior of fish exposed to seismic signals changed.

A summary of findings on potential impacts to fish hearing are as follows:

- There was statistically more ear damage on seismic exposed fish than on control fish but the damage was marginal, and—assuming a linear relationship between hair cell density and hearing capability—this implied that <1% of the fishes' hearing capability was impaired. Hearing damage was monitored through time on *Lutjanus kasmira* (bluestripe snapper) out to 60 days post seismic exposure and did not increase significantly through time, with almost zero damage detected by 60 days (McCauley 2008).
- A study of auditory brainstem response (ABR) in four species of tropical reef fishes following exposure to emissions from the 2,055 in^3 array showed that none of the four species, including the pinecone soldierfish (a hearing specialist) experienced any hearing sensitivity loss (i.e. TTS) following exposure to SELcum up to 190 dB re 1 $\mu Pa^2.s$ (Hastings et al. 2008; Hastings and Miksis-Olds 2012).
- Fish exposed to the seismic passes were sampled for assessment of gross physiological damage by the NT Museum. Observations by researchers present during dissections were that no detectable gross physiological damage was found in individuals from any of the seven species (McCauley and Salgado Kent 2012).

The data collected from the ABR experiment at Scott Reef are consistent with the sound exposure guidelines proposed in Popper et al. (2014), which indicated that TTS may occur at SELcum levels >186 dB re 1 $\mu Pa^2.s$ while other studies (Popper and Hastings 2009; Song et al. 2008) indicate that TTS may occur at levels as high as SPL 205-210 dB re 1µPa (PK).

For this impact assessment the Popper et al. (2014) sound exposure guideline for TTS of 186 dB SEL_{cum} is applied with period of time applied to the SEL metric of 24 hrs as detailed in Section 3.3.2.2. There have recently been some concerns raised by stakeholders on other titleholders' seismic programs in regard to the appropriateness of using a 24-hour period to assess SELcum and the potential for TTS and other effects associated with SELcum. An independent, expert peer review in relation to this issue was conducted by Professor Arthur Popper (Popper 2018). The review considered the potential impacts of cumulative seismic noise from the proposed Santos Bethany 3D seismic survey on fish, including TTS effects, and length of time for recovery and the applicability of an SEL24h metric. Though this information was based on another survey it is applicable to surveys within the Rollo OA as pelagic and demersal fish species within the areas are similar and the premise for the modelling was a racetrack that bought the vessel back to a similar starting point within 24 hrs, thus receiving the closest shots within a 24-hour period.

The review reached the following conclusions (Popper 2018):

- *The time over which energy should be accumulated in each individual fish in the survey area should be limited to the time over which fishes get maximum exposure. Thus, 24 hours is likely far too long a period for calculation of accumulation of energy in determining potential harm (e.g., damage or TTS). There is no scientific basis for longer periods than 24 hours.*
- *It is highly unlikely that there would be physical damage to fishes as a result of the survey unless the animals are very close to the source (perhaps within a few meters).*
- *The most likely effect (if any) to fishes resulting from cumulative sound exposure is temporary threshold shift (TTS). However:*

- *Most fishes in the Bethany region, being species that do not have hearing specializations, are not likely to have much (if any) TTS as a result of the Bethany 3D survey.*
- *If TTS does take place, the duration of exposure to the most intense sounds that could result in TTS will be over just a few hours. Thus, accumulation of energy over longer periods than a few hours is probably not appropriate.*
- *If TTS takes place, its level is likely to be sufficiently low that it will not be possible to easily differentiate it from normal variations in hearing sensitivity.*
- *Even if fishes do show some TTS, recovery will start as soon as the most intense sounds end, and recovery is likely to even occur, to a limited degree, between seismic pulses. Based on very limited data, recovery within 24 hours (or less) is very likely.*

- *Nothing is known about the behavioural implications of TTS in fishes in the wild. However, since the TTS is likely very transitory, the likelihood of its having a significant impact on fish fitness is very low.*

Based on the independent, expert peer review by Popper (2018) the 24-hour period selected to assess SELcum and any associated effects is likely to be conservative for assessing the potential effects to fish.

As detailed in Table 3-18, the maximum range at which the TTS exposure criteria for fish with or without a swim bladder (186 dB SEL24 h) is predicted to occur is within 3.4 km (within the water column) or 3.1 km (at the seafloor) of the array. Based on a predicted radius of 3.4 km the associated region of TTS sonification within the water column over 24 hours is 878-1000 km^2 (for pelagic/demersal fish) and based on a predicted radius of 3.1 km the associated region of TTS sonification at the seafloor over 24 hours is 994 km^2. for site attached fish).

Table 3-18 - Distances to seafloor SEL_{24h} based criteria for the scenario within the Beagle MSS acquisition area

Receptor	Threshold for SEL24h ($L_{E,24h}$; dB re 1 µPa^2·s)	Maximum-over-depth		At seafloor	
		*R*max (km)	*Area* (km^2)	*R*max (km)	*Area* (km^2)
Fish: no swim bladder and swim bladder but not involved in hearing or involved in hearing	186	3.4	1000	3.1	994

To put the potential level of impact in context:

The area of TTS ensonification over 24 hrs does not represent the area or duration where individual fish will be exposed. The seismic source is always moving so these areas represent the total area where individual fish in a population may be briefly exposed to the effects of SEL_{cum} at some point in time during a survey.

- Based on the modelling the TTS exposure criteria is not reached at the following locations where site attached, demersal and pelagic fish may occur:
  - Rankin Bank which is 7 km from NCB OA
  - Glomar Shoal which is 11 km from Beagle OA
  - Bedout Island which is 14 km from Beagle OA

TTS may be experienced in fish that cannot or do not avoid or move away from the area such as site attached species including syngnathid species. Site attached fish species are usually associated with benthic habitats such as seagrass, macroalgae, sponges and soft and hard coral.

The OAs overlap the KEF Ancient Coastline where site attached species may be present and where the TTS exposure criteria is reached. The SPRAT profile for the KEF Ancient Coastline states “Little is known about fauna associated with the hard substrate of the escarpment, but it is likely to include sponges, corals, crinoids, molluscs, echinoderms and other benthic invertebrates’. There is no information on the fish communities

associated with the Ancient Coastline and the closest relevant information available for an area with hard substrate would be the recent studies by AIMS at Glomar Shoal. Benthic studies indicated that at water depths greater than 80 m cover of benthic taxa (macroalgae, hard coral, soft coral, sponge and other organisms) was 0.1% (North West Atlas 2018). Based on this proxy, habitats at a depth of 125 m are unlikely to support significant site attached fish populations and therefore impacts would be low on a local and regional level and based on TTS recovery within 24 hrs impacts would be localised and temporary in nature.

The area where mackerel are most likely to occur is the area where there is catch effort within the Mackerel Managed Fishery Area 2 (based on Fish Cube data 2012-2015) is 31,977 km^2 thus the area of TTS sonification over 24 hrs (1000 km^2) equates to 3.1%.

Pelagic fish such as mackerel and are strong swimmers swimming up to 100 km along the coast (DPIRD, 2018). Mackerel are solitary species but are known to aggregate when spawning (DEH, 2004) when impacts such as TTS are more likely to occur. As seismic surveys will not be undertaken during spawning periods impacts to mackerel populations are unlikely. Therefore, impacts would be low on a local and regional level and based on TTS recovery within 24 hrs impacts would be localised and temporary in nature.

Impacts to demersal fish species such as snapper, emperor and cod that are targeted by the Pilbara trap, line and trawl fisheries and boarfish, snapper and seaperch targeted by the Western Demersal Trawl Fishery are more likely to be behavioural including avoiding or moving away from the area during the survey thus TTS is less likely to occur for these species.

Demersal fish species are most likely to occur in the areas where there is fishery catch effort for that species. There has been no effort within the Western Demersal Trawl Fishery within the OAs in the last five years.

For demersal fish species that are target by the Pilbara trawl, trap and line at most impacts would be temporary within recovery within less than 24 hrs within a localised area.

- The area of effort within the Pilbara Trawl Fishery (based on Fish Cube data 2012-2015) is 23,108 km^2 thus the area of TTS sonification over 24 hrs (1000 km^2) equates to 4.3%.
- The area of effort within the Pilbara Trap Fishery (based on Fish Cube data 2012-2015) is 84,112 km^2 thus the area of TTS sonification over 24 hrs (1000 km^2) equates to 1.2%.
- The area of effort within the Pilbara Line Fishery (based on Fish Cube data 2012-2015) is 135,649 km^2 thus the area of TTS sonification over 24 hrs (1000 km^2) equates to 0.74%.

The KEF Continental Slope Demersal Fish Communities covers an area of 33,182 km^2 thus the area of TTS sonification over 24 hrs (1000 km^2) equates to 3%. This is highly conservative as is based on the whole area of overlap being populated by fish.

The SPRAT profile for the KEF Ancient Coastline details that enhanced productivity within the KEF may attract large pelagic fish (DoEE 2018d). For pelagic and any demersal fish species associated with the KEF Ancient Coastline impacts are more likely to be behavioural including avoiding or moving away from the area during the survey thus TTS is less likely to occur for these species.

In summary, the duration and severity of TTS have been shown to be in the range of seconds to hours. There have been no studies that predict sound effects of this beyond this timeframe. In addition, the literature indicates that fishes affected with TTS can recover quickly thus long term irreversible impacts to fish and fish populations are not predicted. Therefore, impacts would be low on a local and regional level and based on TTS recovery within 24 hrs impacts would be localised and temporary in nature.

Mortality/potential mortal injury – Duration and Severity

No studies to date have demonstrated direct mortality of adult fish in response to airgun emissions, even when fired at close proximity (within 1–7 m; DFO 2004; Boeger *et al.* 2006 as cited in NSW DPI 2014; Popper *et al.* 2014). Carroll *et al* (2017; Table 3-21) conclude that "*For fish, there are few data on the physical effects of seismic airguns (e.g. mortality, barotrauma), and of these none have shown mortality*." Although some fish deaths have been reported during cage experiments, these were more likely caused by experimental artefacts of handling or confinement stress (Hassel *et al.* 2004 as cited in NSW DPI 2014). For free-swimming fish that can move away from seismic sources as they approach, the potential for lethal physical damage

from airgun emissions is even further nullified. However, reef or bottom-dwelling fish that show greater site attachment may be less inclined to flee from a seismic sound source and experience greater effects.

Other than physiological stress responses or hearing loss, no other physical damage to adult fish or invertebrates have been directly attributed to exposure to airgun discharges, even at close proximity (NSW DPI, 2014). It should be noted that some reports of physical damage arise from studies undertaken using explosions and other high-pressure sound waves, and not from air-gun emissions that generate a lower maximum pressure and pressure change (Popper and Hastings, 2009).

Though mortality or mortal injury of fish from seismic sources has not been demonstrated it is industry practice to apply the Popper et al 2014 exposure guidelines as part of the impact assessment process (Table 3-16).

The modelling results against these guidelines are shown in Table 3-19 and Table 3-20. The furthest distance to the guideline for each receptor has been applied which results in 100 m (SEL24) for fish with no swim bladder (mackerel) and 160 m (PK) for fish with a swim bladder. These distances are the same for the recoverable injury exposure guideline.

Table 3-19 -- Maximum (R_{max}) horizontal distances (in m) from the 3260 in^3 array to modelled PK at the seafloor

Receptor	PK Threshold (*L*pk; dB re 1 µPa)	Distance R_{max} (m)		
		Site 1	Site 2	Site 3
Fish: no swim bladder	213	50	20	Not reached
Fish: swim bladder but not involved in hearing or involved in hearing	207	160	160	Not reached

Table 3-20 - Distances to seafloor SEL_{24h} based criteria for the scenario within the Beagle MSS acquisition area

Receptor	Threshold for SEL24h (*LE*,24h; dB re 1 µPa^2·s)	Distance R_{max} (m)	
		Maximum-over-depth	At seafloor
Fish: no swim bladder	219	< 100	Not reached
Fish: swim bladder but not involved in hearing or involved in hearing	207	< 100	Not reached

Based on the modelling mortality, mortal injury or recoverable injury exposure guideline is not reached at the following fish receptors:

- Rankin Bank which is 7 km from NCB OA
- Glomar Shoal which is 11 km from Beagle OA
- Bedout Island which is 14 km from Beagle OA
- KEF Continental Slope Demersal Fish Communities which is within the upper slope (water depth of 225–500 m) and the mid-slope (750–1000 m).
- The Western Deepwater Trawl Fishery as the area of overlap with this fishery is within water depths > 1,000 m and the fishery undertakes demersal (bottom) trawl.

Mackerel – pelagic species

The modelling results for mortality, mortal injury and recoverable injury guidelines result in 100 m for mackerel (fish with no swim bladder). For this assessment the area where there has been catch effort for the Mackerel Managed Fishery Area 2 has been used as a proxy as to where mackerel species would be present within the area. This is a very conservative assessment as the Mackerel Managed Fishery extends from Augusta to the Northern Territory border.

The area of effort within the Mackerel Managed Fishery Area 2 (based on Fish Cube data 2012-2015) is 31,977 km^2 of which the Beagle OA overlaps 2,584 km^2 and NCB OA overlaps 323 km^2 which equates to 2,907 km^2. The area of effort within the Mackerel Managed Fishery Area 2 above the exposure guideline is 2,907 km^2 which equates to 3 % (seismic lines are 600 m apart = 2,907 km^2 x (100 x 2)/600 / 31,977 km^2 x 100).

To put the potential level of impact in context:

- Mortality has never been reported and is only included in the threshold criteria as an extremely conservative measure.
- Potential fish mortality, potential mortality injury and recoverable injury to mackerel are unlikely as mackerel are a pelagic fish species and can swim away from a seismic source. Impacts are more likely to be behavioural including avoiding or moving away from the area for the period of the survey. For the largest area of overlap (Beagle) it would take less than 30 days to complete the area of 2,584 km^2 so behavioural impacts would be short term.
- The area of potential impact assumes that the area will receive the same sound levels at the same time for the period of a survey, which is not the case. The received sound levels at a location will reduce and increase as the seismic vessel moves through the area during a survey. Thus, the actual impact to pelagic fish species will be less than that predicted.
- Pelagic fish such as mackerel and are strong swimmers swimming up to 100 km along the coast (DPIRD, 2018). Mackerel are solitary species but are known to aggregate when spawning (DEH, 2004) when impacts are more likely to occur. As seismic surveys will not be undertaken during spawning periods impacts to mackerel populations are unlikely.
- For the Mackerel Managed Fishery, the three indicator species for assessment and stock status are Spanish mackerel, grey mackerel and samson fish (samson fish is not caught in the North Coast Bioregion (Lewis and Jones 2018)). The spawning biomass and breeding stock for these species has been assessed as sustainable-adequate (Fletcher et al. 2017). If impacts did occur, they would be to a small proportion of the population (3%) based on the application of the threshold to the fishery. As the spawning biomass and breeding stock is sustainable, recruitment and recovery would be expected for any fish that were potentially impacted. As there will be no seismic surveys over the same area within a year this would also allow for recruitment and recovery.
- Only two vessels fish for mackerel within the Beagle and NCB OAs indicating that though mackerel are present they would not be in significant numbers compared to other areas within the fishery where more vessels fish. Thus, impacts if they did occur would not be at a population level.
- In 2016 the WA catch for grey mackerel was 14 t, with 9 t taken in the Pilbara being the highest since 2004. This level of catch is well below the total allowable commercial catch (TACC) of 60 t for grey mackerel (Lewis and Jones 2018). The commercial catch of Spanish mackerel by the MMF was 276 t in 2016 and has been 270-330 t since quotas were introduced in 2006. The TACC for 2016 was 430 t (Lewis and Jones 2018). Reinforcing that mackerel numbers are not significant in the area, well below the TACC and thus impacts if they did occur would not be at a population level.

This assessment is based on an extremely conservative threshold as mortality impacts to fish have not been reported. If impacts did occur they would be on a local scale to a small proportion of the population that is able to recover, thus no population level effects are expected for mackerel species.

Demersal fish species

The modelling results for mortality, mortal injury and recoverable injury guidelines result in 160 m for fish with a swim bladder which includes demersal fish species likely to be present within the OAs such as snapper, emperor and cod. For this assessment the area where there has been catch effort for these species has been used as a proxy as to where these species would be present within the area. This is a conservative assessment as demersal fish species such as snapper, emperor and cod are widespread throughout Western Australia waters and are targeted by other fisheries such as the Gascoyne Demersal Scalefish Managed Fishery and Northern Demersal Scalefish Managed Fishery. Section 2.3.2.5.2 Pelagic and Demersal Commercial Fish Species show these species have a large distribution throughout norther Australia.

This assessment is based on the fish resource which is targeted by the Pilbara line, trap and trawl fisheries collectively called the Pilbara Demersal Scalefish Fishery (Gaughan and Santoro, 2018). As these fisheries overlap this assessment is done on the combined area of effort (based on FishCube 2011 – 2016 data) for the three fisheries as they target the same fish (Figure 3-4). The combined area for these fisheries is 157,294 km^2 of which the NCB OA area overlaps 15,944 km^2 and the Beagle OA 20,707 km^2. Thus, for this assessment it is assumed that demersal fish species such as snapper, emperor and cod are more likely to be present within the area of effort for the three combined fisheries (157,294 km^2).

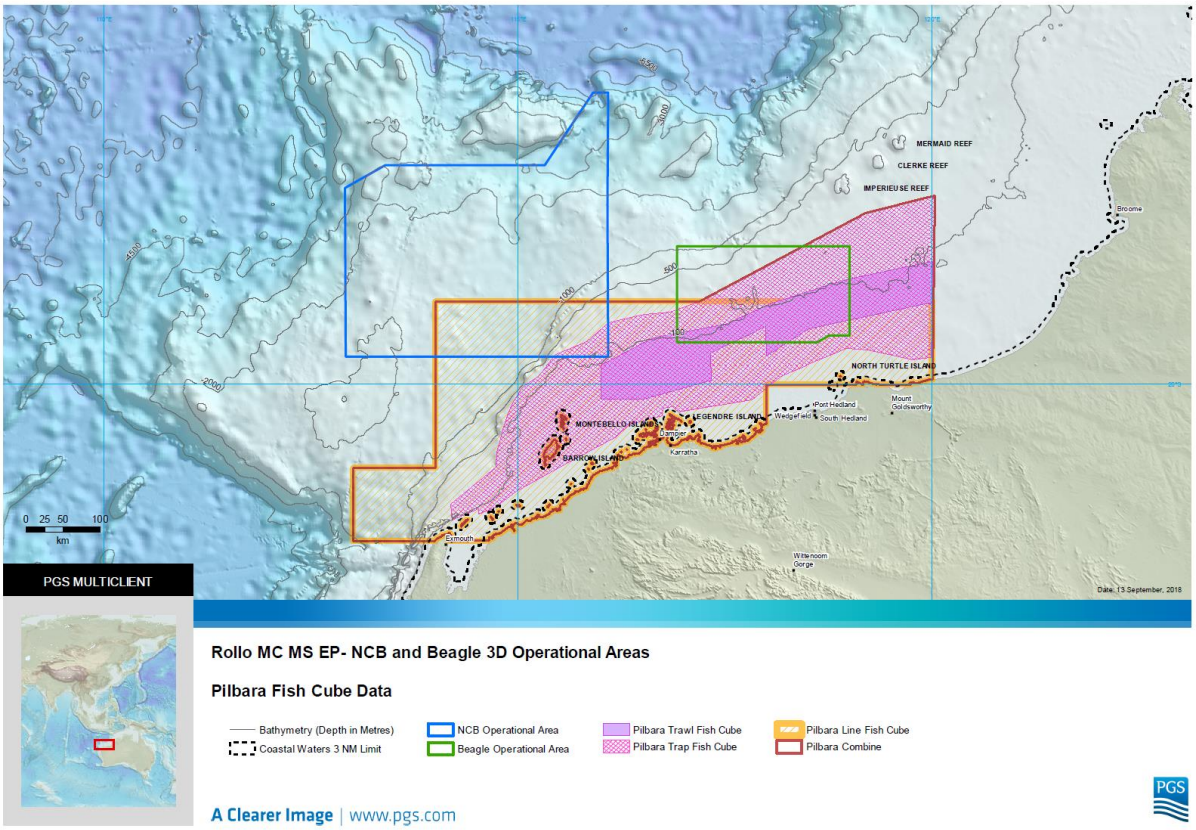


Figure 3-4 – Overlap of the Pilbara line, trap and trawl fisheries

The modelling results for mortality, mortal injury and recoverable injury guidelines result in 160 m for fish targeted by the Pilbara trap, line and trawl fisheries. The area of effort for the Pilbara trap, line and trawl fisheries where spatially demersal fish species such as snapper, emperor and cod are likely to be present is 157,294 km^2 of which the NCB OA overlaps 15,944 km^2 and the Beagle OA overlap 20,707 km^2 giving a total of 36,651 km^2. The area of effort for the Pilbara trap, line and trawl fisheries, and thus where snapper, emperor and cod are likely to be present, above the exposure guideline is 19,547 km^2 which equates to 12% (seismic lines are 600 m apart = 36,651 km^2 x (160 x 2)/600 / 157,294 km^2 x 100).

On an annual basis the area that can be survey is 9,200 km^2 as surveys will only be undertaken within the Pilbara line, trap and trawl fisheries during May, June and July and only one vessel will be within the area of catch effort at a time. This allows 92 days at a rate of 100 km^2 a day giving 9,200 km^2 a year. This equates to 3% based on the area that can be surveyed above the exposure guideline is 4,907 km^2 (seismic lines are 600 m apart = 9,200 km^2 x (160 x 2)/600 / 157,294 km^2 x 100).

To put the potential level of impact in context:

- Mortality has never been reported and is only included in the threshold criteria as an extremely conservative measure.
- Potential fish mortality, potential mortality injury and recoverable injury to demersal species such as snapper, emperor and cod are unlikely with impacts more likely to be behavioural including avoiding or moving away from the area for the period of the survey. Seismic surveys can only be undertaken

within the Pilbara line, trap and trawl areas during May, June and July which is a 92 day period, and would take ~ 92 days so behavioural impacts would be short term.

- The area of potential impact assumes that the area will receive the same sound levels at the same time for the period of a survey, which is not the case. The received sound levels at a location will reduce and increase as the seismic vessel moves through the area during a survey. Thus, the actual impact to demersal fish species will be less than that predicted.
- It would be expected that numbers would increase within the catch effort area during spawning periods as most tropical demersal fish species targeted by the fisheries aggregate to spawn. As seismic surveys will not be undertaken during spawning periods impacts to demersal fish populations are unlikely.
- For the Pilbara line, trap and trawl fisheries the three indicator species for assessment and stock status are red emperor, bluespotted emperor and Rankin cod. A 2016 assessment of the three indicator species in the Pilbara estimated the spawning biomass of red emperor stock to be currently above the threshold level and the stocks of rankin cod and bluespotted emperor are well above the target spawning biomass levels (Gaughan and Santoro, 2018). The biological stock status is classed as Sustainable-Adequate (Gaughan and Santoro, 2018). If impacts did occur to these species it would be to a small proportion of the population and as the spawning biomass is above threshold levels and stock status is classed as Sustainable-Adequate, recruitment and recovery would be expected for any fish that were potentially impacted. As there will be no seismic surveys over the same area within a year this would also allow for recruitment and recovery. Annually the area that could be impacted is ~ 3% leaving significant area available for recruitment and recovery.
- In 2016 the total catch for the Pilbara Demersal Scalefish Fishery was 2,150 t which slightly exceeded the acceptable catch range of 1,217 – 2,080 t. This increased catch represents an increase in stock abundance following nine years of reduced effort in the western trawl managed areas. The total catch of the trap and line fisheries were within the acceptable catch ranges in 2016. This reinforces that stock abundance is increasing and thus impacts if they did occur would not be at a population level (Gaughan and Santoro, 2018).

This assessment is based on an extremely conservative threshold as mortality impacts to fish have not been reported. If impacts did occur they would be on a local scale to a small proportion of the population that is able to recover, thus no population level effects are expected for pelagic species.

KEF Ancient coastlines at 125 m depth contour

The Marine Bioregional Plan for the North-west Marine Region (DSEWPaC 2012) details the following in relation to the Ancient Coastlines:

> *Parts of the ancient coastline, particularly where it exists as a rocky escarpment, are thought to provide biologically important habitats in areas otherwise dominated by soft sediments. The topographic complexity of these escarpments may also facilitate vertical mixing of the water column, providing relatively nutrient-rich local environments. This key ecological feature is recognised for its biodiversity values (unique sea-floor feature with ecological properties of regional significance), which apply to both the benthic and pelagic habitats within the feature.*

The modelling results for mortality, mortal injury and recoverable injury guidelines result in 160 m for fish. The Ancient Coastlines covers on area of 16,242 km^2 of which the Beagle OA overlaps 2,844 km^2 (18%). The area above the exposure guideline is 1517 km^2 which equates to 9.3 % (seismic lines are 600 m apart = 2,844 km^2 x (160 x 2)/600 / 16,242 km^2 x 100).

To put the potential level of impact in context:

- Mortality has never been reported and is only included in the threshold criteria as an extremely conservative measure.
- Potential fish mortality, potential mortality injury and recoverable injury to pelagic and demersal are unlikely as they can swim away from a seismic source. Impacts are more likely to be behavioural

including avoiding or moving away from the area for the period of the survey. For the area of overlap it would take less than 30 days to complete the area of 2,844 km^2 so behavioural impacts would be short term.

- The Marine Bioregional Plan for the North-west Marine Region identifies noise pollution as "of less concern" to the Ancient Coastlines (DSEWPaC 2012).
- The area of potential impact assumes that the area will receive the same sound levels at the same time for the period of a survey, which is not the case. The received sound levels at a location will reduce and increase as the seismic vessel moves through the area during a survey.
- The enhanced productivity of the Ancient Coastline may attract opportunistic feeding by larger marine life including large pelagic fish (DSEWPaC 2012). Thus, pelagic fish populations are not resident but opportunistic and are likely to move away from the area during a seismic survey. As the seismic survey will not impact on the integrity or habitat of the Ancient Coastline it is unlikely that there will be impacts on its' productivity. Hence, it would be expected that of the opportunistic feeding pelagic fish species would return once the seismic vessel had moved away from the area.
- Thus, impacts to pelagic species associated with the Ancient Coastline would be short term as they would move away from the area and return to feed once the seismic vessel had passed.
- The Ancient Coastlines covers on area of 16,242 km^2 of which the Beagle OA overlaps 2,844 km^2 (18%). As the seismic line spacing is 600 m the area above the exposure guideline is 320/600 or 53% of the seismic acquisition area based on the exposure guideline is reached out to 160 m. Thus, the potential area of impact for the Ancient Coastline is 9%. This is highly conservative as is based on the whole area of overlap being populated by fish. The SPRAT profile states "Enhanced productivity associated with the sessile communities and increased nutrient availability may attract larger marine life such as whale sharks and large pelagic fish" (DoEE 2018d). Pelagic fish are less likely to be impacted as can swim away from the seismic source.
- No information could be found regarding benthic fish associations with the Ancient Coastline. The SPRAT profile states "Little is known about fauna associated with the hard substrate of the escarpment, but it is likely to include sponges, corals, crinoids, molluscs, echinoderms and other benthic invertebrates representative of hard substrate fauna in the North West Shelf bioregion (DoEE 2018d). It would be expected that syngnathids, site attached, and benthic/demersal fish species would be associated with these hard substrate habitats. The closest relevant information available for an area with hard substrate would be the recent studies by AIMS at Glomar Shoal. Benthic studies indicated that at water depths greater than 80 m cover of benthic taxa (macroalgae, hard coral, soft coral, sponge and other organisms) was 0.1% (North West Atlas 2018). Thus, any impacts to site attached or benthic/demersal fish species would be less than 0.1%.
- At 600 m line spacing and 160 m to the threshold there is a 280 m strip of seafloor between each line that is un-impacted – i.e. received levels in this area do not exceed the 207 dB PK exposure threshold. Thus, if mortality effects were to occur to site attached fish assemblages within 160 m either side of each line, there is still a significant area of un-affected habitat that could provide recruits into the potentially impacted areas.

This assessment is based on an extremely conservative threshold as mortality impacts to fish have not been reported. If impacts did occur they would be on a local scale to a small proportion of the population that is able to recover, thus it is unlikely to adversely impact on the ecosystem functioning and integrity of this key ecological feature.

Table 3-21 - Edited version of Supplementary Material B from Carroll *et al.* (2017)

NOTE: The table has been edited to revise units and some columns.

Impacts of seismic airgun noise on fish. Sound levels are reported as zero to peak (PK), peak to peak (PK-PK), root-mean-square sound pressure level (SPL) (units of dB re 1 µPa), or sound exposure level (SEL) (units of dB re 1 μPa^2.s). However, the metric is not always evident from the literature. E = estimated, M = measured. * denotes a commercially important species, + denotes freshwater species, L = laboratory experiment (i.e. tank), C = caged field experiment, F = field experiment (uncaged), D = desktop study, # = no control.

Effect Type	Organism	Source	Source levels	Distance of receptor from source	Received levels	Results	Reference	Relevance to Rollo Survey
Physical Effects								
Mortality	Pallid sturgeon (*Scaphirhynchus albus*) and on Paddlefish (*Polyodon spathula*)+	Airguns 620 in^3	Not Relevant, Not shown	0–33.75 Control 160	206 – 231 PK 187 – 205 SEL(single shot)	No mortality or mortal injury that was significantly different between controls and the fish exposed to the highest sound energy. Quote from paper: *The results do not support the hypothesis that there would be mortality of fish exposed to the impulsive airgun sound, at least at peak received sound pressure levels as high as 231 dB re1 µPa.*	(Popper *et al.* 2016)[C]	Highly relevant, indicate criteria applied are highly conservative.
	European seabass (*Dicentrarchus labrax*)	Playbacks (see spectrograms in (Radford *et al.* 2016)	Not relevant	<1m	158.39 PK (replica seismic)	Naïve fish showed elevated ventilation rates, indicating heightened stress, in response to impulsive additional noise (playbacks of recordings of pile-driving and seismic surveys). However, fish exposed to playbacks of pile-driving or seismic noise for 12 weeks no longer responded with an elevated ventilation rate to the same noise type. Fish exposed long-term to playback of pile-driving noise also no longer responded to short-term playback of seismic noise. The lessened response after repeated exposure, likely driven by increased tolerance or a change in hearing threshold. http://onlinelibrary.wiley.com/doi/10.1111/gcb.13352/full	(Radford *et al.* 2016)[*,L]	Not relevant to mortality. Does suggest that fish not accustomed to seismic will experience increased stress during exposure to a survey. This is acknowledged in the behavior section of the EP.
	Rainbow trout (*Salmo gairdneri*, Salmon smolt (*Salmon smolts*)	Airguns 130 in^3	229 (Estimated, and likely PK)	150–4000	142 PK-PK at the cages (4km) (M) 186 PK-PK at	No mortality observed.	(Thomsen 2002)[*,C,#]	Not relevant to mortality as levels significantly lower than those in criteria.

Effect Type	Organism	Source	Source levels	Distance of receptor from source	Received levels	Results	Reference	Relevance to Rollo Survey
					150 m from airguns (M)			
	Demersal fish, blue whiting and some pelagic fish	Airguns 4752 in^3 array	222–250 PK	1–10, 150–300	200-210 (E)	No mortality observed.	(Dalen and Knutsen 1987)[*,C,#]	Relevant – study with large commercial array.
	Red snapper (*Lutjanus synagris*), Schoolmaster snapper (*Lutjanus apodus),* Atlantic spadefish (*Chaetodipterus faber)*	Airguns 635 in^3 array	196 PK	7 m horizontal at 5m depth. 2.5 m below array And 1 m horizontal distance	Not available	No mortality or obvious external damage was recorded, including one specimen that was already in poor health prior to the experiment. No mortality occurred at very close (0 - 7 m horizontal distance) from the air guns.	(Boeger *et al.* 2006)[*,C,#]	Relevant – study with small commercial array.
	Sandeel (*Ammodytes marinus*)	Airguns (PGS commercial array) 3090 in^3	256.9 PK (vertical) 247.7 PK broadside	55–7500	Sand eels within the near-field of the array on the seafloor under track lines	No differences in mortality between control and experimental groups attributable to airgun exposure. Where mortalities occurred, they were attributed to handling procedures (i.e., similar in control and experimental fish).	(Hassel *et al.* 2003, Hassel *et al.* 2004)[C]	Relevant – study with one of the commercial arrays proposed for this survey. Array is the same Track lines directly over habitat, no impact.
	Twelve species	Airguns Single 20 in^3 airgun	223 PK-PK,	5–800	146-195 PK-PK (M)	No immediate mortality. No delayed mortality (up to 58 days) for 1 species.	(McCauley *et al.* 2003)[*,C,#]	Relevant, however this is the only study to have shown this, other studies examining the same thing have shown no damage for several other species (Popper *et al.* 2005; Song *et al.* 2008), see below.

Effect Type	Organism	Source	Source levels	Distance of receptor from source	Received levels	Results	Reference	Relevance to Rollo Survey
	Broad whitefish (*Coregonus nasus*), lake chub (*Couesius plumbeus*), Northern pike (*Esox pucius*)[+]	Airguns 720 in^3 array	Not specified, not relevant	13–17	Average mean of 207 PK (M) Mean SEL(single shot) 177 (M)	No mortality of fish from the 3 species held for 24 hours after exposure.	(Popper *et al.* 2005)*,[C1] 1. Caged outdoor tanks	Relevant – no mortality at close range, however, limited ability to compare to McCauley *et al* 2004 – different paradigm, species, airgun, and transmission loss environment.
	Juvenile Sea bass (*Dicentrarchus labrax*)	Airguns 2500 in^3 array	Not shown	180–6500	210 at 180 m (E) 204 at 800 m (E) 199 at 2500 m (E)	No mortality up to 72 hours post exposure at 180 m from the source.	(Santulli *et al.* 1999)*,C	Relevant – real world study with commercial array.
	Juvenile saithe (*Pollachius virens*) and cod (*Gadus morhua*) Adult pollock (*Pollachius pollachius*) and mackerel (*Scomber scombrus*)	Airguns	Not shown	109, 16 and 5.3 m	195, 210, 218 PK	Exposed fish inhabiting a small coral reef system to seismic airguns with no mortality observed.	(Wardle *et al.* 2001)*,F,#	Highly relevant, indicate criteria applied are highly conservative

3.3.2.8.3 Predicting levels of impact to fishing

Typical effects on fishing from seismic activities are either through physical displacement of the fishers from their license areas if operating simultaneously or from reducing the catchability of the fish. Section 3.3.1 assesses impacts from physical displacement of the fishers.

Catchability (Catch Rates)

As noted by Salgado Kent *et al.* (2016) "*The issue of changes in commercial fisheries catch rates due to seismic surveys is almost always contentious in Australia*". They acknowledge that there has been some effort to relate fisheries catch data to seismic survey effort, but to date none of the Australian efforts to relate fin-fish catch rates with seismic surveys have yielded results of any meaning.

The potential effects of seismic surveys on fish distribution, local abundance or catch has been examined for some teleost species with varying results (Carroll *et al.* 2017). A range of responses has been observed when the behaviour of wild fishes has been studied in the presence of anthropogenic sounds. Studies suggest that fish will generally move away from a loud acoustic source to minimise their exposure, but this response might depend on the animal's motivational state.

Scientific evidence of acoustic impacts on fish catches are somewhat equivocal because of the lack of determination between natural movements and changes in fish. One comprehensive study (Engås *et al.* 1996) observed cod and haddock moving back within an area 3-5 days after seismic survey exposure. Similarly, Slotte *et al.* (2004) observed westward movement of large masses of blue whiting and herring towards and into the survey area 3-4 days after seismic shooting, indicating that migrations proceeded as normal soon after a seismic survey. Therefore, any disruptions would likely be short-term and during the survey, with conditions returning to 'normal' levels soon after.

Studies undertaken by Lokkeborg *et al.* (2012) demonstrated that gillnet catches increased substantially for redfish (86 % increase) and Greenland halibut (132 % increase) during seismic shooting on a Norwegian fishing ground. However, longline catch rates fell (16% for Greenland halibut, 25% for haddock). These contrary results were explained by greater swimming activity versus lowered food search behaviour in fish exposed to air-gun sound emissions. Although catch rates changed in all species studied (including saithe and ling), except for saithe, acoustic mapping of fish abundance did not suggest displacement from fishing grounds.

Not all results from studies have resulted in behavioural alteration. Feeding Atlantic herring (*Clupea harengus*) schools off northern Norway showed no changes in swimming speed, direction or school size in response to a transmitting seismic vessel as it approached from a distance of 27 to 2 km, over a 6-hour period (Peña *et al.* 2013). As fishing areas are large and commercial fish species are free-swimming, if fish are 'scared' temporarily from an area, based on evidence presented, it is likely they will be displaced temporarily to another area still within the fishing zone and so able to be caught.

A recent critical review of the potential impacts of marine seismic surveys on fish and invertebrates (Carroll *et al.* 2017) found that other studies on fish have found positive, inconsistent, or no effects of seismic surveys on catch rates or abundance. A desktop study of four species (gummy shark, tiger flathead, silver warehou, school whiting) in Bass Strait, Australia, found no consistent relationships between catch rates and seismic survey activity in the area, although the large historical window of the seismic data may have masked immediate or short-term effects which cannot therefore be excluded (Przeslawki *et al.* 2016). A subsequent desktop study targeting a single seismic survey in 2015 found that catch rates in the six months following the seismic survey were different than predicted in nine out of the 15 species examined. Across two fishing gear types, six species indicated increases in catch after the seismic survey, and three species indicated decreases in catch. The authors concluded that "*These results support previous work in which the effects of seismic surveys on catch seem transitory and vary among studies, species, and gear types*" (Przeslawski *et al.* 2016).

Given the potential impacts to fishes described above, there is the potential for impacts to catchability of key species, particularly with regards to any behavioural response. However, the body of peer reviewed literature does not indicate any long-term abandonment of fishing grounds by commercial species, with several studies indicating that catch levels returned to pre-survey levels after seismic activity had ceased (Carroll *et al.* 2017).

As noted by Przeslawski *et al.* (2016), it is possible that fish may be displaced from a survey footprint to adjacent areas, however the total number of fish within the fishery stock remains unchanged.

Based on existing information, catch rate impacts are at or below the defined acceptable level based on:

- Given the evidence of fish returning to survey areas following cessation of the acoustic disturbance, if there was an impact to catchability because of the activity, catch rates in surveyed areas post-survey are expected to return to typical catch levels relative to fishing effort.
- The stock assessment for all target species (mackerel, red emporer, bluespotted emperor and rankin cod) indicates adequate stock status, breeding stock and fishery catch levels (Gaughan and Santoro, 2018).

3.3.2.8.4 Demonstration of acceptable levels of impacts from the disturbance to fish and fishing

To demonstrate the environmental impacts from increasing sound exposure for fish and fishing are of an acceptable level a comparison between the defined acceptable levels of impact will be made with the predicted levels of impact.

The defined acceptable levels of impact from seismic surveys within the NCB and Beagle OAs is:

- *No effect to the sustainability of the of the fish populations, habitats and fisheries in the Gascoyne and North Coast fishing marine bioregions.*

In summary, the predicted impacts to fish and fishing are short-term, reversible, and localised. Considering the recruitment and recoverability of fish species from the impacts of fishing the predicted impacts from seismic activities are considered very low.

The impact prediction was based on sophisticated qualitative sound modelling, semi-qualitative data analysis, qualitative discussion, and professional judgements from experienced environmental professionals. This evaluation is considered comprehensive and meets the regulatory requirement of an evaluation that is appropriate to the nature and scale of the impact. Conservatism and precaution applied in making these predictions are:

- Fishing licence areas have been used as a proxy as they are a smaller area than the habitat that would support the fish species identified in this assessment.
- Thresholds adopted throughout the impact assessment are based on peer reviewed literature that states they are conservative.
- Assumption that all fish hear within the 0-200 Hz range and can detect the sound discharged.
- Uncertainty in the effectiveness of control measures has resulted in assessing the impacts as though they weren't in place.
- When considering mortality or mortal injury the overlaps have assumed all fish exposed to sound above the specified threshold have short home ranges, except for pelagic fish, and that fish habitats are discontinuous. Neither condition is accurate in the NCB or Beagle OAs.
- The assessment of pelagic and demersal fish species is based on a conservative assumption that fish occur evenly throughout the area.

To conclude, the environmental impacts associated with the disturbance to fish and fishing from the activities that could be carried out under the Rollo EP are of an acceptable level because:

- The most likely effects on individual fish and schools of fish are behavioural or, at worst, a hearing threshold shift both of which have been proven to be temporary and recoverable. Whilst mortality have been assessed it is unlikely that they would occur as mortality has never been reported and is only included in the threshold criteria as an extremely conservative measure.
- There are no effects predicted to the ecosystem or habitat of the Gascoyne or North Coast fishing bioregions therefore seismic activities do not threaten the sustainability of the fisheries which are significantly smaller areas than the overall distribution of fish in Western Australia.

- The fish populations and the fisheries are considered sustainable with licensed mortal effects from fishing and natural mortality. No mortal affects are predicted from activities contemplated in this EP.
- Recovery from behavioural effects or TTS would be expected in days to weeks. No population level effects are expected to pelagic, demersal or site attached fish species, and for commercial fish species no lasting effects on their catchability and consequently to their catch rates are expected.
- Long term impacts are unlikely as there will be no impact on spawning, as there will be no seismic surveys undertaken during spawning periods for mackerel, goldband snapper, Rankin cod and red emperor which are key indicators species for the commercial pelagic and demersal fisheries.
- Impacts to the ecosystem functioning and integrity of the Ancient Coastlines key ecological feature were not predicted.

3.3.2.9 Disturbance to Sharks

Receptors

The NCB OA overlaps the whale shark foraging and migration area BIA by 0.5% and the Beagle OA by 9.1% (Figure 2-37). It is possible that whale sharks may be encountered during individual surveys undertaken from July to November. as the midrate from Ningaloo up the coast.

While the Whale Shark Recovery Plan (2005-2010; DEH, 2005a) identified numerous possible threats to whale sharks, acoustic impacts were not identified as a specific threat. The recent publication from the (TSSC-CA) for the whale shark did not identify any new information or impacts from seismic activities on whale sharks (DoE, 2015j).

Other shark species may be transient in the OAs. Impacts to sharks within a known migratory path has been used as a worst-case scenario for impacts to sharks.

Impacts

Limited research has been conducted on shark responses to marine seismic surveys. Myrberg (2001) stated that sharks differ from bony fish in that they have no accessory organs of hearing such as a swim bladder and therefore are unlikely to respond to acoustical pressure. The study also suggested that the lateral line system does not respond to normal acoustical stimuli and is unable to detect sound-induced water displacements beyond a few body lengths, even with large sound intensities (Myrberg, 2001). Other reports indicate that sharks are highly sensitive to sound between approximately 40 and 800 Hz, which overlaps with seismic sound frequencies. Klimley and Myrberg (1979) established that an individual shark will suddenly turn and withdraw from a sound source of high intensity (more than 20 dB re 1 µPa above broadband ambient SPL) when approaching within 10 m of the sound source.

There are no defined quantitative noise exposure criteria for sharks. As a conservative and precautionary approach, the Popper *et al.* (2014) exposure guideline for fish with no swim bladder for potential mortality, mortal injury and recoverable injury peak pressure level threshold of > 213 dB re 1 µPa (PK) has been used for this assessment. Based on the modelling this guideline is exceeded out to a maximum of 50 m from the seismic source.

Table 3-22 - Maximum (R_{max}) horizontal distances (in m) from the 3260 in^3 array to modelled PK at the seafloor

Receptor	PK Threshold (*L*pk; dB re 1 µPa)	Distance R_{max} (m)		
		Site 1	Site 2	Site 3
Fish: no swim bladder	213	50	20	Not reached

It is expected that the potential effects to whale sharks associated with acoustic noise will be the same as for other pelagic fish species, resulting in minor and temporary behavioural change such as avoidance. This aligns with Popper et al. (2014) guidelines which detail that there is the potential for high risk of behavioural impacts in fish species near (tens of metres) from the seismic source with the level of risk declining to low at thousands of metres from the seismic source.

Summary

Potential impacts to whale sharks are within an acceptable level based on:

- The distance of potential impact is 50 m from the seismic source.
- Whale sharks congregate at Ningaloo Reef from March to July and then migrate along the 200 m isobath mainly between July and November (DoE 2015j). Though migration can occur during July it would be expected that numbers would be low as it is the start of the migration period. There will be no seismic activity within the whale shark migration / foraging BIA from August to November further reducing potential impacts.

- The application of the EPBC Act Policy Statement 2.1 – Interaction between Offshore seismic exploration: Part A to whale sharks including:
    - Pre-Start-up-Visual Observation.
    - Soft Start Procedure (also known as ramp-up.
    - The following precaution zones:
        - *Observation* zone: 3+ km horizontal radius from the acoustic source.
        - *Low power zone*: 2 km horizontal radius from the acoustic source.
        - *Shut-down* zone: 500 m horizontal radius from the acoustic source
- Seismic noise has not been identified as a threat to whale sharks in either the conservation advice (DoE 2016j) or previous in force Whale Shark Recovery Plan 2005 – 2010 (DEH 2005a). Noise pollution is not identified as a pressure to whale sharks in the Marine Bioregional Plan for the North-west Marine Region (DSEWPaC 2012).

3.3.2.10 Disturbance to Sea Snakes

Snakes lack both an outer ear and a tympanic middle ear but have a connection between the middle ear bone to the jaw bones (Christensen *et al.* 2011). Scientific evidence demonstrated that snakes have dual auditory pathways to detect both airborne and ground-bourne vibrations using the surface of their body and their inner ears (Young, 2003), and the lower jaw of snakes may be stimulated by surface waves and vibrations (Christensen *et al.* 2011; Friedel *et al.* 2008). However, published snake audiograms measured hearing sensitivity to airbourne sounds only (Christensen *et al.* 2011), although it seems plausible that sea snakes may use vibration detection for predator and prey interactions (Young, 2003). Three characteristics suggest that sea snakes could be vulnerable to air gun impacts:

1. Sealed nostrils and an air-filled lung extending the length of the body, plus slower swimming speeds than other marine vertebrates, might mean they are unable to avoid tissue damage at close range.
2. Scale sensillae that allow sea snakes to detect the vibrations of their prey show peak sensitivity to low frequencies that overlap those produced by air guns. This may disrupt feeding (via acoustic masking) and provoke avoidance behaviour.
3. Translocation (a common response to air guns) is associated with high mortality in sea snakes; habitat displacement might have long term consequences for highly isolated populations.

A current research project – "Investigating the impact of seismic surveys on threatened sea snakes in Australia's North West Shelf" – is being undertaken at the School of Earth and Environmental Sciences, the University of Adelaide, supervised by Dr Kate Sanders. This project is testing the following hypotheses:

- sea snakes display avoidance and/or abnormal behaviour in response to simulated air gun activity;
- sea snake hunting/feeding performance is negatively impacted by simulated air gun activity;
- sea snakes exhibit avoidance behaviour and negatively impacted hunting/feeding performance in their natural environment following exposure to actual air gun activities; and
- body condition index (BCI) and characteristics of soft tissues (lungs and dermal sensillae) vary significantly between sound impacted and non-impacted sea snakes.

Information available to date from the study is:

Behaviour**:** Field experiments were trialled over 10 days in the Ningaloo Marine Park in August 2013. Initially deployed Baited Remote Underwater Video Systems (BRUVS), equipped with underwater speakers, were used to assess impacts of airgun sound on sea snake behaviour. BRUVS recorded very few sea snakes, so an alternative method that involved actively searching for snakes and using a baited monopod with a GoPro attached at a fixed distance from the underwater speaker. The aim was to test for correlation between the time for change in underwater sound and time for change in snake behaviour. This experiment was undertaken on six olive sea snakes (*Aipysurus laevis*). None of the snakes showed an observable change in behaviour at the initiation of (or during) the sound treatment. A powerful underwater speaker (Clark Synthesis AQ339) was used to expose snakes to a peak sound pressure of 66.3 db~µPA at 1 metre with

dominant frequencies between 20 and 100 Hz. However, although startle responses were seen in nearby fishes, the sound generated did not reach the received levels considered harmful for other marine vertebrates (above 100 db re µPA). Due to technical difficulties in triggering reactions of wild sea snakes to underwater sound no further assessment was undertaken. It was noted that future studies will be needed to examine the behavioural and physiological effects of sounds, ideally using a real airgun source, on sea snakes.

Morphology: Scanning electron microscopy and comparative phylogenetic analyses were used to provide evidence that the scale sensilla (touch receptors) of terrestrial elapid snakes may function as hydrodynamic receptors in sea snakes. Scale sensilla were more protruding (dome-shaped) in sea snakes than in their terrestrial counterparts, and exceptionally high overall coverage of sensilla was found only in the sea snakes. High sensilla coverage appears to have evolved multiple times within sea snakes, so that the impacts of anthropogenic noise on sea snakes will likely vary among species. These findings are now published (Crowe-Riddell et al. 2016 Open Biology, 6(6):160054-1-160054-12) and were used to inform taxon selection in the electrophysiology study (below).

Electrophysiology: Auditory evoked potentials (AEP) of wild caught sea snakes were measured in 2015 and 2016, providing the first experimental data on the hearing abilities of sea snakes underwater. The audiogram of *Hydrophis stokesii* (based on two individuals) shows a limited frequency range of about 40 Hz to about 1000 Hz, peaking at low frequencies (60 Hz). This sensitivity is similar to species of fish only receptive to particle motion (e.g. fish without a swim bladder, elasmobranchs), which could suggest that sea snakes are not sensitive to sound pressure. By overlapping the signature of a typical airgun on the audiogram of *H. stokesii*, we predict that these snakes can detect an airgun sound up to 100 m from the source. We are currently preparing these results for publication.

Little information is available about the acoustic impacts of seismic surveys on sea snakes. One of the findings of the research and monitoring programme conducted at Scott Reef to study the effects of Woodside's Maxima 3D survey in 2007 on marine life was that the survey did not cause any observed physiological effects or mortality in marine fauna, including sea snakes (Woodside, 2007a and 2007b).

Previously it was assumed that that sea snakes would respond in a similar way to turtles, however, based on the latest work by Dr. Saunders it might be more appropriate to use the sound exposure guidelines applied to fish with no swim bladder. The sound exposure guidelines proposed by Popper et al. (2014) for fish without a swim bladder mortality, potential mortality injury and recoverable injury is > 213 dB re 1 µPa (PK) whereas the sound exposure guidelines for turtle mortality, potential mortality injury and recoverable injury is > 207 dB re 1 µPa (PK).

Based on the modelling the received levels exceed the turtle mortality or mortal injury sound exposure guidelines to a maximum distance of:

> 213 dB re 1 µPa (PK) – 50 m at Site 1

> 207 dB re 1 µPa (PK) – 160 m at Site 1 and Site 2

Typically, the 166 dB re 1 µPa used as the threshold level for turtle behavioural disturbance response (NSF 2011) has been applied to sea snakes.

Based on the modelling the received levels exceed the threshold level for turtle behavioural disturbance response to a maximum distance of:

166 dB re 1 µPa – 5.7 km at Site 2

There are no BIA or critical habitats identified for sea snakes within the NCB and Beagle Operating Areas. At the closest point known habitats for sea snakes (i.e. Ningaloo, Ashmore, Scott, Hibernia and Cartier Reefs) are over a 200 km from the NCB and Beagle Operating Areas. Sea snakes are strongly reef-associated, have high rates of site fidelity and maintain small home ranges. These types of habitats are not present in the NCB and Beagle Operating Areas.

The PMST search identified that sea snakes may be present in the Beagle Operating Area and the Pilbara Trawl Managed Fishery, which overlaps the Beagle Operating Area has recorded sea snakes as by catch (Fletcher et al 2017). Thus, individual sea snakes maybe present typically in shallow waters < 30 m (Cogger

1975, Guinea 2013). Waters < 30 are located a minimum of ~ 15 km from the OAs thus are outside the area of where the sound exposure guidelines for mortality or mortal injury or behavioural disturbance are exceeded. Therefore, the proposed survey activities will not result in acoustic impacts to sea snakes due to the distances to preferred habitats areas.

3.3.2.11 Disturbance to Marine Turtles

Receptors

The PMST identified five species of marine turtle that may occur within the NCB and Beagle AMBAs: flatback turtle; green turtle; hawksbill turtle, leatherback turtle and loggerhead turtle.

The following turtles are identified as receptors for this assessment as impacts to them would be the worst-case scenario.

- Habitat critical to the survival of the species (internesting) for flatback turtles 27 km from the Beagle OA.
- Biologically important area for foraging loggerhead, hawksbill and green turtles 10 km from the Beagle OA.
- Biologically important area for internesting flatback turtles overlaps the NCB and Beagle OAs.

Receptor sensitivity

There is limited information on sea turtle hearing. Migrating turtles may use various acoustic cues, and acoustic disturbances may potentially interfere with their navigational ability (McCauley, 1994). The auditory sensitivity of marine turtles is centred in the 400–1,000 Hz range, with a rapid drop-off in noise perception on either side of this range (Richardson *et al.* 1995). This auditory range matches their weak vocalisation abilities, which are also in the low frequency range (100–700 Hz).

Electrophysiological responses, specifically auditory evoked potentials (AEPs), are the most widely accepted technique for measuring hearing in situations in which normal behavioural testing is impractical. AEP studies on hearing were conducted on various species and stages of life and indicated that the best hearing range for marine turtles is from 100–700 Hz, which overlaps with the frequency range of maximum energy in the horizontally propagating component of a seismic source (McCauley, 1994).

Bartol *et al.* (1999 as cited in BOEM) found that juvenile loggerhead turtles detected sounds in the low frequency range of 250–1000 Hz, with the most sensitive hearing around 250 Hz. Another study on hatchling and juvenile loggerhead and juvenile green turtles (Bartol and Ketten, 2006) found that hatchling loggerheads had the widest range of hearing frequency sensitivity (100–900 Hz), while larger juveniles responded to a narrower range (100–400 Hz). Hearing sensitivity of green turtles also varied with size, as smaller green turtles had a broader frequency range of hearing (100–800 Hz) than that detected in larger subjects (100–500 Hz). Piniak *et al.* (2012) found that leatherback turtle hatchlings detected sounds between 50 and 1,200 Hz, with maximum sensitivity between 100 and 400 Hz. Like other species of marine turtle, they had a relatively narrow, low-frequency range of hearing sensitivity.

Lavender *et al.* (2014) detected no significant differences in behaviour-derived auditory thresholds or AEP-derived auditory thresholds between post-hatchling and juvenile loggerhead turtles. Also, as turtles are in different acoustic environments for each life history stage, individuals may have different hearing capacity throughout ontogeny. However, the measured hearing frequency range (50–1,100 Hz) and highest sensitivity (100–400 Hz) suggested that post-hatchling and juvenile loggerhead sea turtles are low-frequency hearing specialists, exhibiting little differences in threshold sensitivity and frequency bandwidth despite residence in acoustically-distinct environments throughout ontogeny. Consequently, the effects of seismic airgun noise emissions on hatchlings are anticipated to be similar to those of juveniles and adults.

Mortality/potential mortal injury

Popper *et al.* (2014) provided exposure guidelines for marine turtles exposed to seismic airgun noise, with an impact threshold criterion >207 dB PK or >210 dB SEL_{cum} for mortality and potential mortal injury to turtles (Table 3-23). There were no studies conducted on hearing loss or other effects on hearing in any turtle

species. Therefore, Popper *et al.* (2014) extrapolated impact thresholds from fish, based on the rationale that the hearing range for turtles is more like that of fishes than of any marine mammal. There are no specific guideline values proposed by the Working Group for turtle behaviour disturbance due to the limitations described above (Popper *et al.* 2014).

Based on the noise modelling the received levels exceed the turtle mortality or mortal injury exposure guidelines to a maximum distance of 160 m from the source based on the furthest distance for the dual guidelines (Table 3-24 and Table 3-25).

Table 3-23 – Exposure guidelines sound levels for mortality, impairment and behaviour in turtles

Type of animal	Mortality or potential mortal injury	Impairment		Behaviour
		Recoverable injury	TTS	
Sea turtles	>210 dB SEL_{cum} or >207 dB PK	(N) High (I) Low (F) Low	(N) High (I) Low (F) Low	>166 dB SPL

Table 3-24 – Maximum (R_{max}) Horizontal distances (in km) from the 3,260 in^3 array to modelled maximum over depth

Potential Impacts	Threshold criteria	Impact Distance		
		Site 1	Site 2	Site 3
Marine turtles Mortality or potential mortal injury (Popper *et al.* 2014)	>207 dB PK	160 m	160 m	Not reached
Marine turtles Behavioural (NSF, 2011)	>166 dB re 1 µPa	5.6 km	5.7 km	4.0 km

Table 3-25 - Distances to seafloor SEL_{24h} based criteria for the scenario within the Beagle MSS acquisition area

Receptor	Threshold for SEL24h (*LE*,24h; dB re 1 $\mu Pa^2 \cdot s$)	Distance R_{max} (m)	
		Maximum-over-depth	At seafloor
Turtles	210	< 100	Not reached

Impairment

There are no defined quantitative noise exposure criteria for impairment effects (PTS, recoverable injury and TTS) in turtles. Based on the application of the Popper *et al.* (2014) semi-quantitative exposure criteria (Table 3-23) there is a high risk of potential impairment (recoverable injury and TTS) effects to turtles within tens of metres of the array.

Behavioural

There is no scientific evidence implying that turtles actively avoid or are attracted to close range (<500 m) encounters with operating acoustic arrays. However, Moein *et al.* (1994) tested the hearing sensitivity of caged loggerhead turtles altered after exposure to several hundred pulses within 30–65 m of a single airgun (pulse numbers and received sound levels not stated). Hearing was tested before, within a day and then two weeks after exposure. Approximately 50% of the exposed individuals indicated altered hearing sensitivity when tested within a day of their exposure, but none provided any sign of altered hearing two weeks later, compared to the pre-exposure tests. These results suggested that acoustic impacts were not significant, temporary and recoverable with two weeks.

Table 3-26 – Results of airgun exposure to marine turtles

Species	Received SPL (dB re 1 µPa rms)	Effect	Source
Loggerhead turtle	175-176	Avoidance response	O'Hara and Wilcox (1990)
One green and one loggerhead turtle	166	Noticeable increase in swimming behaviour, presumed avoidance response	McCauley *et al.* (2003)
One green and one loggerhead turtle	175	Behaviour becomes increasingly erratic, presumed alarm response	McCauley *et al.* (2003)

However, other studies indicated that marine turtles began to show behavioural responses to an approaching seismic array at received sound levels of SPL ~166 dB re 1 µPa and avoidance at around 175 dB re 1 µPa (McCauley *et al.* 2003; Table 3-26). Eckart *et al.* (2004) used GPS and Time Depth Recorders (TDR) to track movement and behaviour of two leatherback turtles exposed to seismic source noise. They found no change in behaviour or movement from previous turtles that were not exposed to seismic survey noise. Also, Weir (2007) completed observations from on-board a seismic survey vessel during a 10-month 3D survey offshore from West Africa. She concluded that:

"..There was indication that turtles occurred closer to the source during guns-off than full-array, with double the sighting rate during guns-off in all distance bands within 1000 m of the array."

The reduction in number of turtles observed within 1,000 m during operation of a full acoustic array (Weir, 2007) is therefore reasonably consistent with the observations of McCauley *et al.* (2003), which indicated a behavioural response threshold of ~166 dB re 1 µPa SPL. From airgun exposure tests on a caged green turtle and loggerhead turtle that were extrapolated to response levels for a typical acoustic array operating at full power in 100 m water depth, McCauley *et al.* (2003) concluded that turtles would, in general, show behavioural responses at 2 km and avoidance behaviour at 1 km from such operations. However, they also noted that such rules of thumb for acoustic sources with frequencies within the range of turtle hearing (<1 kHz), cannot be reliably applied to shallow coastal waters near reefs, islands and nesting beaches, where transmission losses are typically much higher than in deeper, open water areas.

Seismic surveys in shallow waters (<15 m) near nesting beaches may expose both mating turtles, internesting females and hatchlings to increased sound levels. Mating turtles and internesting females are not known to favour deeper waters (>15 m), and while the air gun discharges may be audible in the deeper water, it is unlikely the sound would be of sufficient intensity to cause a startle response in the animals (Pendoley, 1997).

Similarly, it is unlikely that the noise associated with seismic discharges would override the biologically imprinted drive in turtle hatchlings to complete the initial 24-hour 'swim frenzy' that takes them out to sea as quickly as possible. At most, the sound may cause the hatchlings to deviate from their course to sea. Given the very high mortality rate in hatchlings, it is unlikely that the impacts from seismic source would be measurable (Pendoley, 1997). Observations of turtle behaviour made during a seismic survey on the North West Shelf showed no signs of panic or distress in the turtles in the vicinity of the vessel and during discharge of the air guns. The behaviour noted consisted of either 'steady swimming' or 'diving' to avoid the vessel.

Based on the limited data regarding noise levels that illicit a behavioral response in turtles, the lower level of 166 dB re 1 µPa level drawn from NSF (2011) is typically applied, both in Australia and by NMFS, as the threshold level at which behavioural disturbance could occur.

Based on the noise modelling the received levels exceed the behavioural disturbance threshold at a maximum of 5.7 km from the source (Table 3-24).

Summary

Impacts to turtles is assessed as being acceptable based on:

- Noise levels above the mortality/potential mortal injury exposure guideline will not be reached at the nearest turtle habitat critical to the survival of the species.

- Noise levels above the behavioural exposure guideline will not be reached at the nearest turtle habitat critical to the survival of the species.
- Noise levels above the mortality/potential mortal injury exposure guideline will not be reached at the BIA for foraging loggerhead, hawksbill and green turtles.
- Noise levels above the behavioural exposure guideline will not be reached at the BIA for foraging loggerhead, hawksbill and green turtles
- Noise levels above the mortality/potential mortal injury exposure guideline and the behavioural exposure guideline will be reached within the Montebello Island internesting BIA buffer for flatback turtles that overlaps the NCB OA and the North Turtle Island internesting BIA buffer for flatback turtles that overlaps the Beagle OA.
- Based on the Recovery Plan for Marine Turtles in Australia 2017 – 2027 (DoEE 2017a) nesting of flatback turtles within the Pilbara including the Montebello Island and North Turtle Island is from October to March. The area of overlap with these internesting BIAs is within the Pilbara line trap and trawl areas of catch effort where surveys will only be undertaken during May, June and July which is outside the nesting period and hence internesting turtles are unlikely to be encountered.
- The Recovery Plan for Marine Turtles in A,ustralia 2017 – 2027 (DoEE 2017a) which is based on the latest research details a 60 km internesting buffer area, a 20 km reduction from the BIA information. The recovery plan has higher statutory standing than the BIAs. Noise levels above the mortality/potential mortal injury exposure guideline and the behavioural exposure guideline are not reached within the 60 km buffer.
- The Montebello Island internesting BIA is 20,134 km^2 with the NCB area of overlap of 204 km^2 which equates to 1% and would take 2 days to survey. Mortality/potential mortality impacts are highly unlikely and have not been reported for turtles from seismic surveys. Impacts are more likely to be behavioural with turtles moving away from the area. The Montebello Island internesting BIA is highly precautionary as it is 20 km more than the habitat critical to the survival of the species internesting buffer. The survey area is on the outer boundary of the BIA, so it is more likely that turtles that maybe disturbed would move towards their nesting beach and away from the seismic survey. Thus, impacts to turtles are likely to be short term, behavioural and will not impact on their nesting or internesting behaviour. The implementation of soft starts as recommended by the Recovery Plan for Marine Turtles in Australia (DoEE 2017a) will ensure that turtles have enough time to move away from the seismic source.
- The North Turtle Island internesting BIA is 17,044 km^2 with the Beagle area of overlap of 2,846 km^2 which equates to 17% and would take ~28 days to survey. Mortality/potential mortality impacts are highly unlikely and have not been reported for turtles from seismic surveys. Impacts are more likely to be behavioural with turtles moving away from the area. The North Turtle Island internesting BIA is highly precautionary as it is 20 km more than the habitat critical to the survival of the species internesting buffer. The survey area is on the outer boundary of the BIA, so it is more likely that turtles that maybe disturbed would move towards their nesting beach and away from the seismic survey. Thus, impacts to turtles are likely to be short term, behavioural and will not impact on their nesting or internesting behaviour. The implementation of soft starts as recommended by the Recovery Plan for Marine Turtles in Australia (DoEE 2017a) will ensure that turtles have enough time to move away from the seismic source.
- Individual turtles may traverse through the operating area while a survey is being undertaken, however, impacts would be expected to be limited to behavioural disturbance such as moving further away from the survey.
- As per the Recovery Plan for Marine Turtles in Australia (DoEE 2017a) soft starts will be undertaken during surveys irrespective of location and time of year of the survey.

Thus, impacts to turtles are not predicted based on spatial and temporal restrictions. Thus, the activity is consistent with the Recovery Plan for Marine Turtles in Australia (DoEE 2017a) as impacts will be managed to ensure that biologically important behaviours can continue.

3.3.2.12 Seabirds

Receptors

The OAs overlap the following seabird BIAs:

- Brown Booby – breeding, foraging
- Lesser Crested Tern – breeding, foraging
- Lesser Frigatebird - breeding, foraging
- Roseate Tern - breeding, foraging
- Wedge-tailed Shearwater - foraging
- White-tailed Tropicbird - foraging

Receptor sensitivity

Acoustic noise from seismic surveys is not anticipated to have a direct effect on seabird or shorebird species, due to the method of the activity, and that birds and vessels are transient. Only bird species that plunge dive (such as tropicbirds and tern species) could potentially be exposed to underwater noise, although little or no impact is expected. Stemp (1985 as cited in LGL, 2012) conducted observations on the effects of seismic exploration on seabirds and did not observe any negative effects. Lacroix *et al.* (2003 as cited in LGL, 2012) investigated the effect of nearshore seismic surveys on moulting long-tailed ducks in the Beaufort Sea, Alaska, and also failed to detect any negative effects. Furthermore, they noted that seismic activity did not appear to change the diving intensity of the ducks significantly. However, some species may be affected indirectly as identified below.

Localised, temporary displacement

Seabirds may be displaced physically by vessels or because of increased noise at the sea surface only. However, as a result of acoustic source directivity being focussed downwards towards the seabed and reducing levels with distance from the source, the area of displacement is anticipated to be minimal. Pelagic seabirds (e.g. terns, shearwaters and frigatebirds) cover large areas when foraging (over 100 km). Therefore, as displacement from survey activities would be limited to the area close to the vessel, any impact is anticipated to be temporary and no more than slight behavioural changes.

Modified prey abundance

Prey abundance could either increase or decrease because of seismic activities. If seismic activities disorient, injure, or kills prey species, or otherwise increase the availability of prey species to marine birds, a seismic survey may attract birds. Birds drawn too close to an airgun may be at risk of injury. Alternatively, if prey species do exhibit avoidance of the vessels or source, it is expected to be transitory and limited to a very small portion of a bird's foraging range. Seismic effects on prey species such as fish and invertebrates are outlined in Section 3.3.2.6 and Section 3.3.2.8, and are expected to be limited to short-term behavioural displacement. Therefore, it is unlikely that seabird prey species will be affected significantly by seismic activities, particularly to a degree that affects the foraging success of birds and at the population level.

Disturbance to nesting birds

A vessel (seismic or otherwise) that approaches too close to a breeding colony could potentially disturb nesting birds in response to either acoustic or visual stimuli. There is little potential for this during the proposed surveys, as the closest nesting site is Bedout Island 20 km from the Beagle OA. As nests are located on-shore, the underwater noise from the acoustic source will not impact nesting birds.

Chance of injury or mortality

Species such as the white-tailed tropicbird, lesser crested tern and the wedge-tailed shearwater forage by plunge-diving to depths. It's possible that, during the course of normal feeding or escape behaviour, some birds could be near enough to an acoustic source to be injured. Although no records of this circumstance could be found, a bird would have to be very close to an acoustic source to receive a discharge with sufficient

energy to cause injury, and as such is very unlikely to occur. The approach of the vessel serves as a "ramp-up" in that the received noise levels at a fixed point along a line will gradually increase. As such, birds will be alerted to the approaching seismic vessel and could move away from the acoustic source. Birds may be affected slightly by seismic sounds from the proposed survey, but the impacts are not expected to be significant to individual animals or at the population level.

The EPBC Act Policy Statement 3.21 – *Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (DoE, 2016k) does not identify any impacts and risks to shorebirds from offshore seismic activities. No additional controls will be implemented as impacts and risks to seabirds and shorebirds have been identified above as being ALARP and acceptable.

3.3.2.13 Disturbance to Dugongs

Dugongs are not identified as a receptor as there are no dugong BIAs or habitats within the AMBA (30 km) for the NCB or Beagle Operating Areas.

Based on the limited data regarding noise levels that illicit a behavioral response in Sirenians, the lower level of 160 dB re 1 µPa level from NMFS (2013) is typically applied, both in Australia and by NMFS, as the threshold level at which behavioural disturbance could potentially occur.

From the Jasco noise modelling the maximum distance that the behavioural disturbance threshold of 160 dB re 1 µPa is reached is 11.5 km at Site 2. Thus, no impacts to dugong habitat areas are predicted.

3.3.2.14 Disturbance to Cetaceans

Receptors

The PMST identified 29 cetaceans consisting of 18 whale species and 11 dolphin species that maybe present in the OAs.

The following cetaceans are identified as receptors for this assessment as impacts to them would be the worst-case scenario.

- Humpback whale: The Beagle OA overlaps the humpback whale migration BIA by 1%.
- Pygmy blue whale: The NCB OA overlaps the Pygmy blue whale migration BIA by 5% and Beagle OA by 1.4%, thus 6.4% in total.
- Sperm whale: Whaling records from the 19th century suggest that the Exmouth Plateau may have supported large populations of sperm whales.

No resting, calving or feeding BIAs have been identified within the AMBA and hence cetaceans would be transiting through the operational areas.

Receptor sensitivity

Odontocetes (i.e. toothed whales such as sperm whales) produce a wide range of whistles, clicks, pulsed sounds and echolocation clicks. The frequency range of toothed whale sounds excluding echo location clicks are mostly <20 kHz with most of the energy typically around 10 kHz, although some calls may be as low as 100 to 900 Hz. Sound levels of these calls range from 100 to 180 dB re 1 µPa (Richardson *et al.* 1995). The sounds produced (other than echolocation clicks) are very complex in many species and used for communication between members of a pod in socialising and coordinating feeding activities.

The hearing capability of the majority larger toothed whales is unknown. Generally, larger mammals have more sensitive hearing in the lower frequencies than the smaller toothed cetaceans, for example, killer whales whose most sensitive hearing range extends to as low as 18 kHz (Szynmanski *et al.* 1999). Considering the auditory weighting from NMFS (2018) applicable for the majority of odontocetes in Australian waters, mid-frequency cetaceans, they have low sensitivity to low frequency sounds, such as seismic sources, which have most of energy below 500 Hz. Mid-frequency (MF) cetaceans include sperm, beaked and killer whales, along with bottlenose and common dolphins. High frequency (HF) cetaceans identified from the PMST search are pygmy and dwarf sperm whales.

Baleen whales (humpback and pygmy blue whales) produce a rich and complex range of underwater sounds ranging from about 12 Hz to 8 kHz, but with the most common frequencies below 1 kHz (McCauley 1994). Combined with studies of their hearing structures suggests that their hearing is also best adapted for low frequency sound (Mooney *et al.*, 2012). Baleen whales are predominantly low frequency (LF) species.

For this assessment Table 3-27 details the acoustics threshold used for LF, MF and HF cetaceans. The PTS and TTS thresholds are from NMFS (2018) which is the most current technical guidance for assessing the effect of anthropogenic sound on marine mammal hearing. For the PTS and TTS assessment the threshold which results in the largest isopleth has been applied as per the NMFS (2018) guidance.

The behavioural disturbance threshold criteria applied is from NMFS (2013) which is the current interim U.S. National Marine Fisheries Service (NMFS) criterion (NMFS 2013) for marine mammals.

PGS commissioned JASCO Applied Sciences (JASCO) to model the received sound fields associated with the 3,260 in^3 acoustic array at three locations (Li & McPherson 2018). Figure 3-1 shows the location of the three sites modelled. The acoustic modelling sites were chosen to represent a range of water depths appropriate to receptors. Site 1 in 119 m water depth which was relevant for humpback whales and Site 3 in 350 m water depth and on the shelf was seen as relevant for pygmy blues whales and applicable to the sperm whales at the Exmouth Plateau which is in waters depths form 800 – 4,000 m based on the following advice from Jasco (Li & McPherson 2018):

> *In shallow water the transmission loss close to the source is lower than it is in deep water, due to refractions from the surface and seafloor close to the source. Beyond a number of water depths however, the transmission loss is higher, due to these same refractions, leading to lower sound levels at longer ranges than observed in deep water. Therefore, when considering the area close to the sound source, the levels predicted at a shallower site at a particular distance will be higher than levels at a deeper site at the same distance. A good example of this is the distance (Rmax) to the 166 dB re1uPa (SPL) isopleth, which is 5.6 and 5.7 km at Sites 1 and 2 respectively, but 4.0 km at Site 3. The distance to the 160 dB re1uPa (SPL) isopleth is also greater at Sites 1 and 2 then Site 3; the distance is greater at Site 2; however this is due to the influence of the gradient of the bathymetry in the offshore direction. The bathymetry at Site 3 is both deeper and has a gentler slope, hence the reduced distance to the 160 dB re1uPa (SPL) isopleth in the offshore direction.*
>
> *The water depth at Site 3 is shallower (350 m) than the water depth at the Exmouth Plateau (~800 – 4,000m), therefore the sound levels predicted close to Site 3 will be higher than those which would occur at a similar distance at the Exmouth Plateau, as demonstrated through considering the difference between the results for Sites 1-3. Due to this, approximating a distance at the Exmouth Plateau to the applied behavioural disturbance criteria of 160 dB (SPL) of 9 km, which is greater than what is predicted at Site 3, is a conservative approach that overestimates the potential distance.*
>
> *The ranges to TTS and PTS for mid-frequency cetaceans, such as sperm and beaked whales, are greater for the single impulse peak pressure level (20m) than those from the SEL 24h. Therefore, it is appropriate to extrapolate the distances at which PTS and TTS could occur at Site 3 from the single impulse peak pressure levels for these criteria to operations at the Exmouth Plateau.*

Table 3-27 - Summary of marine mammal acoustic thresholds for impulsive sounds

Hearing Group	Generalised Hearing Range	Threshold criteria		
		PTS	TTS	Behavioural
Low-frequency cetaceans Baleen whales – humpback and pygmy blue whales	7 Hz to 35,000 Hz	219 dB PK 183 dB SEL24h	213 dB PK 168 dB SEL24h	160 dB SPL
Mid-frequency cetaceans Dolphins, toothed whales, beaked whales, bottlenose whales – sperm whales	150 Hz to 160,000 Hz	230 dB PK 185 dB SEL24h	224 dB PK 170 dB SEL24h	160 dB SPL
High-frequency cetaceans (pygmy and dwarf sperm whales)	275 Hz to 160,000 Hz	202 dB PK 155 dB SEL24h	196 dB PK 140 dB SEL24h	160 dB SPL

Notes: dB PK (PK - Peak pressure level threshold, dB re 1 µPa); SPL (dB re 1 µPa). PTS and TTS criteria - NMFS (2018). Behavioural criteria – NMFS (2013).

Mortality/potential mortal injury

There are no defined noise exposure criteria for mortality and potential mortal injury impacts for cetaceans. These effects are extremely unlikely to occur as received sound levels of sufficient magnitude to cause mortality/potential mortal injury may only occur at extremely close range (i.e. <10 m) to an operating seismic source. This scenario is extremely unlikely to occur given the control and mitigation measures that are routinely implemented for marine seismic surveys in Australian waters, in compliance with EPBC Policy Statement 2.1 (i.e. use of MFOs; observation, low-power and shutdown zones; soft starts etc.).

Impairment

Permanent threshold shifts (PTS) occurs when an animal experiences a shift in their hearing threshold caused by prolonged or repeated exposure to high sound levels and resulting in permanent and irreversible damage (Richardson *et al.* 1995). TTS occurs when an animal's hearing threshold is temporarily increased during and immediately after an exposure event to a loud sound source (Richardson *et al.* 1995). Accurately measuring PTS is difficult and not always possible, and thus TTS measurements over time are used to predict likely occurrences of PTS. This process is described in the National Marine Fisheries Service (NMFS) technical guidance (NMFS, 2018), which summates the most recent scientific literature on the impacts of sound on marine mammal hearing.

Table 3-28 and Table 3-29 detail the maximum distances to the PTS and TTS SEL_{24h} threshold from the acoustic modelling for the different cetacean hearing groups.

Table 3-28 - Maximum (R_{max}) horizontal distances (m) from the 3260 m^3 array to PTS and TTS PK threshold criteria

Hearing Group	Threshold criteria	Distance Site 1	Distance Site 2	Distance Site 3
Low-frequency cetaceans Humpback and pygmy blue whales	PTS - 219 dB PK	30	30	30
	TTS - 213 dB PK	60	60	60
Mid-frequency cetaceans Sperm whales	PTS - 230 dB PK	20	20	20
	TTS - 224 dB PK	20	20	20
High-frequency cetaceans Pygmy and dwarf sperm whales	PTS - 202 dB PK	220	220	240
	TTS - 196 dB PK	740	630	450

Table 3-29 - Maximum-over-depth distances to SEL_{24h} based marine mammal PTS and TTS thresholds

Hearing Group	PTS		TTS	
	Threshold for SEL24h (*LE*,24h; dB re 1 µPa²·s)	*R*max (km)	Threshold for SEL24h (*LE*,24h; dB re 1 µPa²·s)	*R*max (km)
Low-frequency cetaceans Humpback and pygmy blue whales	183	0.79	168	22.3
Mid-frequency cetaceans Sperm whales	185	-	170	-
High-frequency cetaceans Pygmy and dwarf sperm whales	155	-	140	0.18

Behavioural

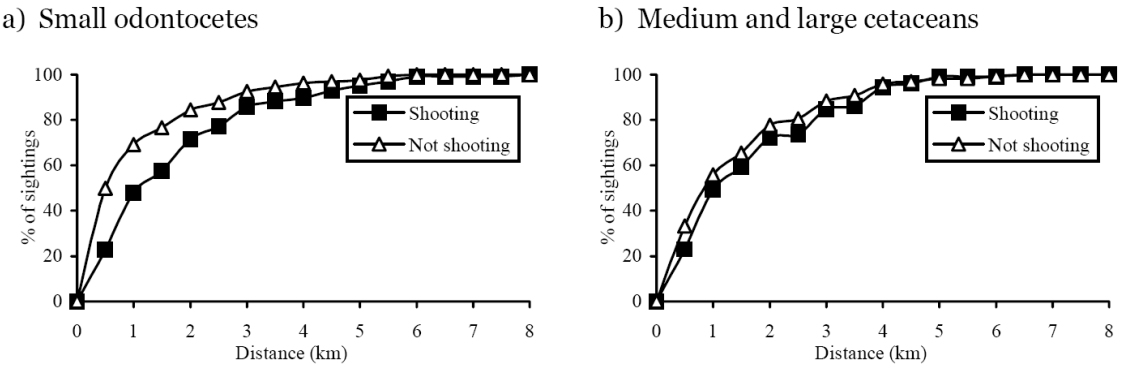
Behavioural responses to underwater sound are difficult to determine because animals vary widely in their response type and strength, and conspecifics who are exposed to the same sound react differently (Nowacek *et al.* 2004, Gomez *et al.* 2016, and Southall *et al.* 2016). An individual's response to a stimulus is influenced by the context in which the animal receives the stimulus and how relevant the individual perceives the stimulus to be. Biological and environmental factors can affect an animal's response—behavioural state (e.g., foraging, travelling or socialising), reproductive state (e.g., female with or without calf, or single male), age (juvenile, sub-adult, adult), and motivational state (e.g., hunger, fear of predation, courtship) at the time of exposure as well as perceived proximity, motion, and biological meaning of the sound and nature of the sound source.

Noise associated with seismic arrays used during seismic surveys can cause behavioural changes in whales (McCauley, 1994). Behavioural responses to airgun noise include swimming away from the source, rapid swimming on the surface and breaching (McCauley *et al.* 2003). The level of noise at which response is elicited varies between species and even between individuals within a species (Richardson *et al.* 1995). Stone (2003) suggested that different groups of cetaceans adopt different strategies for responding to acoustic disturbance from seismic surveys, with baleen and killer whales displaying localised avoidance, pilot whales showing few effects and sperm whales showing no observed effects.

There is little systematic data on the behavioural response of toothed whales to seismic surveys. Richardson *et al.* (1995) reported that sperm whales appeared to react by moving away from surveys and ceasing to call even at great distances from a survey. However, in a 2003 study supported by the US Minerals Management Service (Jochens and Biggs 2003), two controlled exposure experiments were carried out (including one with three simultaneously tagged whales) to monitor the response of sperm whales to seismic source. The whales were exposed to a maximum received level of 148 dB re 1 µPa. There was no indication that the whales showed horizontal avoidance of the seismic vessel nor was there any detected change in feeding rates of the tagged sperm whales.

Furthermore, a recent report from Bureau of Ocean Energy Management (BOEM - Barkaszi *et al.* 2012) indicated that defined species groups (all cetaceans, baleen whales, delphinids, and sperm whales) were sighted at significantly greater distances from seismic sources during full power than during silence, illustrating a level of spatial avoidance to the seismic sources.

Odontocetes have poor hearing in the low frequency range of acoustic array noise (10 to 300 Hz; NMFS, 2018) and seismic operators sometimes report dolphins and other small toothed whales near operating acoustic arrays. However, there is a component of seismic pulses in the higher frequency spectrum and in general most toothed whales do show some limited avoidance of operating seismic vessels. Goold (1996) studied the effects of 3D seismic surveys on common dolphins (*Delphinus delphis*) in the Irish Sea. The results indicated a local displacement of dolphins around the seismic operation. This observation is consistent with data compiled by Stone (2003) from marine mammal observers aboard seismic vessels in the North Sea that shows small toothed whale species tend to move away from operating airguns (Figure 3-5).



Source: Stone (2003).

Figure 3-5 – Proportion of marine mammal sightings occurring within specified distances of the airguns during seismic surveys

A comprehensive study carried out by McCauley *et al.* (2003) monitored the effects of seismic survey noise on humpback whales in the Exmouth Gulf region of Western Australia and concluded the following:

- only localised avoidance was seen by migrating whales during the seismic operation, indicating that the 'risk factor' associated with the seismic survey was confined to a comparatively short period and small range displacement;
- coupled with the fact that humpback whales were seen to be actively utilising the 'sound shadow' near the surface, then it was unlikely that animals were at any physiological risk unless at very short range from a large acoustic array, perhaps of the order of a few hundred metres; and
- upper levels of noise at 1.5 km from the CMST seismic survey array were in the order of 182 dB re 1 µPa, which was still well below the source levels of the highest components of humpback whale song (192 dB re 1 µPa).

With regards to avoidance behaviour by baleen whales, it is known that baleen whales avoid operating seismic vessels, and the distance over which the avoidance occurs seems to be highly variable between species and even within species. It is considered that this avoidance behaviour represents only a minor effect on either the individual or the species unless avoidance results in displacement of whales from nursery, resting or feeding areas, at an important period for the species. McCauley *et al.* (2003) found that migrating humpback whales showed a general avoidance of an operating seismic source at 157 to 164 dB re 1 µPa (SPL).

Recent research from the analysis of the BRAHSS data has found similar results, where significant responses were observed within 3 km of an operating source and received levels were greater than 140 dB re 1 μPa^2 (SEL; Dunlop et al., 2017). However, it is important to note the desktop research of data collected states that these limits "do not represent a threshold, of response, but that responses were more likely to occur within these bounds than outside of them". Responses were highly variable – some groups did not respond, some groups responded outside this (Dunlop et al., 2017).

Table 3-30 details the maximum distances to the behavioural exposure guideline from the acoustic modelling for all cetacean hearing groups. Based on the acoustic modelling the maximum distance that the received sound level which may trigger avoidance behaviours is 11.5 km.

Table 3-30 - Maximum (R_{max}) horizontal distances (m) from the 3260 m^3 array to behavioural threshold criteria

Hearing Group	Threshold criteria	Distance Site 1	Distance Site 2	Distance Site 3
All	Behavioural -160 dB SPL	9.4 km	11.5 km	8.8 km

Summary

Humpback whales

Impacts to migrating humpback whales are within an acceptable level based on:

- The Beagle OA overlaps the humpback whale migratory BIA by 0.86%, though humpback whales maybe present outside of this area in lower numbers during the migration period.
- The maximum distances to the PTS threshold criteria for LF cetaceans, based on the largest isopleth (Table 3-28 and Table 3-29) is 790 m. This equates to 0.92% of the humpback whale migratory BIA. PTS impacts are unlikely as whales are likely to have a behavioural response to avoid a noise level that could result in PTS.
- The maximum distances to the TTS threshold criteria for LF cetaceans, based on the largest isopleth (Table 3-28 and Table 3-29) is 22.3 km. This equates to 3.24% of the humpback whale migratory BIA. However, TTS is based on that there will be full recovery after sound exposure ceases (NMFS 2018). Thus, impacts would be of a temporary nature.
- The maximum distance at which the behavioural disturbance threshold criteria is exceeded is 9.4 km (Site 1 relevant to humpback whales). This equates to 1.68% of the humpback whale migratory BIA.
- Though the area of overlap is small no seismic surveys will be undertaken within the migratory area BIA from mid-July to early August during the northern migration and from late August to mid-October during the southern migration. As the humpback whale migratory BIA overlaps the Pilbara Trawl Fishery seismic surveys will only be undertaken in this area during May, June and July, however, this will be further reduced to mid-July for the portion within the humpback whale migratory BIA. Thus, impacts to migrating whales would be limited to individuals outside of the migratory period which would be expected to be very low.
- As the received sound exposure level for each shot will likely exceed 160dB re $1\mu Pa^2 \cdot s$, for 95% of seismic shots at 1km range, the following precaution zones will be used:
    - Observation zone: 3+ km horizontal radius from the acoustic source.
    - Low power zone: 2 km horizontal radius from the acoustic source.
    - Shut-down zone: 500m horizontal radius from the acoustic source.
- The area of overlap for all threshold criteria do not overlap any calving, resting, foraging areas, or confined migratory pathway. The confined migratory pathway is defined as within 30 km of the coastline and for Western Australia include Geraldton/Abrolhos Islands, and Point Cloats to North West Cape.
- DEWHA (2008) states that at the scale of a seismic survey, such temporary displacements are unlikely to result in any real biological cost to the animals unless the interaction occurs during critical behaviours (e.g. breeding, feeding and resting), or in important areas such as narrow migratory corridors. No impacts to critical behaviours or important areas such as narrow migratory corridors have been identified.
- The Threatened Species Scientific Committee – Conservation Advice (TSSC-CA) for Humpback Whales identify noise interference, including seismic exploration, as a threat (DoE, 2016i). The relevant Conservation and Management Actions identified by the TSSC-CA to protect humpback whales from noise impacts from seismic surveys will be implemented (Table 3-31).

As the Beagle OA is on the outer boundary of the migratory pathway and seismic surveys will not be undertaken within the migratory period impacts are predicted to be temporary, localised, not within a restricted area and unlikely to impact at a population level.

Pygmy blue whales

Impacts to migrating pygmy blue whales are within an acceptable level based on:

- The NCB OA overlaps the pygmy blue whale migratory BIA by 5% and the Beagle OA overlaps the pygmy blue whale migratory BIA by 1.4% giving a total of 6.4%, though pygmy blue whales maybe present outside this area.
- The maximum distances to the PTS threshold criteria for LF cetaceans, based on the largest isopleth (Table 3-28 and Table 3-29) is 790 m. This equates to 6.7% of the pygmy blue whale migration pathway (Beagle OA – 1.5%, NCB OA – 5.2%). PTS impacts are unlikely as whales are likely to have a behavioural response to avoid a noise level that could result in PTS.
- The maximum distances to the TTS threshold criteria for LF cetaceans, based on the largest isopleth (Table 3-28 and Table 3-29) is 22.3 km. This equates to 10.3% of the pygmy blue whale migration pathway (Beagle OA – 2.9%, NCB OA – 7.4%). However, TTS is based on that there will be full recovery after sound exposure ceases (NMFS 2018). Thus, impacts would be of a temporary nature.
- The maximum distance to the behavioural disturbance threshold criteria is 8.8 km (Site 3 relevant to pygmy blue whale). This equates to 8% of the pygmy blue whale migration pathway (Beagle OA - 6%, NCB OA – 2%).
- As the received sound exposure level for each shot will likely exceed 160dB re 1µPa^2·s, for 95% of seismic shots at 1km range, the following precaution zones will be used:
    - Observation zone: 3+ km horizontal radius from the acoustic source.
    - Low power zone: 2 km horizontal radius from the acoustic source.
    - Shut-down zone: 500m horizontal radius from the acoustic source.
- Though the area of potential impact is small, no seismic surveys will be undertaken within 22.5 km of the pygmy blue whale migration BIA during the peak migration periods of 15th May to 15th June and 1 November to 15 December. Thus, impacts to migrating whales would be limited to individuals outside of the peak migratory period which would be expected to be a low number with impacts predicted to be temporary, localised, not within a restricted area and unlikely to impact at a population level.
- While seismic noise may elicit a behavioural disturbance, it is unlikely to pose a conservation risk unless it causes population level consequences such as changes in growth, reproduction and survival of individuals (Double *et al.* 2012). No impacts are identified to critical habitat which includes habitat used to meet essential life cycle requirements such as foraging and breeding.
- DEWHA (2008) states that at the scale of a seismic survey, such temporary displacements are unlikely to result in any real biological cost to the animals unless the interaction occurs during critical behaviours (e.g. breeding, feeding and resting), or in important areas such as narrow migratory corridors. No Impacts to critical behaviours have been identified. However, the area of overlap within the NCB OA could be classed as a narrow migratory corridor and hence there will be no seismic acquisition within this area during the peak migration periods of 15th May to 15th June and 1 November to 15 December.
- The Conservation Management Plan for the Blue Whale (including its sub species) identifies noise interference including seismic surveys as a threat (Commonwealth of Australia 2015). Management actions under the plan aim to address these threats in accordance with the plan's interim objective of demonstrably minimising anthropogenic threats. The relevant action areas to protect pygmy blue whales from noise impacts from seismic surveys will be implemented as detailed in Table 3-32.

As seismic surveys will not be undertaken within 22.5 km of the pygmy blue whale migration BIA during peak periods impacts to pygmy blue whales are predicted to be temporary, localised, not within a restricted or critical area and unlikely to impact at a population level. Thus, the activity is consistent with

the Conservation Management Plan for the Blue Whale as physical injury impacts to pygmy blue whales are unlikely based on the controls to be implemented.

Sperm whales

Impacts to sperm whales can be managed to an acceptable level based on:

- No BIAs or critical habitats for sperm whales where identified within the NCB or Beagle OAs. However, sperm whales may be encountered in the deeper waters of the NCB OA based on records that sperm whales have previously inhabited the Exmouth Plateau KEF.
- The maximum distances to the PTS and TTS threshold criteria for MF cetaceans is 20 m which is considered unlikely that a cetacean would come within this range of an operating seismic vessel especially a deep diving species. The likelihood is reduced even further with the implementation of EPBC Policy Statement 2.1 low power zone and soft-start procedures.
- The SEL_{24hr} PTS and TTS threshold criteria for MF cetaceans is not reached. Thus, no PTS or TTS impacts are predicted to sperm whales that may be inhabiting the Exmouth Plateau KEF.
- As the received sound exposure level for each shot will likely exceed 160dB re 1µPa^2·s, for 95% of seismic shots at 1 km range, the following precaution zones will be used:
    - Observation zone: 3+ km horizontal radius from the acoustic source.
    - Low power zone: 2 km horizontal radius from the acoustic source.
    - Shut-down zone: 500m horizontal radius from the acoustic source.
- The behavioural disturbance threshold criteria is reached at 8.8 km (Site 3 relevant to sperm whales) however, impacts would be temporary, localised, not within a restricted area and unlikely to impact on large numbers of sperm whales.
- For sperm whales that maybe present at the Exmouth Plateau no data could be found regarding seasonality.

Other whale species

Impacts to other whales can be managed to an acceptable level based on:

- Pygmy and dwarf sperm whales were identified as may occur within the NCB and Beagle OAs via the PMST Search, however, there are no BIAs or records of these species for the area (DoEE 2018b, 2018c). Thus, it is unlikely that they would be encountered in significant numbers. The distances to the PTS and TTS threshold criteria for HF cetaceans are 240 and 740 m, respectively. It is unlikely that impacts would occur based on the low numbers likely in the area and the implementation of EPBC Policy Statement 2.1 low power zone and soft-start procedures.
- Other whale species identified via the PMST search may be present in the OA, however, no BIAs or critical habitats were identified. The maximum distances to the PTS and TTS threshold criteria are 790 m and 22.3 km. It is unlikely that impacts would occur based on the low numbers likely in the area and the implementation of EPBC Policy Statement 2.1 Part A including low power and shutdown zones and soft-start procedures.
- As the received sound exposure level for each shot will likely exceed 160dB re 1µPa^2·s, for 95% of seismic shots at 1km range, the following precaution zones will be used:
    - Observation zone: 3+ km horizontal radius from the acoustic source.
    - Low power zone: 2 km horizontal radius from the acoustic source.
    - Shut-down zone: 500m horizontal radius from the acoustic source.
- The behavioural disturbance threshold criteria is reached at a maximum distance of 11.5 km, however, impacts would be temporary, localised, not within a restricted area and unlikely to impact on large numbers of whales.

- DEWHA (2008) states that at the scale of a seismic survey, such temporary displacements are unlikely to result in any real biological cost to the animals unless the interaction occurs during critical behaviours (e.g. breeding, feeding and resting), or in important areas such as narrow migratory corridors. No impacts to critical behaviours or important areas such as narrow migratory corridors have been identified.
- The Threatened Species Scientific Committee – Conservation Advice (TSSC-CA) for sei whales and for fin whale identify anthropogenic noise and acoustic disturbance, which includes seismic surveys, as a threat (DoE 2015c, DoE 2015d). Impacts are unlikely to these species as there are no breeding, feeding and resting), or in important areas such as narrow migratory corridors within the predicted area of impact. EPBC Policy Statement 2.1 low power zone and soft-start procedures will be applied for all whales.

Table 3-31 - Conservation advice for humpback whale management actions and alignment with Rollo EP Controls

Conservation and Management Action	Alignment with Rollo EP Controls
All seismic surveys must be undertaken consistently with the EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales. Should a survey be undertaken in or near a calving, resting, foraging area, or a confined migratory pathway then Part B. Additional Management Procedures must also be applied.	Seismic surveys under the Rollo EP will not impact on a calving, resting, foraging area, or a confined migratory pathway thus EPBC Act Policy Statement 2.1 Part A will be implemented. Components of Part B will also be applied to further reduce impacts to humpback whales within the migration BIA such as increased pre-start observation times from 30 min to 45 min, adaptive management for 3 or more fauna shutdowns and no seismic surveys within the humpback whale migration BIA from mid-July to mid-Aug during the northern migration period and late August to mid-October for the southward migration.
For actions involving acoustic impacts (example pile driving, explosives) on humpback whale calving, resting, feeding areas, or confined migratory pathways site specific acoustic modelling should be undertaken (including cumulative noise impacts).	Acoustic modelling confirms that noise impacts will not occur within humpback whale calving, resting, feeding areas, or confined migratory pathways.
Should acoustic impacts on humpback calving, resting, foraging areas, or confined migratory pathways be identified a noise management plan should be developed. This can include: o the use of shutdown and caution zones, o pre and post activity observations, o the use of marine mammal observers and / or Passive Acoustic Monitoring (PAM), and o Implementation of an adaptive management program following verification of the noise levels produced from the action (i.e. if the noise levels created exceed original expectations).	Seismic surveys under the Rollo EP will not impact on a calving, resting, foraging area, or a confined migratory pathway, however, the following controls will be implemented: o use of shutdown and caution zones, o pre-activity observations o use of marine mammal observers o adaptive management program

Table 3-32 - Conservation Management Plan for the Blue Whale action areas and alignment with Rollo EP Controls

Action Areas	Alignment with Rollo EP Controls
Assessing the effect of anthropogenic noise on blue whale behaviour.	Acoustic modelling has been undertaken and used to assess impacts and determine controls to manage impacts to an acceptable level.
Anthropogenic noise in biologically important areas will be managed such that any blue whale continues to utilise the area without injury and is not displaced from a foraging area.	No impacts to blue whale foraging areas were identified from the impact assessment. Received levels above the threshold criteria for PTS, TTS and behavioural disturbance were identified within the pygmy blue whale migration BIA. The likelihood of impacts will be reduced through the implementation of EPBC Policy

Action Areas	Alignment with Rollo EP Controls
	Statement 2.1 low power zone and soft-start procedures and not undertaking seismic surveys within the pygmy blue whale migration BIA during the peak migration periods of 15th May to 15th June and 1 November to 15 December. Thus, injury to pygmy blue whales is not likely.
EPBC Act Policy Statement 2.1—Interaction between offshore seismic exploration and whales is applied to all seismic surveys.	EPBC Act Policy Statement 2.1 Part A will be implemented for all seismic surveys within the Rollo OA. In addition, the following Part B controls will be implemented for those areas that overlap the pygmy blue whale migratory path: • Two experienced marine mammal observers. • Seismic surveys will not be undertaken within the pygmy blue whale migration BIA during the peak migration periods of 15th May to 15th June and 1 November to 15 December. • Adaptive management program

3.3.2.15 Disturbance to Divers

Interaction with divers includes a variety of different types of diving activities, for example (but not limited to) commercial, recreational, scientific, and fisheries (e.g. pearl oyster divers). Divers exposed to high levels of underwater sound can suffer from dizziness, hearing damage or other injuries to other sensitive organs, depending on the frequency and intensity of the sound. The human auditory system is significantly less sensitive underwater than in air and is further degraded if diving equipment obstructs the ears or face (e.g. diving with a hood or full facemask). Underwater auditory threshold curves indicate that the human auditory system is most sensitive to waterborne sound at frequencies between 400 Hz to 1 kHz (Parvin *et al.* as cited in Anthony *et al.* 2009), and these frequencies have the greatest potential for damage. In general, within this frequency band, underwater hearing is 35-40 dB less sensitive than in air. Within the literature (all as cited in Ainslie, 2008), there is some variation in acceptable SPLs for divers:

- NATO military divers: 177 dB re 1 µPa (31.5-2,500 Hz);
- NATO recreational divers: 154 dB re 1 µPa (600–2,500 Hz);
- Ainslie *et al.* (2008): 160 SPL (up to 4,000 Hz)
- Parvin *et al.* (2005): 155 dB re 1 µPa (500–2,500 Hz).

Two of the thresholds above apply to frequency levels higher than (i.e. not relevant to) the proposed acoustic source, which has most of sound energy <500 Hz (Section 3.3.2.3). Furthermore, Parvin *et al.* developed a weighting scale to enable the allowable level of noise underwater to be assessed and directly compared to air levels. Therefore, the survey activities within the Rollo OAs will adhere to the most precautionary and conservative diver acoustic impact threshold, this being Parvin (2005) threshold (Reported in Ainslie *et.* al., 2008) of SPL 155 dB re 1 µPa.

From the acoustic modelling (Table 3-33) the maximum distance where received levels to exceed SPL 155 dB re 1 µPa is 20.1 km.

Table 3-33 – Maximum (R_{max}) Horizontal distances (in km) from the 3,260 in^3 array to modelled maximum over depth for impacts to divers, Parvin *et al.* (2002) threshold criterion

Potential Impacts	Threshold criteria	Impact Distance (km)		
		Site 1	Site 2	Site 3
Divers	SPL 155 dB re 1 µPa	14.2	20.1	16.8

Source: Li and McPherson (2018)

Guidance note (DMAC 12) issued by the UK Diving Medical Advisory Committee (DMAC) "Safe Diving Distance from Seismic Surveying Operations" (DMAC 2011) recommends that where diving and seismic activity occur within 10 km of each other, a joint risk assessment should be conducted. This guidance is currently being reviewed as IMCA reported that on several occasions diving had to be halted at around 30 km of separation. The reports strongly suggest that the 10 km distance as being an appropriate distance for the initiation of a joint risk assessment between all parties is "far too short."

A workgroup comprising of IMCA, the International Association of Oil & Gas Producers, DMAC and seismic surveying representatives was formed to consider the matter and the draft updated guidance will recommend:

- Where diving and seismic activity are scheduled to occur within 60 km, all parties should be made aware of the planned activity. As a minimum, this should include clients/operators, diving and seismic contractors.
- Where seismic survey/diving SIMOPS are proposed within 30 km, a joint risk assessment should be undertaken. The risk assessment should consider ramp-up trials as well as other risk control measures.
- If the risk assessment generates a requirement for a ramp-up trial, the starting point for the trial will also need to be determined by the risk assessment.
- Should any member of the diving team in the water suddenly experience discomfort, the seismic source should be turned off immediately if a request is made to do so.

Recreational diving is common along the mainland coast and inshore islands of WA and is generally restricted to water depths less than 40 m, which is the prescribed depth limit for recreational divers (World Recreational Scuba Training Council). Charter boat operators do not offer bluewater diving tours (i.e. depths >40 m) and the maximum dive depths of 40 m is limited to exceptionally experienced divers. Recreational diving is therefore usually conducted in shallow waters of 40 m or less, as this is the depth limit that standard recreational dive certification allows (www.padi.com).

The draft DMAC guidance of 60 km for consultation has been used to identify areas where diving maybe undertaken within 40 m water depth from these areas. There are no known diving areas within the Rollo OAs. Areas where diving may up occur in water depths up to 40 m within 60 km of the Rollo OAs are:

- Rankin Bank - 9 km from the NCB OA
- Glomar Shoal - 12 km from the Beagle OA
- Bedout Island - 17 km from Beagle OA
- Pearl farm lease – 49 km from Beagle OA

The distance to the 40 m water depth for Montebellos Islands and Imperiesue Reef are outside the 60 km distance at 73 km and 86 km, respectively. The closest area where diving may potentially occur within Eighty Mile Beach Marine Park is around Bedout Island.

As part of the of the pre-planning process for a seismic survey within 60 km of the above known areas where diving may occur, consultation will be undertaken with diving and fishing tour operators and research organisations that visit these locations and pearl farm operators to inform them of the activities. Where diving activities are likely to be within 30 km of the seismic survey, or outside of this area but requested by the stakeholder, an operating protocol will be developed and agreed by both parties. The operating protocol will document the joint risk assessment and agreed controls such as:

- Exclusion areas for divers and/or the seismic vessel, if appropriate.
- Notification and communication processes before and during the survey.
- Process for ramp-up trials if applicable.
- Agreed shut-down processes between divers and the seismic vessels if impacts are identified.

Based on the acoustic impact threshold of SPL <155 dB re 1 µPa being reached at a maximum of 20.1 km this would encompass:

- Rankin Bank - 9 km from the NCB OA
- Glomar Shoal - 12 km from the Beagle OA

- Bedout Island - 17 km from Beagle OA

These areas are not known as recreational diving sites and are more popular with charter fishing companies. Rankin Bank and Glomar Shoal are areas where diving may occur as part of studies of these areas.

In addition to the above consultation and development of an operating protocol, for those areas where the impact threshold may be exceeded, the seismic source will not be discharge within 21 km of an area where people are diving. This will be implemented via the consultation process detailed above in addition to having a scout vessel at these areas to engage with any vessels present that maybe involved in diving activities. If an agreed protocol cannot be obtained and hence divers are in the water the seismic source will not be active within the area until the all clear that no divers are in the water is given from the scout vessel.

Stakeholder consultation with charter boat operators and diving companies has been undertaken (see Chapter 1). However, to date there has been no response.

As there will be a minimum distance of 21 km between the seismic vessel and any divers in the water and impacts to fish and turtles have not been identified at these distance divers experience will not be impacted.

Considering the above, PGS believes that with these management controls and stakeholder engagement, potential interactions with divers from proposed survey activities are considered ALARP and will be managed to acceptable levels.

3.3.2.16 Disturbance to Heritage and Conservation Values

Based on the seismic noise assessment impacts were not identified for World Heritage Properties, National Heritage Properties, Commonwealth Heritage Properties, Ramsar wetlands, WA State or Commonwealth Marine Parks, Indigenous Heritage Sites or EPBC listed critical habitat or threatened ecological communities.

Based on the seismic noise modelling no impacts to Eighty Mile Beach Marine Park values (10 km from the Beagle OA) were identified based on the maximum distance at which the behavioural disturbance threshold criteria is exceeded is 9.4 km for humpback whales.

Table 3-34 summarises the values and the appropriate sections of this EP for the evaluation of impacts to the KEFs within or adjacent to the OAs.

Table 3-34 - KEF within, or adjacent to, the proposed OA

Feature	Values	Description
Ancient coastline at 125 m depth contour	Unique seafloor feature with ecological properties of regional significance Benthic invertebrate representative of hard substrate fauna in the bioregion. Whale sharks Large pelagic fish Migrating humpback whales	The NCB OA overlaps the Ancient coastline at 125 m depth contour by 2% and the Beagle OA by 18%. Based on the noise impact assessment impacts to the values of the KEF are acceptable as detailed in Sections: • 3.3.2.7 Invertebrates • 3.3.2.8 Fish • 3.3.2.9 Sharks • 3.3.2.14 Cetaceans
Continental slope demersal fish communities	High levels of endemism Demersal fish communities	The NCB OA overlaps the Continental slope demersal fish communities by 0.5%. Based on the noise impact assessment impacts to the values of the KEF are acceptable as detailed in Sections: • 3.3.2.7 Invertebrates • 3.3.2.8 Fish

Feature	Values	Description
Exmouth Plateau	Unique seafloor feature with ecological properties of regional significance Benthic filter feeds, scavengers and epifauna Sperm whales	The NCB OA overlaps the Exmouth Plateau by 27%. Based on the noise impact assessment impacts to the values of the KEF are acceptable as detailed in Sections: • 3.3.2.7 Invertebrates • 3.3.2.14 Cetaceans
Glomar Shoal	High productivity and aggregations of marine life Invertebrates Commercial and recreational pelagic fish species	The Beagle OA is 11 km from Glomar Shoal. Based on the noise impact assessment impacts to the values of the KEF are acceptable as detailed in Sections: • 3.3.2.7 Invertebrates • 3.3.2.8 Fish

3.3.2.17 Simultaneous Operations and Cumulative Impacts

A key initial step in the strategic business planning of multi-client marine seismic survey companies like PGS involves obtaining environmental approval with the view of marketing readiness to the petroleum block titleholder. Hence, the multi-client marine seismic survey company business model usually relies on securing a petroleum block titleholder client to purchase the data prior to its acquisition.

It would be unnecessary for a petroleum block titleholder to obtain data from more than one seismic survey of the title, which in turn would render mobilization of multiple surveys highly unlikely and commercially non-viable irrespective of whether environmental approval had been obtained for more than one survey over the same area. Consequently, although multiple seismic surveys are proposed, not all will go ahead as block titleholders will allocate work to one seismic company only.

Cumulative impacts can occur from multiple surveys occurring at the same time leading to an increase in predicted noise levels on receptors. It can also occur from repeated surveys within the same area over time.

For seismic surveys that occur at the same time the Bureau of Ocean Energy Management (BOEM 2014) recommends a 40 km geographic separation distance (based on worst case scenarios) between the sources of simultaneous seismic surveys to minimise the impacts to marine life by providing a 'corridor' between vessels. A 40 km separation distance is also supported by the maximum noise criteria met in this impact assessment of 11.5 km. A 40 km separation distance provides a zone of 16 km to allow for another survey may have an increased noise distance, though this is likely to be within a km or two, thus allowing an area of no impact between surveys. No critical habitats for breeding, feeding or resting are within 40 km of the NCB or Beagle OAs.

Cumulative impacts can occur when the timing between surveys is less than the recovery rate of any potential impacts. A review of receptors that the operating areas overlap and have the potential to be impacted by seismic noise and estimated recovery times are detailed in Table 3-35. Based on this assessment the longest recovery time could be one year for site attached fish species.

PGS has committed to a period of 1 year between seismic surveys within the same area within the following areas:

- Ancient Coastline at 125 m KEF
- Migratory/foraging whale shark BIA
- Exmouth Plateau KEF
- Migrating humpback and pygmy blue whales BIA
- Commercial fishing areas where there is catch effort.

This is a conservative approach based on these being restricted areas with ecological or commercial value.

Table 3-35 - Receptor estimated recovery times

Receptor	Estimated Recovery Time
Plankton including commercial fish spawn	Based on the impact assessment that identified that potential impacts are within natural mortality rates plankton would commence recovery once they were > 15 km from the seismic source. Thus, recovery would commence with days to months.
Invertebrates associated with the Ancient Coastline at 125 m KEF	Lethal effects were not identified to invertebrates on the Ancient Coastline at 125 m KEF. Sub-lethal effects were identified but were unlikely to impact recruitment.
Commercial demersal and pelagic fish species and demersal and pelagic fish associated with the Ancient Coastline at 125 m KEF	Mortality or injury impacts to demersal and pelagic fish are unlikely as they can swim away from the source. Fish that may have TTS impacts were shown to recover within 24 hrs. Thus, recovery would occur within 24 hrs of the seismic vessel moving > 3.4 km.

Receptor	Estimated Recovery Time
Site-attached fish species associated with the Ancient Coastline at 125 m KEF	Mortality or injury impacts to site-attached fish were identified. If impacts did occur recovery is likely within 1 year based on Planes et al (2005) which identified that as the structural and biological integrity of the habitat is maintained, and there are neighbouring un-impacted areas that can supply recruits, coral reef fish assemblages appear able to respond rapidly to large-scale natural and anthropogenic change. Planes et al. (2005) identified that after nuclear testing removed all fish over on area of 12 km^2 but left the benthic habitat untouched fish assemblages recovered to pre-test assemblages within 1 – 5 years. One year is used for this assessment based on not all fish will be impacted as was the case for the nuclear test. Fish that may have TTS impacts were shown to recover within 24 hrs. Thus, recovery would occur within 24 hrs of the seismic vessel moving > 3.4 km.
Migratory/foraging whale sharks	Impacts to migrating whale sharks where identified within a very small area (50 m) thus recovery would occur once a whale shark moved away from the survey vessel.
Sperm whales at the Exmouth Plateau KEF	Injury impacts to sperm whales where identified within a very small (20 m) of the seismic source. Thus, long term impacts are unlikely. The behavioural exposure guideline reached out to 8.8 km thus recovery would occur immediately after a whale moved greater than this distance from the seismic source.
Migrating humpback and pygmy blue whales	TTS and PTS impacts to humpback and pygmy blue whales where identified within a distance of 22.3 km and 790 m, respectively, from the seismic source. PTS impacts are unlikely based on the lower power zone of 2 km and impacts are more likely to be behavioural as in moving away from the area. TTS is based on that there will be full recovery after sound exposure ceases (NMFS 2018). Thus, impacts would be of a temporary nature and less than 24 hrs. The behavioural exposure guideline reached out to 8.8 km for humpback whales and 9.4 km for pygmy blue whales thus recovery would occur after a whale moved greater than these distances from the seismic source.
Commercial fishers	Fish are likely to return to survey areas following cessation of the acoustic disturbance and if not immediately within a couple of days or weeks.

In relation to the cumulative impact of undertaking a maximum of 25,000 km^2/year of seismic acquisition the OAs overlap two areas above 25,000 km^2. These are the North West Slope Trawl and Pilbara Line Fishery (Table 3-36). These fisheries have larger fishery and effort areas and therefore are not as restricted in the areas they can fish when compared to the to the Pilbara Trap and Trawl fisheries.

In addition to the controls for cumulative impacts from different surveys over the same area, spatial restrictions will be implemented where appropriate as detailed in Table 3-36.

Table 3-36 – Overview of key receptors overlap with 25,000 km² per year acquisition and controls

Receptor	Area of Overlap	Controls
Ancient Coastline at 125 m KEF	3,191 km²	Below 25,000 km² 1 year between seismic surveys within the same area
Exmouth Plateau KEF	13,199 km²	Below 25,000 km² 1 year between seismic surveys within the same area
Migratory/foraging whale shark BIA	21,077 km²	Below 25,000 km² 1 year between seismic surveys within the same area
Migrating humpback whales BIA	1,365 km²	Not required as below 25,000 km² 1 year between seismic surveys within the same area
Migrating pygmy blue whales BIA	20,337 km²	Below 25,000 km² 1 year between seismic surveys within the same area
Mackerel Managed Fishery	2,916 km²	Below 25,000 km² 1 year between seismic surveys within the same area Only one survey at a time in area of overlap with the OAs and the fishery catch effort area.
North West Slope Trawl	47,500 km²	Not restricted fishery equates to 7.8% of fishery effort area over 5 years. 1 year between seismic surveys within the same area Only one survey at a time in area of overlap with the OAs and the fishery catch effort area.
Pilbara Trap Fishery	19,521 km²,	Below 25,000 km² however, committed to 5%/year (4,206 km²/ year) as restricted fishery by area. 1 year between seismic surveys within the same area Only one survey at a time in area of overlap with the OAs and the fishery catch effort area.
Pilbara Trawl Fishery	23,108 km²	Below 25,000 km² however, committed to 5%/year (1,155 km²/year0 as restricted fishery by area. 1 year between seismic surveys within the same area Does not overlap both OAs.
Pilbara Line Fishery	27,238 km²	Not a restricted fishery equates to 20% of fishery effort area over 5 years. 1 year between seismic surveys within the same area Only one survey at a time in area of overlap with the OAs and the fishery catch effort area.

3.3.2.18 Adaptive Management Measures

As per EPBC-2.1, mitigation and management controls will be implemented to minimise potential acoustic impacts and risks to whales and whale sharks as the OAs overlap the pygmy blue whale and humpback whale migration route and the whale shark migratory/foraging route. As a practical and minimum standard, these management controls will also serve as initial indicators that a low density of marine fauna is in the survey area. However, PGS proposes to use a more conservative approach:

Whales

If observed numbers of whales are higher than expected, as determined by there being three or more whales within the shutdown/powerdown zones in 24 hours the following will be implemented:

- Relocation – survey vessel will relocate to another survey line >22.5 km from location of last sighting of a whale and will not return within 24 hours; OR.
- Cessation – if there are no options for relocation (e.g. no other survey lines), no survey operations for 24 hours in current location.

With relocation, the survey vessel will move to another survey line >22.5 km away from the location of the last sighting based on the maximum distance to the TTS threshold (Section 3.3.2.14) rounded from 22.3 km to 22.5 km.

Survey vessels may return to the previous location after 24 hours, subsequently providing fauna species with a sufficient recovery period, which is expected to occur within 18–24 hours following sound exposure, dependent on the species. This based on the NMFS recommended 24 hr accumulation period for calculating sound exposure levels (NMFS 2018).

Whale sharks

If observed numbers of whale sharks are higher than expected, as determined by there being three or more whale sharks within the shutdown/powerdown zones in 24 hours the following will be implemented:

- Relocation – survey vessel will relocate to another survey line >2 km from location of last sighting of a whale shark and will not return within 24 hours; OR.
- Cessation – if there are no options for relocation (e.g. no other survey lines), no survey operations for 24 hours in current location.

With relocation, the survey vessel will move to another survey line >2 km away from the location of the last sighting based on the low power zone as the maximum distance to impact threshold for whale sharks is 50 m (Section 3.3.2.9) so the low power zone was used as a conservative measure as it is not feasible to move 50 m.

Adaptive management assessment

Based on industry experience, it is highly unlikely for more than three power-downs/shut-downs to occur within 24 hours. Rather, one or two power-downs/shut-downs may be implemented within 24 hours, which is usually followed by gap periods of no observations and thus demonstrates that a low density of whales may be transiting through the survey area and is not necessarily indicative of an increased population of whales in the surrounding area. Two key indicators of an increase in the density of whales in the survey area include (Table 3-37):

1. SIGHTINGS INDICATOR: An increase in the number of sightings within the power-down or shut-down zone.
2. OCCURANCE RATE INDICATOR: A higher percentage of occurrence over an extended period (i.e. percentage of sightings over a 24 hour period).

Table 3-37 – Summary of key indicators to determine increased density of whales within individual survey area

Sightings [11]	Rate of Occurrence [12]	Estimated Whale Density Level	Relocate Survey Vessel			Cease Survey Operations		
			Effective	Cost proportionate	Feasible	Effective	Cost proportionate	Feasibile
1	8%	LOW	*Yes*	*No*	*No*	*Yes*	*No*	*No*
2	16%	LOW	*Yes*	*No*	*No*	*Yes*	*No*	*No*
3+	25%	MODERATE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

If there are no options for relocation (e.g. no other survey lines to acquire data), ceasing survey operations after a 24-hour duration of higher than expected density of marine fauna (i.e. three or more sighting occurred within the power-down/shut-down zone) is a conservative approach to reduce acoustic impacts if there is an unexpected higher density of marine fauna. It will ensure potential impacts and risks to marine fauna at night are mitigated to ALARP, especially considering that the acoustic source will not be generating noise at night when visual observations are not possible.

Example Scenario 1: One sighting occurred within the power-down/shut-down zone during preceding 24 hours:

- SIGHTINGS INDICATOR triggered – one sighting is an increase in the number of sightings within the power-down / shut-down zones.
- OCCURANCE RATE INDICATOR not triggered – rate of occurrence is low at ~8% (Table 3-37).
- Likelihood of encountering whales remains LOW.

In scenario 1, only the SIGHTINGS indicator was triggered and increased. However, the occurrence rate did not increase substantially (i.e. only 8% increase per day), which is insufficient evidence to suggest that the density of marine fauna in the survey area increased or is greater than expected.

If only one or two power down/shut down events are triggered in a 24 hour period, this does not represent a sufficiently high occurrence indicator to warrant a vessel relocation or acquisition cessation for 24 hours. These actions could double the cost of the survey and are grossly disproportionate to any benefits gained (short-term behavioural responses which are considered insignificant at the population level).

Example Scenario 2: three sightings of the same species occurred within the power-down/shut-down zone during preceding 24 hours:

- SIGHTINGS INDICATOR triggered – three sightings per day is an increase in the number of sightings within the power-down/shut-down zones.
- OCCURANCE RATE INDICATOR triggered – rate of occurrence increased as percentage of sightings per day increased to ~25% (Table 3-37).
- Likelihood of encountering whales increased to MODERATE.

In Scenario 2, both sightings and occurrence rate indicators are triggered, it is therefore reasonable to conclude that the likelihood of encountering the marine fauna species in the survey area increased from 'low' to 'moderate' (i.e. greater than expected). Relocating the survey vessel or ceasing survey operations for 24 hours are acceptable mitigation procedures to reduce acoustic impacts and risks to marine fauna in areas where 'moderate to high' numbers are encountered, and the environmental benefit outweighs the costs. Thus, these adaptive management measures are feasible in this scenario.

[11] Sightings in Power-down/Shut-down Zone during preceding 24 hours, and during the 12 hours that MFO are on dedicated observation effort.

[12] Percent of sightings within the power-down/shut-down zones

3.3.2.19 Pre-survey planning

PGS will undertake pre-survey planning (Chapter 3 – Section 3.1.1) to continue to manage impacts. Pre-survey planning will include a review of existing information in relation to any component of the receiving environment described in Section 2. This includes reviewing and consideration of any new issues raised by stakeholders, or available scientific literature. As part of pre-survey stakeholder consultation, PGS will engage with all government agencies regarding updates or changes to marine fauna species and habitats. CMR status and relevant IUCN principles, information from other MSS surveys, and potential cumulative impacts from past or proposed surveys (if known). If new information regarding the receiving environment relevant to the proposed OA is present, then an internal risk assessment will be conducted as described in Chapter 3-Section 3.10. If sighting data is available from previous PGS surveys, or new information regarding whale migration is available, the information will be used in planning the timing of individual surveys within the proposed OA.

The pre-survey planning will also include an assessment of the acoustic source size to be used for the survey. The acoustic source will be designed to provide sufficient seismic energy to illuminate the geological objective of the survey, whilst minimising environmental disturbance. Seismic source modelling software will be used on a survey-by-survey basis to determine the ideal array volume to be used. PGS is also committed to continual improvement of the acoustic model.

3.3.2.20 Temporal Restrictions

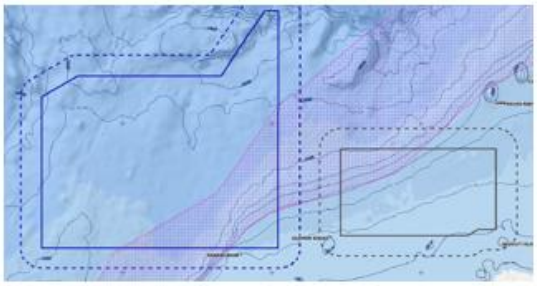
The application of temporal restrictions in the area is complex as there are numerous receptor areas and timings. Table 3-38 details the timings of migration periods, spawning and weather and Figure 3-6 shows the spatial overlaps. Based on the impact assessment and stakeholder consultation the following temporal restrictions will be implemented to managed impacts and risk ALARP and an acceptable level:

- No seismic surveys will be undertaken within 22.5 km (based on the TTS exposure guideline) of the pygmy blue whale migration BIA during 15th May to 15th June and 1 November to 15 December.
- To reduce potential impacts to commercial fish spawn seismic surveys will only be undertaken within the Mackerel and Pilbara line, trap and trawl fisheries catch effort areas during May, June and July which is outside of known spawning timing.
- As the whale shark migration BIA overlaps the Pilbara trap fishery area this means that surveys will be undertaken within the BIA during May, June and July. Whale sharks congregate at Ningaloo Reef from March to July and then migrate along the 200 m isobath mainly between July and November (DoE 2015j). Though migration can occur during July it would be expected that numbers would be low as it is the start of the migration period. There will be no seismic activity within the whale shark migration / foraging BIA from August to November.
- The Beagle OA overlaps the outer edge of the humpback whale migration path by 0.86% and the northern migration is mid-July to mid-Aug. Surveys will not be undertaken in this area from mid-July to mid-August.
- For sperm whales that maybe present at the Exmouth Plateau no data could be found regarding seasonality.

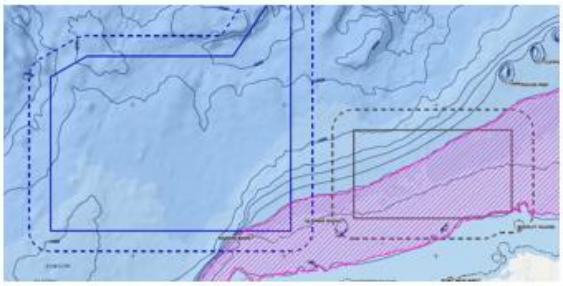
Table 3-38 – Overview of migration periods, spawning events and weather

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Humpback peak whale migration							Nth	Nth/Sth	Sth	Sth		
Pygmy blue whale migration				Nth	Nth	Nth	Nth	Nth			Sth	Sth
Whale shark migration												
Pearl spawning (peak period)												
Goldband snapper spawning												
Rankin cod spawning												
Red emperor spawning												
Spanish mackerel spawning												
Cyclone season (NWS)												

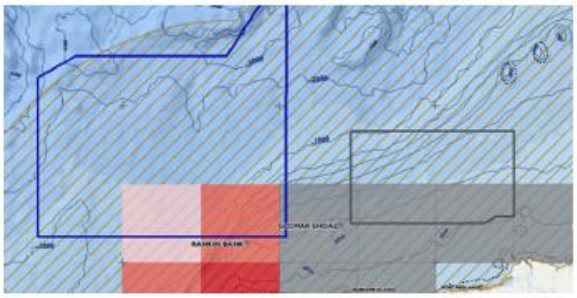
Pygmy blue whale Apr – Aug, Nov- Dec



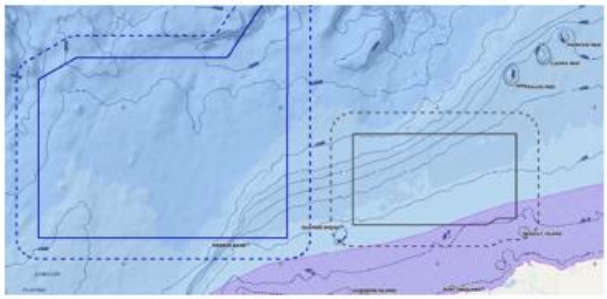
Whale shark Jul - Nov



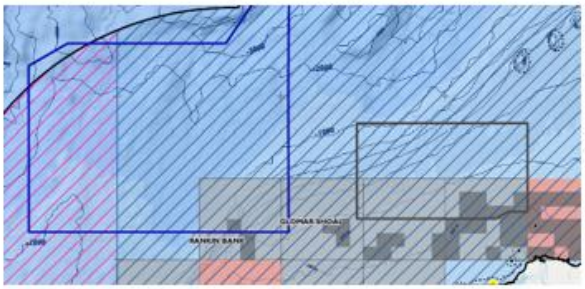
Pilbara Line Spawn Jan – Apr, Aug – Oct



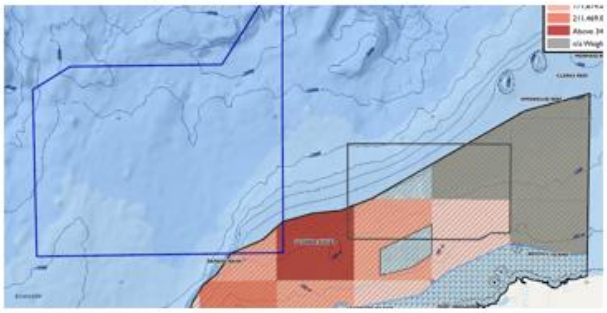
Humpback whale Jul - Oct



MMF Spawn Aug- Nov



Pilbara Trap Spawn Jan – Apr, Aug - Oct



Pilbara Trawl Spawn Jan – Apr, Aug -Oct

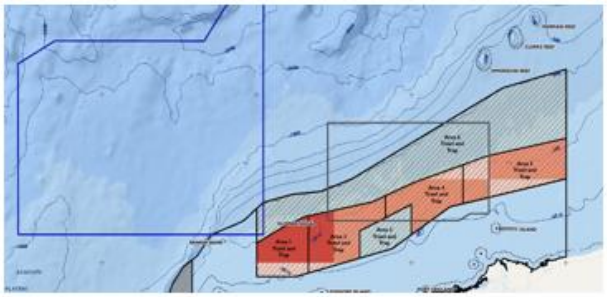


Figure 3-6 – NCB and Beagle OAs spatial overlaps

3.3.2.21 ALARP Decision Context

Decision Type	Justification
B	3D seismic surveys are commonly undertaken in both Australian and international waters. There are numerous studies on the effects of seismic sound on receptors with a range of effects to no effects identified. Seismic surveys in Australia are well regulated and guidance is available for managing potential impacts to sound sensitive marine fauna. The OAs overlap BIAs for migrating/foraging whale sharks and migrating humpback whales and pygmy blue whales. The OAs overlap the KEFs; Ancient coastline at 125 m, Exmouth Plateau and Continental Slope Demersal Fish Communities. The OAs overlap the Mackerel Managed Fishery, North West Slope Trawl Fishery and the Pilbara Line, Trap and Trawl Fisheries. During consultation with commercial fisher's concerns were raised regarding the impacts of seismic surveys on commercial fish species. Decision Context B is applied to this aspect.

3.3.2.22 Demonstration of ALARP

	Control Measure	Cost	Benefit	Applied
24	EPBC Act Policy Statement 2.1 – Interaction between Offshore seismic exploration: Part A applied to cetaceans and whale sharks	The implementation of Part A of the EPBC Act policy statement for cetaceans to all cetaceans and whale sharks is good practice thus has not been evaluated further.	Minimise acoustic impacts to cetaceans and whale sharks transiting through the survey area. The benefits outweigh the cost.	Yes
25 27	EPBC Act Policy Statement 2.1 – Interaction between Offshore seismic exploration: Part B. B.1 Marine Mammal Observers	Employment of experienced MMOs is not considered a significant cost to surveys.	The benefit of having trained MFOs ensures controls are implemented and they are experienced at observing and identifying cetaceans and other fauna. Two dedicated MFOs will be employed during individual surveys to ensure sufficient coverage and management of fatigue. The benefits outweigh the cost.	Yes
41	EPBC Act Policy Statement 2.1 – Interaction between Offshore seismic exploration: Part B. B.2 Night time/poor visibility	Increased restrictions for poor visibility / night time conditions may potentially double the time to undertake a survey and significantly increase costs (~ $12 M at a daily survey cost of ~ $165,000). In addition to the economic cost a survey would take twice as long which could lead to further disruption to commercial fishers or overlaps with sensitive	The costs outweigh the benefits for implementing night time restrictions as controls are proposed to manage night time operations: EPBC Act Policy Statement 2.1 - Interaction between Offshore seismic exploration: A3.6 Night-time and Low Visibility Procedures will be implemented which accounts for if the observed numbers of fauna are higher than expected.	No

	Control Measure	Cost	Benefit	Applied
		periods requiring the survey to stop and then restart at a mob/demob cost of $1.5M.	For surveys within cetacean BIA during migration periods soft-starts will be limited to conditions that allow visual inspection of the precaution zone. PAM will be implemented for the detection of sperm whales when operating on the Exmouth Plateau.	
56	EPBC Act Policy Statement 2.1 – Interaction between Offshore seismic exploration: Part B. B.3 Spotter vessel and aircraft	The cost of an extra vessel or aircraft could be $10 - $20K a day which could equate to $1M for one survey.	Costs outweigh benefits as other controls will be implemented where the likelihood of encountering whales is high such as: No seismic activity during peak migration periods thus limiting the activity during periods where the likelihood of encountering whales is high. Adaptive management procedures if observed numbers of fauna are higher than expected. Increased observation time during migratory periods and for deep diving species.	No
57	EPBC Act Policy Statement 2.1 - Interaction between Offshore Seismic exploration: Part B. B.4 Increased Precaution zones and Buffer Zones	Increased cost of shutdowns with limited environmental benefit as OAs are not within important habitats, such as feeding, breeding, or resting areas which the EPBC Act Policy Statement 2.1 details as area where it may be advisable to increase distances of power-down procedures.	Costs outweigh benefits as OAs are not within important habitats, such as feeding, breeding, or resting areas which the EPBC Act Policy Statement 2.1 details as area where it may be advisable to increase distances of power-down procedures. Other controls to be implemented, such as avoiding peak migration periods, will manage impacts to cetaceans to an acceptable level.	No
36	EPBC Act Policy Statement 2.1 - Interaction between Offshore Seismic exploration: Part B.5 Passive acoustic monitoring	PAM detections of baleen whales during active seismic surveys are extremely low or entirely absent (Abadi et al 2017), but the method can work well with many odontocete species. PAM is not very accurate at determining distances and could lead to an increased level of low power and shut downs. This can increase the time of the survey at a cost of ~ $165,000. Increased time for the survey could lead to further disruption to commercial fishers or overlaps with sensitive periods requiring the survey to stop and then restart at a mob/demob cost of $1.5M.	PAM detections of baleen whales during active seismic surveys are extremely low or entirely absent, but the method can work well with many odontocete species (Verfuss 2017). Other controls such as no seismic acquisition during periods of migration within migrations BIAs, increased observation periods and adaptive management if whale numbers are greater than expected will be implemented to reduce the level of impact to humpback and pygmy blue whales. For sperm whales the PTS and TTS noise criteria are reached within 20 m for the PK criteria and is not reached for the SEL_{24hr} criteria. It is highly unlikely for a whale to come this close to the vessel/seismic source.	Yes

	Control Measure	Cost	Benefit	Applied
		There is also an increased cost of the set-up of PAM and operators of ~ $200,000.	The OAs do not overlap a sperm whale BIA and numbers are expected to be low. Other controls such as increased observation periods and adaptive management if whale numbers are greater than expected will be implemented to reduce the level of impact to sperm whales. However, as the operational area overlaps the Exmouth Plateau where sperm whales maybe present and this species are deep diving and therefore may not be easily visually observed PAM will be used in addition to visual observations.	
34	EPBC Act Policy Statement 2.1 - Interaction between Offshore Seismic exploration: Part B. B.6. Adaptive Management	The OAs overlap several areas where whales and whale sharks are predicted to occur. For migration BIAs the areas and timings are estimates and may change season to season. Seasonal restrictions have been applied for some fauna but outside these times it is hard to predict fauna numbers and hence shutdowns. Thus, an adaptive management plan acts as a decision process to ensure that the survey acquisition can continue albeit in another part of the survey area. The implementation of an adaptive management program would ensure that the survey can continue without significant time delays and therefore costs.	Benefits outweigh the cost and therefore an adaptive management process will be implemented for all surveys.	Yes
59	Schedule surveys to avoid receptor seasonal timings.	As surveys have not yet been scheduled it difficult to assess the cost if a survey cannot be undertaken during a period when a titleholder requires it to be completed. This could be up to $4M per survey. There is an increased cost if a survey cannot be completed within the timing and return later with mob/demob costs of $1.5M. Cost can also be attributed to shut downs and if the vessel is required to move due to increased fauna in an area which is typically associated with migration periods. This could be up to $400,000 a day.	Reduction of impacts to receptors to an acceptable level. Avoidance of peak migratory for cetaceans and whale sharks can reduce costs from shutdowns or having to move. The benefits of not undertaking seismic surveys within the PBW migration pathway during June and July (peak migration timing) outweigh the costs. However, further timing restrictions would have decreasing benefit for increased cost. To reduce potential impacts to commercial fish spawn seismic surveys will only be undertaken within the Mackerel and Pilbara line, trap and trawl fisheries	Yes

	Control Measure	Cost	Benefit	Applied
		As there are two OAs that cover a combined area of 117,833 km^2 avoidance of areas with seasonal timings should be able to be accommodated without significant cost or loss.	catch effort areas during May, June and July which is outside of known spawning timing. As the whale shark migration BIA is the same area as the Pilbara trawl fishery area this means that surveys will be undertaken within the BIA during May, June and July. Though migration can occur in the area during June there will be no seismic activity within the remaining months where migration occurs (Jul to Nov). The Beagle OA overlaps the outer edge of the humpback whale migration path by 0.86% and the northern migration is mid-July to mid-Aug. Surveys will not be undertaken in this area from mid-July to mid-Aug. For sperm whales that maybe present at the Exmouth Plateau no data could be found regarding seasonality.	
29	Vessels will not undertake seismic acquisition activities within 40 km of another vessel that is also acquiring data	No additional cost as typically seismic companies do not undertake seismic surveys closer than 20 - 40 km to ensure not cross contamination of data.	BOEM 2014 recommends a 40 km geographic separation distance between the sources of simultaneous seismic surveys to minimise the impacts to marine life by providing a 'corridor' between vessels. Control reduces noise impacts to fauna with no additional costs.	Yes
31	Increase the time between seismic surveys over the same area.	Potential loss of business if a titleholder wanted to obtain a survey over an area as previous data not adequate, however, would be an unlikely scenario within a year. Longer time periods would be of commercial disadvantage as titleholders typically want to obtain further data or do a 3D survey over an area where 2D has been undertaken within a 5-year cycle.	A year between surveys provides sufficient time to ensure receptors recovery based on the worst case for site attached fish as detailed in Section 3.3.2.17 Simultaneous Operations and Cumulative impacts. This timing has been increased from the original control of 1 month. This not only provides sufficient time for fauna to recover but further reduced potential impacts to commercial fishers by not being in the same area twice within a year.	Yes
32 33 36	Increased pre-start visual observations	No increased costs as MMOs in place on vessel and undertaking observations even when seismic acquisition not being undertaken.	Benefits outweigh costs. Allows for a longer search time / detection time for deep-diving marine mammals with prolonged dive times. Sperm whales prefer deep water (>200 m) and can perform long and deep dives, often	Yes

	Control Measure	Cost	Benefit	Applied
			lasting 60–90 mins, though most dives tend to last around 35-45 mins. Part B of the EPBC Act Policy Statement 2.1 advises proponents to consider implementing adaptive management procedures to manage the uncertainty of increased likelihood of encountering whales, particularly if a survey area is spatially and temporally on the edge of areas considered to be biologically important habitat. Pre-start and shut-down time for visual observations increased to 90 mins water depths >200 m. Pygmy blue whales – from 1 April to 30 August, and 1 October to 15 January: Pre-start and shut-down time for visual observations increased to of 45 mins. Humpback whales – from 1 June to 30 October: Pre-start and shut-down time for visual observations increased to of 45 mins.	
40	No discharge of the acoustic source outside of the proposed OA.	No additional cost as this requirement is factored into the process when tendering on a survey that would be undertaken under this EP.	No impacts outside the area of the Rollo OAs for which the impact assessment has been undertaken for.	Yes
42	Mitigation source: a single acoustic source will be discharged during line turns	No additional cost as this is industry practice.	EPBC Act Policy Statement 2.1 details that firing of a single gun during turns is an industry standard and is generally considered a reasonable precaution. This sound source may alert whales in the area to the presence of the seismic array and reduce chances of entanglement or contact.	Yes
43 45	Decrease the seismic source.	PGS has reduced the seismic source from 4,130 in^3 to 3,260 in^3. The volume of the source is ALARP when considering the geological targets being imaged and the criteria regarding operational stability, predictable behaviour, and fit-for-purpose subsurface seismic imaging. The total array volume is optimized for the depth ranges of all likely hydrocarbon targets.	The acoustic modelling demonstrated that there is not a significant difference (< 2dB) in the peak pressure level of the 3,260 in^3 array to the 3,090 in^3 and 2,360 in^3. This may slightly reduce impacts but may not achieve the acquisition requirements for a survey. Seismic source modelling software will be used during the pre-survey planning phase to determine the ideal array volume to be used. PGS shall not use a sound source that produces an equivalent peak SPL greater	Yes

	Control Measure	Cost	Benefit	Applied
		A further reduction in the seismic source could lead to not being able to achieve the acquisition requirements for a survey.	than 249 dB re 1µPa (at 1 m) as defined by Nucleus modelling.	
46	Restrict the survey area to reduce the area of overlap with pearl fishing and spawning areas.	PGS has implemented an exclusion out to the 100 m water depth contour in the POMF Zone 1 and 2 pending research outcomes that are acceptable to the PPA. This will eliminate any seismic noise impacts on the fishery and broodstock. DPIRD-Fisheries has requested that this area be removed from the Rollo EP. There is a financial cost to this in that if research shows that the deeper water pearl stock does not provide stock to the shallower water stock and PGS can acceptance from PPA, seismic surveys can be undertaken in this area under this EP. It cost ~$250K to write a new EP, undertake stakeholder engagement and EP submission costs and can lead to delays.	Based on PGS's consultation with the PPA and DPIRD-Fisheries the following additional control measures will be implemented: No survey acquisition in the Pearl Oyster Fishery Zone 1 and 2 out to the 100 m contour pending research outcomes that are acceptable to the PPA. A 10 km spatial buffer from any new pearl lease. These control measure will ensure no impacts to POMF or pearl oyster stock. Further controls such as removing these areas from the EP do not further reduced impacts.	Yes
52	Restrict the survey area to reduce the area of impact to divers	Restrictions on the area where surveys can be undertaken could result in lost contract work from titleholders. It is not possible to estimate the cost of this but could potentially be $4M for a survey.	Based on the acoustic impact threshold of SPL <155 dB re 1 µPa being reached at a maximum of 20.1 km this would encompass: • Rankin Bank - 9 km from the NCB OA • Glomar Shoal - 12 km from the Beagle OA • Bedout Island - 17 km from Beagle OA These areas are not known areas for divers. AIMS who undertake research at Rankin Bank and Glomar Shoal do not dive at these locations due to their water depths. As there is limited diving at these areas any surveys planned within 60 km would trigger consultation and surveys within 20 km can be managed by not activating the seismic source if diving is occurring at these areas.	No
54	Reduce the survey area	The Rollo OA has been reduced from 830,000 km^2 to 117,833 km^2 which is a reduction of 86%. The annual area of acquisition has been reduced from 35,000 km^2 to 25,000 km^2.	Stakeholder engagement has been undertaken on a larger area of 35,000 km^2 and issue raised addressed. Maintaining an area of 25,000km^2 reduces stakeholder engagement fatigue.	Yes

	Control Measure	Cost	Benefit	Applied
		Further reduction in the EP OA would limit the titleholder surveys that PGS can tender on. This could cost ~$250K in writing a new EP, stakeholder engagement and EP submission costs and lead to delays. Stakeholder engagement has been undertaken on a larger area of 35,000 km^2 and issues raised have been addressed.	Environmental impacts have been shown to be able to be managed to an acceptable level by placing spatial and temporal restrictions which would be less likely to be able to implement within a smaller area as it allows PGS to be able to schedule surveys within the broader area based on the unrestricted areas.	
60	Payment of compensation to fishermen for loss of catch	There would be a cost to the project and this would depend on the level of compensation. A number of controls have been applied such as reduction in areas and timing of seismic surveys within commercial fishing area of effort at a significant cost to PGS.	Difficulty of proving cause/effect relationship between seismic acquisition and any real/perceived loss of catch.	No
61	Increase line spacing/ Number of streamers	The streamer configuration is determined based on considers operational and vessel constraints, geophysical objectives, water depth and commercial viability. A broader streamer configuration means a lesser percentage of the survey area will be adequately imaged which could potentially compromise the geophysical objectives of the survey.	Increasing the minimum number of streamers would increase line spacing thereby reducing the number of lines and the area affected by peak received noise levels. It will also reduce the survey duration. The EP assessment was undertaken on a 600 m line spacing (rather than a 500 m line spacing) and impacts were assessed as being acceptable. However, as impacts are required to be ALARP PGS will assess the streamer/line spacing for each survey and where more streamers can be used, and hence the line spacing will increase, without comprising the survey acquisition objective it will be implemented. This process will be documented.	Yes
62	Restrict the survey area to reduce the area of overlap with commercial fisheries	As surveys have not yet been scheduled it difficult to assess the cost if a survey cannot be undertaken during a period when a titleholder requires it to be completed. This could be up to $4M per survey. There is an increased cost if a survey cannot be completed within the timing and return later with mob/demob costs of $1.5M. Further restrictions to the areas where the fisheries overlap the OAs may	Allows commercial fishers within fisheries that have restricted areas (Pilbara trap and trawl) to have sufficient area to move to be able to continue fishing. The following have been agreed to commercial fishers during stakeholder consultation. • There will be <5% annual overlap with PFTIMF Zone 2 areas actively fished which equates to no more than 1,155 km2 acquisition per year.	Yes

	Control Measure	Cost	Benefit	Applied
		not provide sufficient area for PGS to undertaken titleholder survey resulting in loss of business.	• There will be <5% overlap with PTMF Schedule 1 areas actively fished which equates to no more than 4,206 km2 acquisition per year. For fisheries such as the Mackerel Managed Fishery and Pilbara Line a 5% restriction was not implemented as these fisheries are not as spatially restricted as the PFTIMF and PTMF. Also, other controls such as only undertaking seismic surveys during May, June and July restricts the maximum area that can be undertaken within the fisheries within the 3 month period.	

3.3.2.23 Demonstration of Acceptability

The potential impacts of underwater noise emissions from discharge of the acoustic array are considered 'Broadly Acceptable' (for surveys during 'standard operating periods') or 'Acceptable if ALARP' (for surveys during 'sensitive operating periods') in accordance with the Environment Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		

Internal Context	Is the proposed management of the impact or risk aligned with the PGS Environment Policy and HSEQ Commitment Statement?	The control measures are consistent with the objectives of the PGS Environment Policy and HSEQ Commitment Statement (Chapter 3):
		• PGS Environment Policy
		  ○ Prevent harm to the environment by reducing risk related to the activity
		  ○ Comply with applicable legal and industry standard requirements associated with the activity
		  ○ Achieve continual improvement in environmental performance.
		• HSEQ Commitment Statement (such as):
		  ○ Increase HSEQ awareness and reduce unsafe behaviour
		  ○ Reduce total risk exposure
		  ○ Prevent incidents
		  ○ Minimise harm to the environment.
		Thus, the control measures are acceptable to achieve PGS's environmental management requirements for this survey.

External Context – Social Acceptability	Have stakeholders raised any concerns about activity's impacts or risks, and if so, are measures in place to address those concerns?	Chapter 1 included all stakeholder consultation, including PGS' assessment of merits and claims as required by Regulation 16(b), including concerns and questions about acoustic impacts. Where concerns have been raised PGS has provided a response to stakeholders and assessed the merits of any objections and claims raised. In most cases, further controls have been implemented to address stakeholder's concerns. These include: • Increase in the pre-survey notification period from 4 to 8 weeks to allow time for consultation. • Application of timing restrictions during peak migration periods for whales. • Application of timing restrictions to avoid commercial fish species spawning periods. • Application of spatial restrictions for restricted fisheries to allow sufficient area for them to fish within while a survey is being undertaken. • Reduction in the seismic source size. • Reduction in the operating area size by 86%. • Reduction in seismic acquisition area per year from 35,000 km^2 to 25,000 km^2.
External Context – Natural Environment	Are the control measures providing appropriate protection to the receiving environment (e.g. sensitive or unique environmental features) from potential impacts and risks introduced by the activity?	As detailed in each receptor impact assessment for seismic noise, potential impacts have been managed to an acceptable level with the implementation of appropriate controls including spatial and temporal restrictions.

		Plankton Potential impacts to plankton, including fish eggs and larvae and coral spawn are within an acceptable level based on: • Predicated impacts to plankton, fish eggs and larvae of 14% are within natural mortality rates. • Hard and soft coral cover at Glomar Shoal is 0.4% and 1.3%, respectively (AIMS 2014) thus coral cover is low and therefore coral spawning is likely to be at low levels. • It is likely that whale shark feeding while migrating is opportunistic and if plankton, fish eggs and larvae are affected they will still be available within the water column as food. • The area of overlap with fisher's target areas (area of catch effort) range from 5 to 15%. Thus, in the worst case 85% of the target areas are not impacted and available to provide spawn for commercial species. • To reduce potential impacts to commercial fish spawn seismic surveys will only be undertaken within the Mackerel and Pilbara line, trap and trawl fisheries catch effort areas during May, June and July which is outside of known spawning timing. • Spawning biomass for the indicator species for the mackerel and Pilbara line, trap and trawl fisheries are assessed as adequate or above. *Invertebrates* Potential impacts to invertebrates are within an acceptable level based on: • Impacts to scampi or catch rates within the North West Slope Trawl Fishery are likely to be < 6%. • Impacts to the Ancient Coastline KEF are likely to be ~ 2%. • Sub-lethal effects resulting in the possibility of reduced fitness are unlikely to occur to all invertebrates. Thus, impacts at a population level due to reduced fitness would be unlikely as there would be sufficient unaffected population crustaceans to maintain the population. • Impacts to Glomar Shoal, Rankin Bank and Exmouth Plateau are not predicted. • No impacts to the Pearl Oyster Managed Fishery or pearl oyster were predicted based on seismic acquisition (seismic source would not be activated) within water depths to 100 m within POMF Zone 1 and Zone 2 pending research outcomes that are acceptable to the PPA. • No impacts to hard or soft corals are predicted. *Fish* Potential impacts to fish are within an acceptable level based on: • No potential mortality, mortal injury or recoverable injury impacts to fish at Rankin Bank, Glomar Shoal, Bedout Island, KEF Continental Slope Demersal Fish Communities and Mackerel Managed Fishery. • Potential mortality, mortal injury or recoverable injury impacts to other fish receptors, if occurred would be on a local scale to a small proportion of the population that is able to recover, thus no population level effects are expected. • Temporary threshold shift impacts were not predicted to fish at Rankin Bank, Glomar Shoal and Bedout Island.

The potential impacts of underwater noise emissions from discharge of the acoustic array are considered 'Broadly Acceptable' (for surveys during 'standard operating periods') or 'Acceptable if ALARP' (for surveys during 'sensitive operating periods') in accordance with the Environment Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		
		• Temporary threshold shift impacts would be low on a local and regional level and based on TTS recovery within 24 hrs impacts would be localised and temporary in nature.. • Behavioural impacts to fish are likely to be short lived and fish would return to normal behaviours once the vessel has moved away. • Catch rates in surveyed areas post-survey are expected to return to typical catch levels relative to fishing effort. *Whale sharks* Potential impacts to whale sharks are within an acceptable level based on: • The distance of potential impact is 50 m from the seismic source. • No seismic activity within the whale shark migration / foraging BIA from August to November. • Application of the EPBC Act Policy Statement 2.1 to whale sharks. *Sea snakes* Potential impacts to sea snakes are within an acceptable level based on: • No impacts to sea snake habitat areas were identified. *Marine turtles* Potential impacts to turtles are within an acceptable level based on: • Impacts to turtles are not predicted based on spatial and temporal restrictions. Thus, the activity is consistent with the Recovery Plan for Marine Turtles in Australia (DoEE 2017a) as impacts will be managed to ensure that biologically important behaviours can continue. *Seabirds* Potential impacts to seabirds are within an acceptable level based on: • Seabirds may be affected by seismic sounds from the proposed survey, but the impacts are not expected to be significant to individual animals or at the population level. *Dugongs* Potential impacts to dugongs are within an acceptable level based on: • No impacts to dugong habitat areas are predicted. *Cetaceans* Potential impacts to cetaceans are within an acceptable level based on: • PTS and TTS impacts to cetacean within biologically important areas are unlikely as seismic surveys will not be undertaken during peak migration periods. For other periods impacts will be minimised by the implementation of EPBC Policy Statement 2.1 Part A including low power zone and soft-start procedures. • The maximum behavioural disturbance threshold criteria is reached at a maximum distance of 11.5 km, however, impacts would be temporary, localised and not within a restricted area. • No impacts are identified to critical habitat which includes habitat used to meet essential life cycle requirements such as foraging and breeding.

The potential impacts of underwater noise emissions from discharge of the acoustic array are considered 'Broadly Acceptable' (for surveys during 'standard operating periods') or 'Acceptable if ALARP' (for surveys during 'sensitive operating periods') in accordance with the Environment Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		
		• Additional controls have been implemented for surveys within migration BIAs such as increased observation times, avoidance of peak periods and adaptive management procedures for higher than predicated cetaceans in the area. *Heritage and Conservation Values* Potential impacts to heritage and conservation values are within an acceptable level based on: • Noise assessment impacts were not identified for World Heritage Properties, National Heritage Properties, Commonwealth Heritage Properties, Ramsar wetlands, WA State or Commonwealth Marine Parks, Indigenous Heritage Sites or EPBC listed critical habitat or threatened ecological communities. • Impacts to the values of KEFs within the OAs are within acceptable levels .
Legislation and Conventions	Is the impact or risk being managed in compliance with relevant Australian or international environmental management laws or standards (e.g. EPBC Act and Policy Statements, MARPOL, OPGGS Act, etc.)?	Control measures to reduce impacts and risks from the acoustic source are compliant with relevant legislations and conventions, including the requirements of the EPBC Act Policy Statement 2.1. Furthermore, the control measures are consistent with following recovery and conservation plans: • Seismic noise has not been identified as a threat to whale sharks in either the Conservation Advice (DoE 2016j) or previous in force Whale Shark Recovery Plan 2005 – 2010 (DEH 2005a). Noise pollution is not identified as a pressure to whale sharks in the Marine Bioregional Plan for the North-west Marine Region (DSEWPaC 2012). However, PGS will apply EPBC Act Policy Statement 2.1 to whale sharks as a precautionary and more conservative approach to prevent potential, acoustic impacts and risks. • *The Conservation Management Plan for the Blue Whale* identified seismic noise as a potential source of anthropogenic noise impacts, which was determined a threat with a Very High Priority for pygmy blue whales. Recovery actions include managing anthropogenic noise in BIAs such that any blue whale continues to utilise the area without injury and is not displaced. Thus, control measures have been implemented to reduce seismic noise impacts within the pygmy blue whale migration BIA such as no seismic surveys during the peak migration period of June/July, increased observation periods and adaptive management measures. • *The Conservation Advice for the Humpback Whale and the Humpback Whale Recovery Plan* identifies seismic exploration noise as a source of noise interference and threat to the species. Conservation actions included assessing and addressing anthropogenic noise from seismic surveys, recommending adherence to the EPBC Act Policy Statement 2.1, site-specific acoustic modelling and management measures (e.g. shutdown and caution zones, observations, PAM and adaptive management

The potential impacts of underwater noise emissions from discharge of the acoustic array are considered 'Broadly Acceptable' (for surveys during 'standard operating periods') or 'Acceptable if ALARP' (for surveys during 'sensitive operating periods') in accordance with the Environment Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		
		procedures). Thus, control measures have been implemented to reduce seismic noise impacts within the humpback whale migration BIA such as no seismic surveys during the peak migration period of mid-July to mid-Aug, increased observation periods and adaptive management measures. • The EPBC Act Policy Statement 3.21 – Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (DoE, 2016k) does not identify any impacts and risks to shorebirds from offshore seismic activities.
Industry Standards and Best Practice	Is the impact or risk being managed in accordance with industry standards, guidelines and best practice (e.g. APPEA Code of Environmental Practice, IAGC guidelines, etc.)?	Control measures to reduce impacts and risk from the acoustic source are in accordance with industry standards and best practice, including: • IAGC Mitigation Measures for Cetaceans during Geophysical Operations includes the core commitment that operations will not have a significant effect on a cetacean population and implements specific management measures, all of which are included in this EPs control measures. • APPEA Code of Environmental Practice recommends that geophysical surveys have an environmental objective to reduce impacts on cetaceans and other marine life to ALARP and acceptable levels with evidence that appropriate management measures were implemented according to legislation and that further studies and new knowledge were considered.
Comparison between Predicted and Acceptable Levels	Are the predicted environmental impacts and risks within the defined acceptable levels (above)?	With implemented control measures, the predicted environmental impacts and risks are with the defined acceptable levels as detailed in this table and the impacts assessment section and formalised as performance outcomes in Section 3.3.2.25 Summary of Environmental Performance.
ESD Principles	Is the impact or risk being managed in accordance to the principles of ESD (as per the EPBC Act)?	The ERA demonstrated compliance with the principles of ESD: • Decision-making processes integrated both long-term and short-term economic, environmental, social and equitable considerations. No long term impacts to receptors where identified with most of the potential impacts recovery rates being day to week to months. Only one impact was identified to have a recovery rate of a year. • No threats of serious or irreversible environmental damage were identified. • The principle of inter-generational equity is maintained for the benefit of future generations. • The conservation of biological diversity and ecological integrity were fundamental considerations in decision-making and development of control measures.

The potential impacts of underwater noise emissions from discharge of the acoustic array are considered 'Broadly Acceptable' (for surveys during 'standard operating periods') or 'Acceptable if ALARP' (for surveys during 'sensitive operating periods') in accordance with the Environment Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		
		• The approved control measures considered improved valuation, pricing and/or incentive mechanisms.

3.3.2.24 Summary of Environmental Risk Assessment

Residual Risk Assessment				
Potential Environmental Impact		Consequence	Likelihood	Residual Risk
Pathological impacts (lethal and sub-lethal injuries) - immediate and delayed mortality and physiological effects to nearby marine organisms	Planktonic organisms	Moderate	Possible	Medium
	Benthic invertebrates	Slight	Remote	Low
	Fish	Minor	Highly Unlikely	Low
	Sharks	Slight	Remote	
	Sea snakes			
	Marine turtles			
	Seabirds			
	Odontocetes			
	Mysticetes			
Physiological impacts - permanent or temporary hearing loss	Planktonic organisms	Minor	Possible	Medium
	Benthic invertebrates	Slight	Highly Unlikely	Low
	Fish	Minor		
	Sharks	Slight	Remote	
	Sea snakes			
	Marine turtles			
	Seabirds			
	Odontocetes			
	Mysticetes			
Behavioural impacts - disruptions to feeding, mating, breeding or nursery activities of marine fauna	Planktonic organisms	Minor	Possible	Medium
	Benthic invertebrates	Slight	Highly Unlikely	Low
	Fish	Minor		
	Sharks	Slight	Remote	
	Sea snakes			
	Marine turtles		Highly Unlikely	
	Seabirds		Remote	
	Odontocetes	Minor	Highly Unlikely	
	Mysticetes			
Impacts to commercial fisheries - altered behaviour or breeding patterns of commercially-targeted marine species in such a way that commercial or recreational fishing activities are compromised	Benthic invertebrates (catch rates)	Minor	Highly Unlikely	Low
	Fish (catch rates)			
Impacts to conservation values of a sensitive location	Fish communities	Minor	Highly Unlikely	Low

3.3.2.25 Summary of Environmental Performance

EPO	EPS	Control Measure No.	Measurement Criteria
Undertake seismic acquisition in a manner that prevents injury and PTS impacts to cetaceans and whale sharks from seismic sound emissions consistent with EPBC Act Policy Statement 2.1.	*Survey timing* The will be no seismic surveys: • Within 22.5 km of the pygmy blue whale migration BIA during 15th May to 15th June and 1 November to 15 December. • Within the whale shark migration BIA from 1 August to 30 November • Within 22.5 km of the humpback whale migration BIA from 15 July to 31 August.	59	MFO records Vessel track logs Shot point records Exclusion zones available in seismic vessel mapping system
	EPBC Act Policy Statement 2.1 Part A EPBC Act Policy Statement 2.1 Part A consisting of the following will be implemented for the survey for cetaceans and whale sharks: • A.3.1 Pre Start-up-Visual Observation • A.3.2 Soft Start Procedure (also known as ramp-up) • A.3.3 Start-up Delay Procedure • A.3.4 Operations Procedure • A.3.5 Stop Work Procedure • A.3.6. Night-time and Low Visibility Procedures • A.4 Compliance and Sighting Reports The following precaution zones will be implemented: • Observation zone: 3+ km horizontal radius from the acoustic source. • Low power zone: 2 km horizontal radius from the acoustic source. • Shut-down zone: 500m horizontal radius from the acoustic source.	24	MFO records
	Marine Fauna Observers • Two MFOs will be on the survey vessel with one MFO on watch during daylight hours. • MFOs will have completed the JNCC Marine Mammal Observer Course or equivalent with the lead MFO also having a minimum of 10 weeks experience on a seismic survey vessel as an MFO.	25 27	MFO records MFO qualifications
	Passive Acoustic Monitoring Passive acoustic monitoring (PAM) will be used when seismic acquisition occurs within the KEF Exmouth Plateau. When both PAM and MFO are being used the method that identifies a whale closest to the shutdown/powerdown zones will be used to initiate the shutdown/powerdown.		PAM specifications PAM records PAM operator qualifications

EPO	EPS	Control Measure No.	Measurement Criteria
	The PAM system and monitoring process will meet the requirements as detailed in the IAGC Guidance on the Use of Towed Passive Acoustic Monitoring during Geophysical Operations including: • Calibrated hydrophone arrays with full system redundancy to estimate bearing and distance of vocalising cetaceans to at least 2 km. • Two PAM operators will be on the survey vessel with one PAM operator on watch when the acoustic source is operating. • PAM operators will have completed a PAM operator course with the lead PAM operator also having a minimum of 10 weeks experience on a seismic survey vessel as a PAM operator. • One PAM operator will be on watch while the acoustic source is operating.		
	Adaptive Management Procedure If observed numbers of whales are higher than expected, as determined by there being three or more whales within the shutdown/powerdown zones in 24 hours the following will be implemented: • Relocation – survey vessel will relocate to another survey line >22.5 km from location of last sighting of a whale and will not return within 24 hours; OR. • Cessation – if there are no options for relocation (e.g. no other survey lines), no survey operations for 24 hours in current location. If observed numbers of whale sharks are higher than expected, as determined by there being three or more whale sharks within the shutdown/powerdown zones in 24 hours the following will be implemented: • Relocation – survey vessel will relocate to another survey line >2 km from location of last sighting of a whale shark and will not return within 24 hours; OR. • Cessation – if there are no options for relocation (e.g. no other survey lines), no survey operations for 24 hours in current location.	34	MFO records
	Pre-start visual observations The following pre-start visual observation times will be implemented: • 90 mins in water depths >200 m within the KEF Exmouth Plateau. • 45 mins in the pygmy blue whale migration BIA from 1 April to 30 August, and 1 October to 15 January. • 45 mins in the humpback whale migration BIA from 1 June to 30 October.	32 33 36	MFO records
Undertake seismic acquisition in a manner that prevents:	*Array volume and source level* • A seismic source equal to or less than 3,260 in^3 will be used. • A seismic source that produces an equivalent or less peak SPL greater than 249 dB re 1µPa (at 1 m) as defined by Nucleus modelling will be used.	43 45	Record of seismic source size Nucleus modelling report Sound source modelling report

EPO	EPS	Control Measure No.	Measurement Criteria
1. serious or irreversible impacts to plankton or fauna dependent on plankton as a food source 2. long term or population impacts to invertebrates and fish including commercial fish species 3. long term or population impacts to cetaceans, whale sharks or turtles 4. serious or irreversible impacts to the values of the KEFs: • Ancient coastline at 125 m • Exmouth plateau • Continental Slope Demersal Fish Communities • Glomar shoal	*Source operation* • No discharge of the acoustic source outside of the NCB and Beagle OAs. • A single acoustic source will be discharged during line turns. • No more than 25,000 km^2 of 3D will be acquired within a 12-month period, for the five-year validity of the EP.	40 42 54	Record of survey acquisition area Vessel track logs Shot point records
	Line spacing/Number of streamers • Line spacing will not be less than 600 m. • Streamer/line spacing for each survey will be assessed and where more streamers can be used and line spacing increased, without comprising the survey acquisition objective, it will be implemented.	61	Record of line spacing/streamer configuration Record of streamer/line spacing assessment
	Areas of survey overlap • No more than two seismic surveys will be undertaken within the Rollo OAs at the same time. • Seismic acquisition will not be undertaken within 40 km of another vessel that is also acquiring data. • Seismic acquisition will not be undertaken less than one year after a survey has been undertaken over the same area.	29 31	Vessel track logs Record of timing of planned and previous seismic surveys within an area
Undertake seismic acquisition in a manner that prevents: • long term or population impacts pearl oyster stocks	*Operational restrictions* • No survey acquisition in the Pearl Oyster Managed Fishery Zone 1 or 2 out to the 100 m depth contour pending research outcomes that are acceptable to the PPA. • At least 6 months notice to PPA and DPIRD -Fisheries of a proposed survey within the 100 m depth contour of the Pearl Oyster Managed Fishery Zone 1 or 2. • No survey acquisition within 10 km of a pearl lease.	46	Vessel track logs Shot point records Exclusion zones available in seismic vessel mapping system Stakeholder consultation records

EPO	EPS	Control Measure No.	Measurement Criteria
• impacts to pearl oyster fisheries	*Research and provision of data* • PGS will request voluntary contributions from all purchasers of MultiClient data acquired under the Rollo EP, with such funds to be directed towards seismic/fishing interaction research. • PGS will provide bathymetric data where available within the relevant fishing zones from its existing 3D data library. • PGS will provide additional bathymetric data from any new 3D surveys acquired under the Rollo EP within PPA fishing zones. • PGS will provide raw data from its sounders when acquiring seismic within PPA fishing zones that could be of future benefit to PPA.	46	Request for contributions Record of contributions and research funded. Provision of data to PPA.
Undertake seismic acquisition in a manner that prevents: • long term or population impacts on commercial fishery stocks	*Operational restrictions* • Seismic surveys will only be undertaken within the Mackerel and Pilbara line, trap and trawl fisheries catch effort areas (as defined by the last five years of data from Fish Cube) during May, June and July which is outside of known spawning timing. • If new information becomes available through consultation or new publications regarding key locations for spawning and/or fishing locations within the operational area, PGS shall determine the feasibility of avoiding these periods/locations. • No more than one PGS survey will be undertaken at one time within a fishery area where there is catch effort. • There will be <5% annual overlap with PFTIMF Zone 2 areas actively fished which equates to no more than 1,155 km^2 acquisition per year. • There will be <5% overlap with PTMF Schedule 1 areas actively fished which equates to no more than 4,206 km^2 acquisition per year.	59 62	Vessel track logs Fish Cub data Record of new information assessment and outcomes
	Research and provision of data • PGS will request voluntary contributions from all purchasers of MultiClient data acquired under the Rollo EP, with such funds to be directed towards seismic/fishing interaction research. • PGS will provide bathymetric data where available within the relevant fishing zones from its existing 3D data library. • PGS will provide additional bathymetric data from any new 3D surveys acquired under the Rollo EP within fishery licence holders fishing zones. • PGS will provide raw data from its sounders when acquiring seismic within licence holders fishing zones that could be of future benefit to licence holders. • PGS will carrying out the research described in the CSIRO proposal Variation in schools and scattering layers to environmental conditions and seismic operations.		Request for contributions Record of contributions and research funded. Provision of data to fishery licence holders CSIRO research report

EPO	EPS	Control Measure No.	Measurement Criteria
Undertake seismic acquisition in a manner that prevents impacts to divers consistent with Guidance note (DMAC 12)	*UK Diving Medical Advisory Committee (DMAC 12)* For seismic surveys within 60 km of: • Rankin Bank • Glomar Shoal • Bedout Island • Pearl farm lease consultation will be undertaken with diving and fishing tour operators and research organisations that visit these locations and pearl farm operators. Where diving activities are likely to be within 30 km of the seismic survey, or requested by the stakeholder, an operating protocol will be developed and agreed by both parties. The operating protocol will document the joint risk assessment and agreed controls such as: • Exclusion areas for divers and/or the seismic vessel, if appropriate. • Notification and communication processes before and during the survey. • Process for ramp-up trials if applicable. • Agreed shut-down processes between divers and the seismic vessels if impacts are identified. If a seismic survey is within 21 km of: • Rankin Bank • Glomar Shoal • Bedout Island • Pearl farm lease a scout vessel will be present at the area; and the seismic source will not be operated within 21 km if people are diving.	52	Consultation records Operating protocol Scout vessel records

3.3.3 Noise Emissions (non-seismic)

3.3.3.1 *Description of Risk*

The source of environmental risk discussed within this section is noise emitted from the survey vessel and support vessel (i.e. engines, propellers, hull flow noise – excluding noise generated by the seismic acoustic source) or from helicopter operations causing potential short-term localised disturbance to marine fauna, such as alteration of behaviour and localised displacement.

3.3.3.2 Receptors

The OAs overlap the migration BIA for humpback whales and pygmy blue whales and foraging BIA for whale sharks. The nearest turtle BIA is 12 km from the OAs.

3.3.3.3 *Potential Environmental Impacts*

3.3.3.3.1 Vessels

During the surveys, underwater noise will be generated from the survey vessel and support vessel(s). Studies of underwater noise associated with petroleum operations have generally reported that the main source of noise relates to the use of thrusters to maintain vessel position, rather than cruising. Noise characteristics and levels vary considerably between vessel types, size, speed and the particular activity being conducted.

The sound levels and frequency characteristics of underwater noise produced by vessels are related to vessel size and speed. When idle or moving between sites, vessels generally emit low-level noise. Tugboats, crew boats, supply ships, and many research vessels in the 50-100 m size class typically have broadband source levels in the 165-180 dB re 1µPa range (Gotz *et al.* 2009). In comparison, underwater noise levels generated by fishing trawlers can peak at around 175 dB re 1µPa, and large ships can produce levels exceeding 190 dB re 1µPa (Gotz *et al.* 2009). These levels are significantly lower than the seismic source noise levels discussed in Section 3.3.2.

Underwater noise generated by the presence of the survey vessel may result in incidental changes in behaviour of marine fauna (primarily cetaceans, whale sharks and marine turtles), such as disturbance, avoidance or attraction. However, these impacts are likely to be localised and temporary. The recommended root mean square (rms) SPL threshold (Southall *et al.* 2007) that could result in possible avoidance is 120 dB re 1µPa at 1 m. The recommended rms SPL threshold (Southall *et al.* 2007) that could result in physical injury is not expected to be exceeded by non-pulse noise sources vessel noise.

Furthermore, underwater noise from the survey vessel is transient, in that the vessel will be moving across large areas rather than concentrating activities in a small area, and the type of noise is no different to that emitted by the commercial shipping traffic and fishing vessels operating in these areas. Given the slow operating speed (generally less than 4-5 knots), and the low numbers of marine fauna anticipated to be in the area at the time of the survey, the probability of significant impacts from disturbance to marine fauna is assessed to be Low.

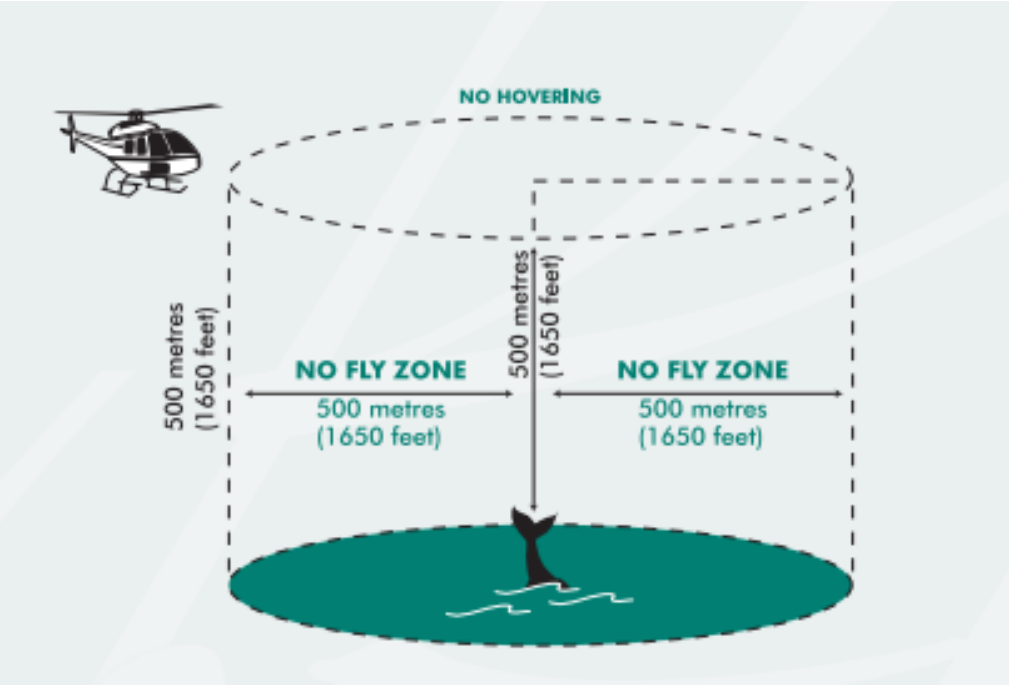
3.3.3.3.2 Helicopters

The intensity of sound travelling from a source in the air (e.g. helicopter) to a receiver underwater depends on source altitude and lateral distance, receiver depth, water depth, and other variables. 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 1uPa.

However, as per EPBC Regulations (8.07) helicopters (including gyrocopters) must (Figure 3-7):

- not fly lower than 500 m (1,650 feet) within a 500 m (1,650 feet) radius of a whale or dolphin;
- not hover over the no fly zone;
- avoid approaching a whale or dolphin from head on;

- avoid flying directly over, or passing the shadow of the helicopter directly over a whale or dolphin; and
- cease the activity if the whale or dolphin shows signs of disturbance.



Source: modified from DEH (2005).

Figure 3-7 – Approach distances for aircraft

3.3.3.4 *Summary of Environmental Impacts*

Potential Environmental Impacts	Environmental Values and Sensitivities Affected	Decision Type
Temporary, localised behavioural disturbance to marine fauna from vessel and helicopter noise emissions	Marine fauna: cetaceans, whale sharks and marine turtles	A

3.3.3.5 *Justification for Implemented Control Measures*

No.	Control Measures	Justification
55	During periods when the survey vessel is transiting the proposed OA without the seismic array deployed, or during the process of deployment or retrieval of the array: • the vessel will not travel at speeds greater than 6 knots within 300 m (caution zone) of a cetacean, turtle, or whale shark, and will not approach closer than 100 m from an animal). • the survey and support vessel must not enter the caution zone of a calf. • if a calf appears in the caution zone, then the vessel must be immediately stopped and must either: turn off the vessel's engines; or disengage the gears; or withdraw the vessel from the caution zone at a constant speed of less than 6 knots.	Survey operations must adhere to the relevant EPBC Regulations, including how vessels and helicopters interact with whales and dolphins. These regulations ensure compliance with the EPBC Act and protection of MNES (e.g. cetaceans and threatened species). As these control measures will reduce impacts from vessels and helicopters with spatial and speed restrictions, PGS is confident that these control measures are effective in reducing impacts and risks from vessel and helicopter noise.
56	• A helicopter must not be operated at a height lower than 1,650 ft. or within a horizontal radius of 500 m of a cetacean; and • No aircraft must approach a cetacean head-on.	

3.3.3.6 *Summary of Environmental Risk Assessment*

Residual Risk Assessment				
Potential Environmental Impact		Consequence	Likelihood	Residual Risk
Temporary, localised behavioural disturbance from vessel and helicopter noise emissions	Cetaceans	Slight	Unlikely	Low
	Whale sharks			
	Marine turtles			

3.3.3.7 *Demonstration of ALARP*

On the basis of the ERA conducted, the use of relevant decision-making tools appropriate to the decision type and the application of the 'Hierarchy of Controls' philosophy (below), the control measures described above are appropriate to manage the risk of vessel and helicopter noise emissions and to ensure that reasonable and practicable solutions have not been overlooked. Therefore, the residual risk ranking for this potential impact is considered Low, as good industry practice or comparable standards have been applied to control the risk, and any further effort towards risk reduction (e.g. additional, alternative or modified control measures) would not provide further environmental benefit and/or is not reasonably practicable without sacrifices that are grossly disproportionate to the benefit gained. The environmental impacts and risk are thus reduced to ALARP.	
Eliminate	• Noise from vessels cannot be eliminated, and without a vessel, the survey cannot be undertaken. • Elimination of the support vessel would remove a key control measure for managing interactions with stakeholders in the operational area. • The elimination of helicopter transfers would require vessels to return to port which increases fuel consumption, noxious emissions and survey duration.
Substitute	Substitution of the survey vessel with another purpose-built seismic survey vessel would not change the level of vessel noise emissions to any significant extent.
Engineering	Seismic vessels are designed to reduce vessel propeller cavitation noise as far as reasonably practicable, particularly to reduce unnecessary noise that could reduce the quality of geological imaging. Thus, survey vessels will be designed with practicable engineering options to further reduce the noise transmitted in the marine environment.
Isolation	Survey vessel operations will isolate marine fauna from the environmental impacts and risks from vessel noise disturbance by maintaining safe distances away from animals and traveling at slow speeds.
Administrative	All personnel required to work on the survey and support vessels will be given an HSE&Q induction prior to the commencement of surveys within the operational area (Chapter 3). The induction will include an overview of the marine fauna likely to be in the area and the procedures for interactions with marine fauna.

3.3.3.8 *Demonstration of Acceptability*

The potential impacts of vessel and helicopter noise emissions are considered 'Broadly Acceptable' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		

Internal Context	Is the proposed management of the impact or risk aligned with the PGS Environment Policy and HSEQ Commitment Statement?	The control measures are consistent with the objectives of the PGS Environment Policy and HSEQ Commitment Statement (Chapter 3):
		• PGS Environment Policy
		  ○ Prevent harm to the environment by reducing risk related to the activity
		  ○ Comply with applicable legal and industry standard requirements associated with the activity
		  ○ Achieve continual improvement in environmental performance.
		• HSEQ Commitment Statement (such as):
		  ○ Increase HSEQ awareness and reduce unsafe behaviour
		  ○ Reduce total risk exposure
		  ○ Prevent incidents
		  ○ Minimise harm to the environment.

The potential impacts of vessel and helicopter noise emissions are considered 'Broadly Acceptable' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		
		Thus, the control measures are acceptable to achieve PGS's environmental management requirements for this survey.
External Context – Social Acceptability	Have stakeholders raised any concerns about activity's impacts or risks, and if so, are measures in place to address those concerns?	Chapter 1 included all stakeholder consultation, including PGS' assessment of merits and claims as required by Regulation 16(b), and stakeholders did not raise concerns or claims about potential impacts from vessel or helicopter noise. No additional input was provided. Therefore, it is reasonable to conclude that the environmental impacts and risks are acceptable.
External Context – Natural Environment	Are the control measures providing appropriate protection to the receiving environment (e.g. sensitive or unique environmental features) from potential impacts and risks introduced by the activity?	The OAs overlap the migration BIA for humpback whales and pygmy blue whales and migration / foraging BIA for whale sharks. Based on the ERA evaluation of potential impacts and risks from vessel and helicopter noise, all known control measures (including EPBC Regulations, speed limits, spatial buffers) have been adopted, and additional or alternative control measures would not provide additional environmental protection or benefit. Thus, the control measures provide appropriate protection to the receiving environment, and the potential impacts and risks are of an acceptable level.
Legislation and Conventions	Is the impact or risk being managed in compliance with relevant Australian or international environmental management laws or standards (e.g. EPBC Act and Policy Statements, MARPOL, OPGGS Act, etc.)?	Control measures to reduce impacts from vessel and helicopter noise are compliant with relevant legislations and conventions, including the requirements of the EPBC Regulations 2000 (See Justification above). Furthermore, the control measures are consistent with following recovery and conservation plans: • *Whale shark management – Wildlife Management Program no. 57* identified vessel noise as an existing and potential pressure facing whale sharks and restricted the number of vessels allowed to interact with a whale shark. However, as this does not apply to seismic survey vessels, PGS will apply the EPBC Regulation for interactions with cetaceans to whale sharks as a precautionary and more conservative approach. • The *Conservation Management Plan for the Blue Whale* identified shipping noise as a potential source of anthropogenic noise impacts, which was determined a threat with a Very High Priority for pygmy blue whales. Thus, control measures to help reduce vessel noise impacts are consistent with the conservation actions for the blue whale. • The *Conservation Advice for the Humpback Whale* and the *Humpback Whale Recovery Plan* also identified vessel noise as a source of habitat degradation and threat to the species, and the proposed control measures to reduce vessel noise impacts are consistent with the Recovery Plan's action to protect their habitat. • The *Recovery Plan for Marine Turtles in Australia* identified shipping noise interference as a threat to their recovery. However, as the Recovery Plan does not have specific restrictions for seismic survey vessels, PGS will apply the EPBC Regulation for interactions with cetaceans to marine turtles as a precautionary and more conservative approach. Thus, the proposed control measures to reduce survey vessel noise impacts on marine turtles are consistent with the Recovery Plan's objectives.

The potential impacts of vessel and helicopter noise emissions are considered 'Broadly Acceptable' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		
Industry Standards and Best Practice	Is the impact or risk being managed in accordance with industry standards, guidelines and best practice (e.g. APPEA Code of Environmental Practice, IAGC guidelines, etc.)?	Control measures to reduce impacts and risks from vessel and helicopter noise emissions are in accordance with industry standards and best practice, including: • IAGC Environmental Manual for Worldwide Geophysical Operations, such that geophysical vessels ensure that noise and emissions are kept to appropriate levels. • APPEA Code of Environmental Practice recommends that geophysical surveys have an environmental objective to reduce impacts on cetaceans and other marine life to ALARP and acceptable levels.
Comparison between Predicted and Acceptable Levels	Are the predicted environmental impacts and risks within the defined acceptable levels (above)?	With implemented control measures, the predicted environmental impacts and risks are Low, ALARP and within the acceptable levels defined above (i.e. PGS Environment Policy and HSEQ Commitment Statement, external context, legislation, conventions, and industry standards and best practice). The extent, severity and duration of vessel and helicopter noise will be short-term and localised.
ESD Principles	Is the impact or risk being managed in accordance to the principles of ESD (as per the EPBC Act)?	The ERA demonstrated compliance with the principles of ESD: • decision-making processes integrated both long-term and short-term economic, environmental, social and equitable considerations (e.g. reducing impacts from vessel and helicopter noise on marine fauna). • no threats of serious or irreversible environmental damage were identified. • the principle of inter-generational equity is maintained for the benefit of future generations. • the conservation of biological diversity and ecological integrity were fundamental considerations in decision-making and development of control measures. • the approved control measures considered improved valuation, pricing and/or incentive mechanisms.

3.3.3.9 *Summary of Environmental Performance*

EPO	EPS	Control Measure No.	Measurement Criteria

Vessel and helicopter operations adhere to the requirements of the EPBC Regulation Part 8	During periods when the survey vessel is transiting the proposed OA without the seismic array deployed, or during the process of deployment or retrieval of the array:
	• the vessel will not travel at speeds greater than 6 knots within 300 m (caution zone) of a cetacean, turtle, or whale shark, and will not approach closer than 100 m from an animal.
	• the survey and support vessel must not enter the caution zone of a calf.
	• if a calf appears in the caution zone, then the vessel must be immediately stopped and must either:
	  • turn off the vessel's engines; or
	  • disengage the gears; or
	  • withdraw the vessel from the caution zone at a constant speed of less than 6 knots.
		55	MFO reports confirm that vessels and helicopters operated according to vessel-marine fauna interaction procedures.

	Interaction between helicopters and cetaceans within the proposed OA will be consistent with EPBC Regulations 2000 – Part 8 Division 8.1 (Regulation 8.07) – Interacting with cetaceans. • A helicopter must not be operated at a height lower than 1,650 ft. or within a horizontal radius of 500 m of a cetacean; and • No aircraft must approach a cetacean head-on.	56	

3.3.4 Vessel Light Emissions

3.3.4.1 *Description of Risk*

Lighting on both the survey and support vessels is required for safe navigation and work practices at night and has the potential to create light pollution.

3.3.4.2 Receptors

Light emissions may affect some marine species, primarily seabirds and turtles. The nearest turtle BIA is a foraging BIA 12 km from the Beagle OA and the closest marine turtle critical habitat is 26 km (Figure 2-34 and Figure 2-35). The Beagle OA overlaps the brown booby, lesser crested tern, lesser frigatebird, wedge-tailed shearwater and white tailed tropicbird foraging BIAs and the roseate tern breeding area buffer. The closest bird BIA to the NCB OA is the wedge-tailed shearwater foraging BIA at ~ 10 km.

3.3.4.3 Potential Environmental Impacts

Artificial lighting has the potential to affect marine fauna, notably marine turtles. Behavioural responses to light can alter foraging and breeding activity in turtles, seabirds, fish and dolphins, conferring competitive advantage to some species and reducing reproductive success and/or survival in others.

Light pollution reaching nesting beaches is widely considered detrimental owing to its ability to alter important nocturnal activities including choice of nesting sites and orientation/navigation to the sea by post-nesting females and hatchlings (Witherington and Martin, 2003). Innate sea finding by hatchling turtles relies on light cues that include horizon brightness, shape and colour (Salmon *et al.* 1992; Salmon, 2003). However, Pendoley (2005) also noted that onshore light influences hatchling orientation more than offshore light since an offshore light will assist in attracting hatchlings in the direction of the ocean whilst they are traversing the beach.

Once in the ocean, hatchlings are thought to remain close to the surface, orient by wave fronts and swim into deep offshore waters for several days to escape the more predator-filled shallow inshore waters. During this period, light spill from coastal port infrastructure and ships may alter hatchling swimming behaviour, reducing the success of their seaward dispersion and potentially increasing their exposure to predation via silhouetting (Salmon *et al.* 1992).

Owing to their migratory habits, all six (6) species of turtle identified via the PMST (Chapter 2) have the potential to be present in open ocean habitats throughout the NCB and Beagle OAs, albeit in low densities as the nearest turtle BIA (foraging) is 12 km from the Beagle OA. Thus artificial light will not have an impact on foraging turtles or nesting sites. Additionally, the vessel will be continually moving and will be operating 24 hours a day, albeit at a low speed, and consequently the effects of artificial lighting are likely to be less than for a stationary source.

Therefore, the density of animals in the proposed operating areas is likely to be low, and as such the probability of artificial light impacts on turtles is also low. It is unlikely that turtles would use these areas for any significant period and artificial light is therefore unlikely to significantly affect the population of any marine turtle species. Therefore, the impacts of light on marine turtles has been reduced to ALARP.

There are no recovery or other plans specific to the bird species that the Beagle OA overlap. GBRMA (2012) did not identify light as a potential impact to inshore and coastal foraging seabirds. The Beagle OA overlaps the roseate tern breeding area buffer. The roseate tern breeds on Bedout Island which is 20 km from the Beagle OA. Thus, no impacts to breeding roseate terns is predicted due to the separation distance. The Beagle OA overlaps a number of bird foraging BIAs which could result in localised attraction to food sources such as squid and fish that maybe attracted to vessel lights. Impacts would be localised due to the small area that would be lit and temporary nature of the lighting as the vessels move through the area.

The potential impacts to other marine fauna of light emissions from seismic vessels is expected to be restricted to localised attraction, temporary disorientation and increased predation and as such, any impacts arising from light emissions are considered to be minor and localised to a small proportion of the population.

Lighting from survey vessels will be no greater than the lighting from the other numerous vessels in the area associated with shipping, commercial fishing or petroleum activities.

3.3.4.4 Summary of Environmental Impacts

Potential Environmental Impacts	Environmental Values and Sensitivities Affected	Decision Type
Temporary, localised behavioural disturbance to marine fauna from vessel light emissions	Marine fauna: marine turtles and seabirds	A

3.3.4.5 Justification for Implemented Control Measures

No.	Control Measures	Justification
57	External lighting of vessels will be minimised to that required for safe navigation, vessel safety and safety of deck operations, except in the case of an emergency.	• As required under COLREG and the *Navigation Act 2012* for safety reasons, lighting cannot be eliminated from nor substituted on vessels, as it is required for safe working conditions and navigation. PGS will ensure that vessel lighting is designed to ensure adequate illumination on the vessels for safe working conditions and navigation. • Marine Order 30 requires that vessels have lights and signals in accordance with International Regulations and IMO Resolutions. • Marine Order 32 includes requirements for vessel lights for safety during cargo operations. • PGS will adhere to these regulations and are confident that these control measures are formally managed and will be effective to reduce impacts and risks from vessel light emissions.

3.3.4.6 Summary of Environmental Risk Assessment

Residual Risk Assessment				
Potential Environmental Impact		Consequence	Likelihood	Residual Risk
Temporary, localised behavioural disturbance from vessel light emissions	Marine turtles	Slight	Highly Unlikely	Low
	Seabirds			

3.3.4.7 Demonstration of ALARP

On the basis of the ERA conducted, the use of relevant decision-making tools appropriate to the decision type and the application of the 'Hierarchy of Controls' philosophy (below), the control measures described above are appropriate to manage the risk of vessel light emissions and to ensure that reasonable and practicable solutions have not been overlooked. Therefore, the residual risk ranking for this potential impact is considered to be Low, as good industry practice or comparable standards have been applied to control the risk, and any further effort towards risk reduction (e.g. additional, alternative or modified control measures) would not provide further environmental benefit and/or is not reasonably practicable without sacrifices that are grossly disproportionate to the benefit gained. The environmental impacts and risk are thus reduced to ALARP.	
Eliminate	Lighting cannot be eliminated from vessels, as it is required for safe working conditions and navigation.
Substitute	Use of lighting cannot be substituted.
Engineering	Lighting is designed to ensure adequate illumination on the vessels for safe working conditions and navigation.
Isolation	The nearest turtle BIA is 12 km from the Beagle OA and the Beagle OA overlaps a number of seabird foraging BIAs. Due to the distance from known turtle nesting beaches and BIAs, exclusion zones are not required.
Administrative	All personnel will receive appropriate environmental induction and training (Chapter 3), including an overview of the marine fauna likely to be in the area and the environmental management measures regarding vessel lighting.

3.3.4.8 Demonstration of Acceptability

The potential impacts from vessel light emissions are considered 'Broadly Acceptable' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		

Internal Context	Is the proposed management of the impact or risk aligned with the PGS Environment Policy and HSEQ Commitment Statement?	The control measures are consistent with the objectives of the PGS Environment Policy and HSEQ Commitment Statement (Chapter 3):
		• PGS Environment Policy
		  ○ Prevent harm to the environment by reducing risk related to the activity
		  ○ Comply with applicable legal and industry standard requirements associated with the activity
		  ○ Achieve continual improvement in environmental performance.
		• HSEQ Commitment Statement (such as):
		  ○ Increase HSEQ awareness and reduce unsafe behaviour
		  ○ Reduce total risk exposure
		  ○ Prevent incidents
		  ○ Minimise harm to the environment.
		Thus, the control measures are acceptable to achieve PGS's environmental management requirements for this survey.

The potential impacts from vessel light emissions are considered 'Broadly Acceptable' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		
External Context – Social Acceptability	Have stakeholders raised any concerns about activity's impacts or risks, and if so, are measures in place to address those concerns?	Chapter 1 included all stakeholder consultation, including PGS' assessment of merits and claims as required by Regulation 16(b). With regard to impacts and risks from vessel light emissions, no stakeholder concerns were raised, and no additional input was provided. Therefore, it is reasonable to conclude that the environmental impacts and risks are acceptable.
External Context – Natural Environment	Are the control measures providing appropriate protection to the receiving environment (e.g. sensitive or unique environmental features) from potential impacts and risks introduced by the activity?	The ERA for vessel light emission impacts considered that the proposed OAs are 12 km from the nearest turtle BIA and overlap several bird BIAs. As survey vessels will always be transiting, the amount of light emitted will not cause significant behavioural responses. Vessel lighting will be similar to that associated with normal shipping activities in the area.
Legislation and Conventions	Is the impact or risk being managed in compliance with relevant Australian or international environmental management laws or standards (e.g. EPBC Act and Policy Statements, MARPOL, OPGGS Act, etc.)?	Control measures to reduce vessel light emission impacts and risks are compliant with relevant legislation and conventions: • Both COLREG and the *Navigation Act 2012* have requirements for vessel lighting for safe working conditions and navigation, all of which will be implemented during a survey. • As per the *Recovery Plan for Marine Turtles*, PGS will ensure best management practices to minimise light impacts to marine turtles such that they are not displaced from important habitats and that important behaviours are not changed. Thus, the control measures are compliant with the Recovery Plan objectives. • *EPA Guideline #5 Environmental Assessment Guideline for Protecting Marine Turtles from Light Impacts* (EPA, 2010) stated that a darkness zone of at least 1.5 km should be maintained from all significant rookeries. The nearest nesting area is > 80 km from the OAs and thus the survey operations are compliant with EPA guidelines.
Industry Standards and Best Practice	Is the impact or risk being managed in accordance with industry standards, guidelines and best practice (e.g. APPEA Code of Environmental Practice, IAGC guidelines, etc.)?	Control measures to reduce impacts from vessel light emissions are in accordance with industry standards and best practice, including: • IAGC Environmental Manual for Worldwide Geophysical Operations, such that geophysical vessels ensure that emissions are kept to appropriate levels. • Although not identify as an environmental concern for offshore geophysical surveys, the APPEA Code of Environmental Practice recommends that other offshore operations (e.g. drilling, production) to reduce light emissions to ALARP and acceptable levels.
Comparison between Predicted and Acceptable Levels	Are the predicted environmental impacts and risks within the defined acceptable levels (above)?	With implemented control measures, the predicted environmental impacts and risks are Low, ALARP and within the acceptable levels defined above (i.e. PGS Environment Policy and HSEQ Commitment Statement, external context, legislation, conventions, and industry standards and best practice). The extent, severity and duration of vessel light emissions will be short-term and localised.

The potential impacts from vessel light emissions are considered 'Broadly Acceptable' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		
ESD Principles	Is the impact or risk being managed in accordance to the principles of ESD (as per the EPBC Act)?	The ERA demonstrated compliance with the principles of ESD: • decision-making processes integrated both long-term and short-term economic, environmental, social and equitable considerations (e.g. reducing impacts from vessel light emissions on marine fauna). • no threats of serious or irreversible environmental damage were identified. • the principle of inter-generational equity is maintained for the benefit of future generations. • the conservation of biological diversity and ecological integrity were fundamental considerations in decision-making and development of control measures. • the approved control measures considered improved valuation, pricing and/or incentive mechanisms.

3.3.4.9 Summary of Environmental Performance

EPO	EPS	Control Measure No.	Measurement Criteria
External lighting of vessels will be minimised to levels required for safe navigation, vessel safety and safety of deck operations, except in the case of an emergency.	Operations of the survey vessel must comply with: • International Regulations for Preventing Collisions at Sea 1972 (COLREG; Marine Order 30) • Marine order 21 (Safety of navigation and emergency procedures).	57	Confirmation that vessel lighting was acceptable for safety in: • Pre-mobilisation audit

3.4 UNPLANNED ACTIVITIES (ACCIDENTS AND INCIDENTS)

3.4.1 Anchoring and Equipment Drag or Loss

3.4.1.1 Description of Risk

The accidental dragging or loss of seismic streamer equipment or use of anchors has the potential to cause minor physical damage to benthic habitats and biological communities as described in Chapter 2.
Vessel grounding is not a risk as the minimum water depth in the operating areas is 40 m.

3.4.1.2 Receptors

The potential and significance of impacts caused by anchoring or loss of equipment is in part dependent on the type of receiving environment. Soft sediment benthic areas relatively devoid of sensitive habitats and consisting of sandy /silt substrate is the predominant benthic receiving environment within the NCB and Beagle OAs. Sensitive habitats such as corals, seagrasses and macro algal beds have not been identified in the NCB or Beagle OAs.

3.4.1.3 Potential Environmental Impacts

Equipment dragging and Loss

In the unlikely event of damage to or loss of a solid seismic streamer, potential environmental effects will be limited to physical impacts on benthic communities arising from the cable and associated equipment sinking to the seabed. Seismic streamers and vanes are fitted with pressure-activated, self-inflating buoys that are designed to bring the equipment to the surface if lost accidentally during a survey. As the equipment sinks it passes a certain water depth at which point the buoys inflate and bring the equipment back to the surface where it can be retrieved by the seismic or support vessels

Dragging of the streamer along the seabed may result in localised physical disturbance of substrates, benthic habitats and communities if located within the OA. The streamer tow depth may be between 8 - 26 m, however, PGS will ensure streamers will be towed at a depth that will not allow them to be closer than 10 m from the seabed.

Steaming too close to an emergent structure could result in streamer entanglement, damage or loss. Vessels and associated equipment, including deployed streamers, will not enter any petroleum safety zones (PSZ) around any emergent petroleum infrastructure as provided for in Chapter 6, Part 6.6 of the OPGGSA. As per Section 668 of the OPGGSA, PSZ are usually identified as a 500 m radius around the facility.

Anchoring

The size of the anchor and chain and the frequency of anchoring will affect any potential damage. Much of the benthos in the OA is sand/mud/silt (Chapter 2). Anchoring in these habitats typically cause minimal disruption to the soft sediment and, given the widely distributed benthic flora and fauna found within these areas, would have a minimal to negligible impact to the benthic communities.

Anchoring is not a planned activity and would only occur in emergency circumstances. Furthermore, due to depths within the OA, anchoring is not always possible. Vessels are fitted with highly sophisticated position fixing equipment.

3.4.1.4 Summary of Environmental Impacts

Potential Environmental Impacts	Environmental Values and Sensitivities Affected	Decision Type
Direct physical damage from: • deployment/retrieval of anchors • equipment dragging or loss	Benthic habitats	A

3.4.1.5 Justification for Implemented Control Measures

No.	Control Measures	Justification
65	Vessels will use approved navigation systems and depth sounders.	As per the *Navigation Act of 2012*, approved navigation systems are required for maritime safety, navigation efficiency and management of marine pollution. As such, PGS is confident that this control measure will be effective to reduce impacts and risks from anchoring and equipment loss.
66	Streamers will be: • equipped with pressure-activated, self-inflating buoys designed to bring the equipment to the surface if lost accidentally • streamers will be towed at a depth that will not allow them to be closer than 10 m from the seabed • solid streamers, rather than fluid-filled streamers • shall be checked/inspected prior to use (including associated equipment).	• Standard practice in the industry includes the use of streamers fitted with pressure-activated, self-inflating buoys, which will allow for easy retrieval of lost equipment and gear and for the prevention of navigational hazards and additional costs to replace gear. • Standard practice in the industry includes maintaining a minimum tow depth to prevent dragging the streamer along the seabed, which may cause localised physical disturbance to the benthic habitat as well as significant damage to the streamer. • PGS developed solid streamers that are resistant to damage from rough weather conditions and will not leak oil and other contaminants to the environment, which is a risk from using fluid-filled streamers. • PGS shall inspect the streamers and associated equipment to achieve the HSEQ Commitment Statement objectives to reduce total risk exposure, prevent incidents and minimise harm to the environment.
22	In-water equipment lost will be recovered (where possible): • records maintained of any loss of in-water equipment If equipment lost is irretrievable: • records maintained of the circumstances that prohibited the equipment from being recovered • AMSA informed of the potential navigation hazard to other mariners.	As per IAGC guidelines for conducting geophysical field operations in an environmentally sensitive manner (IAGC 2013), contingency plans for retrieval of lost equipment must be documented and communicated to help mitigate environmental impacts from lost equipment. Lost equipment must be retrieved as soon as possible after a sighting is reported, and a reasonable effort must be made to retrieve lost equipment. The appropriate regulatory agencies should be notified when equipment is lost.

No.	Control Measures	Justification
67	Anchoring will not occur within the Rollo OA, except in the event of an emergency.	Anchoring is not a planned activity for the survey and would only occur in emergency circumstances.

3.4.1.6 Summary of Environmental Risk Assessment

Residual Risk Assessment				
Potential Environmental Impact		Consequence	Likelihood	Residual Risk
Direct physical damage from deployment/retrieval of anchors	Benthic habitats	Minor	Highly Unlikely	Low
Direct physical damage from equipment dragging or loss		Slight	Unlikely	

3.4.1.7 Demonstration of ALARP

On the basis of the ERA conducted, the use of relevant decision-making tools appropriate to the decision type and the application of the 'Hierarchy of Controls' philosophy (below), the control measures described above are appropriate to manage the risk of anchoring and equipment dragging or loss and to ensure that reasonable and practicable solutions have not been overlooked. Therefore, the residual risk ranking for this potential impact is considered Low, as good industry practice or comparable standards have been applied to control the risk, and any further effort towards risk reduction (e.g. additional, alternative or modified control measures) would not provide further environmental benefit and/or is not reasonably practicable without sacrifices that are grossly disproportionate to the benefit gained. The environmental impacts and risk are thus reduced to ALARP.	
Eliminate	The survey cannot be acquired without the use of vessels, streamers and associated equipment. In an emergency, and if necessary, the use of anchors cannot be eliminated.
Substitute	There are no suitable substitutes for use of a seismic vessel, streamer and associated equipment.
Engineering	Surveys will include best available engineered options to prevent anchoring and equipment drag or loss: • solid streamers • accurate depth control of the streamer via use of the birds and tail buoys. • streamers fitted with pressure-activated, self-inflating buoys • AIS and other approved navigation system and depth sounders.
Isolation	Control measures to isolate benthic habitats include no anchoring (except in emergency circumstances) and maintenance of minimum tow depth (i.e. streamers will not be towed closer than 10 m to the seabed).
Administrative	PGS procedures developed that include streamer pre-deployment checks. In advance of a survey commencing, PGS will provide updated information of the survey operations to all stakeholders, e.g. AMSA RCC and NTM by AHS (for the issuance of NAVAREA X and AUSCOAST warnings), relevant fisheries, shipping and other petroleum titleholders. All personnel will receive appropriate environmental induction and training (Chapter 3), including the relevant PGS shipboard safety procedures and the roles and responsibilities of vessel personnel.

3.4.1.8 Demonstration of Acceptability

The potential risks of anchoring and equipment drag or loss are considered 'Broadly Acceptable' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		

Internal Context	Is the proposed management of the impact or risk aligned with the PGS Environment Policy and HSEQ Commitment Statement?	The control measures are consistent with the objectives of the PGS Environment Policy and HSEQ Commitment Statement (Chapter 3):
		• PGS Environment Policy
		  ○ Prevent harm to the environment by reducing risk related to the activity
		  ○ Comply with applicable legal and industry standard requirements associated with the activity
		  ○ Achieve continual improvement in environmental performance.
		• HSEQ Commitment Statement (such as):
		  ○ Increase HSEQ awareness and reduce unsafe behaviour
		  ○ Reduce total risk exposure
		  ○ Prevent incidents
		  ○ Minimise harm to the environment.
		Thus, the control measures are acceptable to achieve PGS's environmental management requirements for this survey.

External Context – Social Acceptability	Have stakeholders raised any concerns about activity's impacts or risks, and if so, are measures in place to address those concerns?	Chapter 1 included all stakeholder consultation, including PGS' assessment of merits and claims as required by Regulation 16(b). With regard to potential disturbance of benthic habitats and communities from vessel grounding or anchoring and equipment dragging or loss, no stakeholder concerns have been raised, and no additional input was received. Therefore, it is reasonable to conclude that the environmental impacts and risks are of an acceptable level.
External Context – Natural Environment	Are the control measures providing appropriate protection to the receiving environment (e.g. sensitive or unique environmental features) from potential impacts and risks introduced by the activity?	The NCB OA minimum water depth is 110m. The Beagle OA minimum is 40 m, however, this is a very small area (< 50 m is 0.13%) and no sensitive benthic habitats and communities (e.g. corals, seagrasses, macro algal beds) are identified in the OAs. Based on the ERA evaluation of potential impacts and risks to benthic habitats and biological communities, appropriate control measures have been adopted, and additional or alternative control measures would not provide additional environmental protection or benefit. Thus, the control measures provide appropriate protection to the receiving environment, and potential impacts and risks are of an acceptable level.
Legislation and Conventions	Is the impact or risk being managed in compliance with relevant Australian or international environmental management laws or standards (e.g.	Control measures to prevent anchoring and equipment drag or loss are compliant with relevant legislations (see Justification above), such as: • *Navigation Act of 2012*

The potential risks of anchoring and equipment drag or loss are considered 'Broadly Acceptable' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		
	EPBC Act and Policy Statements, MARPOL, Navigation Act, etc.)?	• Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009.

Industry Standards and Best Practice	Is the impact or risk being managed in accordance with industry standards, guidelines and best practice (e.g. APPEA Code of Environmental Practice, IAGC guidelines, etc.)?	Control measures to reduce impacts and risks from anchoring and equipment drag or loss are in accordance with industry standards and best practice:
		• IAGC Environmental Manual for Worldwide Geophysical Operations advised that:
		  ○ contingency plans for retrieval of lost equipment must be documented and communicated to help mitigate environmental impacts from lost equipment
		  ○ lost equipment must be retrieved as soon as possible after a sighting is reported, and a reasonable effort must be made to retrieve lost equipment
		  ○ the appropriate regulatory agencies should be notified when equipment is lost
		  ○ fully recover equipment (e.g. anchored buoys) as soon as they are not needed, or the survey is completed.
		• APPEA Code of Environmental Practice identified disturbance to benthos via anchors, grounding or collision as a potential environmental issue for offshore geophysical surveys and recommended the environmental objective to reduce to benthic communities to ALARP and acceptable levels.

Comparison between Predicted and Acceptable Levels	Are the predicted environmental impacts and risks within the defined acceptable levels (above)?	With implemented control measures, the predicted environmental impacts and risks are Low, ALARP and within the acceptable levels defined above (i.e. PGS Environment Policy and HSEQ Commitment Statement, external context, legislation, conventions, and industry standards and best practice). The extent, severity and duration of impacts and risks from anchoring and equipment drag or loss will be short-term and localised.
ESD principles	Is the impact or risk being managed in accordance to the principles of ESD (as per the EPBC Act)?	The ERA presented in this EP demonstrated compliance with the principles of ESD: • decision-making processes integrated both long-term and short-term economic, environmental, social and equitable considerations (e.g. preventing vessel grounding or anchoring and equipment dragging or loss). • no threats of serious or irreversible environmental damage were identified. • the principle of inter-generational equity is maintained for the benefit of future generations. • the conservation of biological diversity and ecological integrity were fundamental considerations in decision-making and development of control measures. • the approved control measures considered improved valuation, pricing and/or incentive mechanisms.

3.4.1.9 Summary of Environmental Performance

EPO	EPS	Control Measure No.	Measurement Criteria
Zero incidents of physical damage to benthic habitats and communities from: • vessel anchoring; or • dragging or loss of the streamers and associated equipment.	PGS will adhere to the *Navigation Act of 2012*, regarding the use of approved navigation systems and depth sounders.	65	Pre-mobilisation audit confirms approved navigation systems on-board.
	Streamers will be: • equipped with pressure-activated, self-inflating buoys designed to bring the equipment to the surface if lost accidentally • streamers will be towed at a depth that will not allow them to be closer than 10 m from the seabed • solid streamers, rather than fluid-filled streamers • shall be checked/inspected prior to use (including associated equipment).	66	Pre-mobilisation audit confirms appropriate streamer specifications.
	Anchoring will not occur within the NCB or Beagle operational areas except in the event of an emergency.	67	Vessel bridge logs, PGS incident reports and MFO reports confirm that no anchoring occurred during a survey unless in emergency circumstances.
	In-water equipment lost will be recovered (where possible): • records maintained of any loss of in-water equipment If equipment lost is irretrievable: • records maintained of the circumstances that prohibited the equipment from being recovered • AMSA informed of the potential navigation hazard to other mariners.	22	Reportable incidents will be documented in: • PGS incident report • MFO reports • NOPSEMA reports • Annual Report.

3.4.2 Collision between Vessels / Towed Array and Marine Fauna

3.4.2.1 Description of Risk

The survey and support vessels may present a potential physical hazard to marine fauna via vessel strike or entanglement in the streamer tail buoys.

3.4.2.2 Receptors

Given the susceptibility of cetaceans, turtles and whale sharks to vessel strikes, only potential impacts on these species have been considered. Other fauna such as birds, fish and sea snakes are likely to avoid vessels operating in the area and so are considered at low risk of potential strike.

3.4.2.3 Potential Environmental Impacts

The impact from vessel interactions with marine fauna can be as minimal as behavioural changes by the marine fauna to severe impacts such as mortality resulting from vessel strikes. Vessel collisions contribute to the mortality of marine fauna, notably turtles (Lutcavage *et al.* 1997; Hazel and Gyuris, 2006; Hazel *et al.* 2007) and large cetaceans (Knowlton and Kraus 2001; Laist *et al.* 2001; Jensen and Silber 2003). Stranding records for Queensland indicate that 14% of dead marine turtles had been struck by vessels (Hazel and Gyuris, 2006). These records are largely from populated areas of the state and comprise an unknown proportion of the total mortality. A report on vessel strikes in Queensland (DoE, 2007) has indicated that "*both commercial and recreational boats have been responsible for striking marine animals. Recreational vessels, however, account for 96.9% and commercial vessels only 0.001% of registered vessels in Queensland in 2003*".

Marine seismic surveys involve the use of two or more vessels travelling at slow speed (~4 knots) along defined paths. The timing and location of surveys within the proposed OAs may coincide with sensitive periods such as humpback whale, blue whale and whale shark migration periods.

3.4.2.3.1 Cetaceans

The likelihood of vessel/whale collision being lethal is influenced by vessel speed; the greater the speed at impact, the greater the risk of mortality (Laist *et al.* 2001, Jensen and Silber 2003). Vanderlaan and Taggart (2007) found that the chance of lethal injury to a large whale because of a vessel strike increases from about 20% at 8.6 knots to 80% at 15 knots. During seismic data acquisition, the survey vessel will be moving at a speed of ~4 knots. According to the data of Vanderlaan and Taggart (2007), it is estimated that the risk of a vessel-whale collision resulting in lethal outcome is less than 10% at a speed of 4 knots. Vessel/whale collisions at this speed are uncommon and, based on reported data contained in the US National Ocean and Atmospheric Administration database (Jensen and Silber, 2003) there are only two known instances of collisions when the vessel was travelling at less than 6 knots. Both were from whale watching vessels that were deliberately placed amongst whales.

A recent study of the behavioural responses of blue whales and large ships identified that the incidence and severity of ship-whale collisions are linked to several factors (speed of the ship being the major factor) in lethal injuries to cetaceans (McKenna *et al.* 2015). When a ship-whale collision occurred, vessels travelling at speeds between 14-15 knots had a higher probability of causing lethal injuries, especially in comparison to vessels travelling at slower speeds (i.e. <10 knots). Based on these findings (McKenna *et al.* 2015), the probability of a lethal whale-ship interaction with the seismic vessel travelling at ~4 knots (8-9 km) is rare and therefore acceptable and ALARP

3.4.2.3.2 Turtles

Marine turtles on the sea surface or in shallow coastal waters have been observed to avoid approaching vessels by typically moving away from the vessels track (Hazel *et al.* 2007). Hazel *et al.* (2007) suggests this observed avoidance behaviour is based primarily on visual cues (although these authors acknowledge that vessel noise is within range of turtle hearing) and the success of this behaviour in avoiding a vessel strike is largely dependent on the speed of the approaching vessel (rather than vessel type) and the prevailing water clarity.

While the potential for vessel strikes at various speeds has not been quantified, the success of avoidance behaviour is a factor of the response time available (i.e. visual observation distance/vessel speed) and Hazel *et al.* (2007) suggests that higher vessel speed is more likely to cause impacts particularly in shallow waters where turtles are abundant. Thus, there is less opportunity for turtles to avoid vessels travelling at higher speeds in turbid waters. While vessel speed is a significant factor, vessel draft may also contribute to the risk of vessel strikes, with vessels with less draft providing a greater clearance distance between the turtle and the vessel. In the event of a collision, the turtle's carapace provides a level of protection from serious injury, although the type and severity of the injuries would be dependent on the force of the collision and structure of the vessel and whether the animal is struck by the hull or propellers.

Turtle entrapment with streamer tail buoys can lead to mortalities (Ketos Ecology, 2007, 2009). This has been an issue particularly for marine seismic surveys off the west coast of Africa. In recent years, geophysical acquisition companies and seismic contractors have been designing and implementing "turtle guards" - modifications to the tail buoys that minimise the potential for turtle entrapment.

More recently, developments in the design of tail buoys has resulted in tail buoys that do not represent a turtle entrapment threat. An example of these tail buoys is the PartnerPlast 900L, which are designed to skim along the surface with just a single chain extending beneath the surface. The survey vessel to be used for surveys within the proposed OAs shall either be fitted with the abovementioned tail buoys or turtle guards to prevent entrapment.

3.4.2.3.3 Whale Sharks

Although the whale shark's skin is thicker and tougher than any other shark species, the species may be behaviourally vulnerable to boat strike. They spend a significant amount of their time close to the surface of the water (DEH 2005a; Norman 1999) and several sharks bear scars that have probably been caused by boat contact (DEH 2005a). There have been several reports of whale sharks being impaled on the bows of larger ships in other regions (Norman 1999).

DPaW have developed a code of conduct for commercial vessels engaged in whale shark watching to minimise the risk of disturbance to normal whale shark behaviour and boat strike. These measures have been used to develop minimum requirements for vessels within the proposed OA and efforts to maintain a minimum approach distance of 300 m shall be employed.

3.4.2.4 Summary of Environmental Impacts

Potential Environmental Impacts	Environmental Values and Sensitivities Affected	Decision Type
Mortality or injury to marine fauna	Marine Fauna: cetaceans, marine turtles, and whale sharks	A

3.4.2.5 Justification for Implemented Control Measures

No.	Control Measures	Justification
69	Any incidents of vessel or towed array collision with cetaceans, turtles or whale sharks will be reported as per Chapter 3 Section 4.11 to NOPSEMA and the Secretary of the Department of Environment and Energy. Any incidents of vessel or towed array collision with cetaceans will be reported via the online National Ship Strike Database.	• The OPGGS (Env) Regulations detail the requirement to notify NOPSEMA of reportable and recordable incidents. • The EPBC Act requires that notification of death of injury of a listed threatened species be reported to the Secretary of the Department of the Environment within seven days of becoming aware of the action. • The Draft National Strategy for Mitigating Vessel Strike of Marine Mega-fauna, specifically requires fauna strikes to be documented in the National Ship Strike Database. • The Australian Marine Mammal Centre is the first national research centre focused on understanding, protecting and conserving the whales, dolphins, seals and dugongs in the Australian region. To inform marine mammal conservation and policy, the National Marine Mammal Data Portal collects national sightings, strandings and entanglement data.
70	Operations of the vessels will be in accordance Marine Notice 15/2016: Minimising the risk of ships colliding with cetaceans and EPBC Regulations 2000 - Part 8 Division 8.1, such as: • Warn other vessels in the vicinity using all appropriate means of communication, if cetaceans have been sighted. • Travel at less than 6 knots within the caution zone of a cetacean (150 m radius for dolphins, 300 m for whales, whale sharks and turtles). • Do not approach closer than the caution zones for whales, whale sharks, turtles and dolphins. • If whales, whale sharks, turtles or dolphins show signs of disturbance move away at a constant speed less than 6 knots.	• AMSA Marine Notice 15/2016 provides guidance to shipowners, operators and seafarers to reduce the risk of collision with cetaceans in accordance with IMO Circular MEPC.1/Circ.674. While they have no legal standing, Marine Notices provide important safety related information, general guidance or details about legislation changes. PGS will comply with all relevant AMSA Marine Notices. • It is good industry practice is to apply the EPBC Regulations 2000 - Part 8 Division 8.1 Division 8.1— Interacting with cetaceans to other mega fauna species that maybe present in the survey area.

No.	Control Measures	Justification
	• Warn other vessels in the vicinity if whales, whale sharks, turtles or dolphins have been sighted.	
71	The towed seismic array will be fitted with streamer tail buoys that do not represent an entanglement risk to turtles – either tail buoys fitted with turtle exclusion devices or use of tail buoys that do not represent an entanglement risk.	• Some tail buoys (e.g. PartnerPlast 900) are designed without features that have entanglement risks, i.e. without an undercarriage structure or with only a single tow line. Thus, there is no impact from or risk of turtle entanglement. • Other tail buoys may be fitted with turtle exclusion devices (i.e. turtle guards) which are simple to manufacture for a relatively low cost and could be done either on-board a seismic vessel or pre-fabricated and sent to the ship for fitting to tail buoys during survey mobilisation (Ketos Ecology 2009). However, the efficacy of the turtle guards on seismic tail buoys is largely unknown, due to a lack of feedback and reporting from seismic personnel. • PGS will only use tail buoys that do not have an entanglement risk or are fitted with tail guards, and the consequence of turtle entanglement will be Minor. Thus, PGS is confident that these additional control measures are effective in further reducing impacts and risks from vessel collisions and towed array entanglement.
59	Schedule surveys to avoid receptor seasonal timings.	The OA overlaps the migration BIA for humpback whales (1%), pygmy blue whales (6.4%) and whale sharks (10%). Reducing the time when the seismic and support vessels overlap with migration periods will also reduce the risk of impact from collision or entanglement. The benefits of not undertaking seismic surveys within the PBW migration pathway during June and July (peak migration timing) outweigh the costs. However, further timing restrictions would have decreasing benefit for increased cost. As the whale shark migration BIA is the same area as the Pilbara trawl fishery area this means that surveys will be undertaken within the BIA during May, June and July. Though migration can occur in the area during June there will be no seismic activity within the remaining months where migration occurs (Jul to Nov). The Beagle OA overlaps the outer edge of the humpback whale migration path by 0.86% and the northern migration is mid-July to mid-Aug. Surveys will not be undertaken in this area from mid-July.

3.4.2.6 Summary of Environmental Risk Assessment

Residual Risk Assessment				
Potential Environmental Impact		Consequence	Likelihood	Residual Risk
Mortality or serious injury to marine fauna	Cetaceans	Minor	Remote	Low
	Marine turtles		Highly Unlikely	
	Whale sharks		Remote	

3.4.2.7 Demonstration of ALARP

On the basis of the ERA conducted, the use of relevant decision-making tools appropriate to the decision type and the application of the 'Hierarchy of Controls' philosophy (below), the control measures described above are appropriate to manage the risk of collisions between vessel/towed array and marine fauna and to ensure that reasonable and practicable solutions have not been overlooked. Therefore, the residual risk ranking for this potential impact is considered Low, as good industry practice or comparable standards have been applied to control the risk, and any further effort towards risk reduction (e.g. additional, alternative or modified control measures) would not provide further environmental benefit and/or is not reasonably practicable without sacrifices that are grossly disproportionate to the benefit gained. The environmental impacts and risk are thus reduced to ALARP.	
Eliminate	The use of the survey vessel and towed array cannot be eliminated. Elimination of a support vessel would increase the risk of disruption to other maritime users in the area.
Substitute	No substitution of the survey vessel and support vessels for vessels that have a lower likelihood of interaction with marine fauna is possible. Reduction of survey vessel speed during seismic acquisition entails substantial additional cost and would compromise the ability to collect seismic data within correct parameters. The survey would require more time to acquire data, thus introducing additional environmental risk overall. There is no additional benefit to reduce the slow speed of vessel any further.
Engineering	The surveys will implement effective, engineering solutions, such as modified tail buoys (e.g. PartnerPlast 900L) or turtle guards that do not represent an entanglement risk to turtles
Isolation	The OA overlaps the migration BIA for humpback whales (1%), pygmy blue whales (6.4%) and whale sharks (10%). Given the slow operating speed of the survey and support vessels (unless in an emergency) and the low likelihood of large numbers of animals being present based on the exclusion periods, the potential for vessel strike to impact significantly on cetacean or whale shark populations in the proposed OA is assessed to be low. Impacts are further reduced by applying timing restrictions during peak migratory periods such as: No seismic surveys will be undertaken during June and July which is the peak period for the migration of the pygmy blue whale through the operating areas. Whale sharks congregate at Ningaloo Reef from March to July and then migrate along the 200 m isobath mainly between July and November (DoE 2015j). Though migration can occur during July it would be expected that numbers would be low as it is the start of the migration period. There will be no seismic activity within the whale shark migration / foraging BIA from August to November further reducing potential impacts. Though the area of overlap is small no seismic surveys will be undertaken within the area of overlap from mid-July at the start of the northern migration. As the humpback whale migratory BIA overlaps the Pilbara Trawl Fishery seismic surveys will only be undertaken in this area during May, June and July, however, this will be further reduced to mid-July for the portion within the humpback whale migratory BIA.
Administrative	Vessel-marine fauna interaction procedures will be prepared to ensure any interactions between the support vessel and cetaceans, whale sharks and turtles are managed in accordance with Part 8 of the EPBC Regulations 2000, and with guidelines from the Commonwealth Government (DoEE 2017). These procedures will be distributed to the support vessel Masters, and the crew will be made aware of these requirements at induction prior to commencement of surveys within the proposed OA. All personnel will receive appropriate environmental induction and training (Chapter 3), including overview of marine fauna likely to be in the area, spatial boundaries and exclusion zones and procedures for reporting environmental incidents.

3.4.2.8 Demonstration of Acceptability

The potential risk of collision between survey vessels and the towed array and marine fauna is considered 'Broadly Acceptable' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		

Internal Context	Is the proposed management of the impact or risk aligned with the PGS Environment Policy and HSEQ Commitment Statement?	The control measures are consistent with the objectives of the PGS Environment Policy and HSEQ Commitment Statement (Chapter 3):
		• PGS Environment Policy
		  ○ Prevent harm to the environment by reducing risk related to the activity
		  ○ Comply with applicable legal and industry standard requirements associated with the activity
		  ○ Achieve continual improvement in environmental performance.
		• HSEQ Commitment Statement (such as):
		  ○ Increase HSEQ awareness and reduce unsafe behaviour
		  ○ Reduce total risk exposure
		  ○ Prevent incidents
		  ○ Minimise harm to the environment.
		Thus, the control measures are acceptable to achieve PGS's environmental management requirements for this survey.

External Context – Social Acceptability	Have stakeholders raised any concerns about activity's impacts or risks, and if so, are measures in place to address those concerns?	Chapter 1 included all stakeholder consultation, including PGS' assessment of merits and claims as required by Regulation 16(b), including: • AMSA provided advice about updated Marine Notices and the specific sections of the EP that required revisions accordingly, all of which have been incorporated by PGS. • Cape Conservation Group expressed support for slow vessel speeds and requested further clarification regarding additional control measures to reduce vessel collisions. They also shared their concerns regarding entanglements with towed cables and marine fauna. PGS provided a detailed and accurate response to all of the Group's concerns, provided a copy of the full draft EP and met with representative members to have an in-person and in-depth discussion. The Cape Conservation Group did not send additional responses or feedback. • No additional stakeholder concerns have been raised, and no additional input provided. Therefore, it is reasonable to conclude that the impacts and risks are of an acceptable level.
External Context – Natural Environment	Are the control measures providing appropriate protection to the receiving environment (e.g. sensitive or unique environmental features) from potential impacts and risks introduced by the activity?	The OA overlaps the migration BIA for humpback and pygmy blue whales, and whale sharks. The ERA indicated that the collision risk presented by the survey and support vessels to marine fauna is low, largely because of the slow vessel speeds during the activities. Restrictions on surveys during peak migratory periods within the OAs have been implemented as controls further reducing any potential impacts. Marine turtle entanglement is unlikely to occur based on modified tail buoys and/or use of turtle guards. All known control measures have been adopted, and additional or alternative control measures would not provide additional environmental protection or benefit.

The potential risk of collision between survey vessels and the towed array and marine fauna is considered 'Broadly Acceptable' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		
		Thus, the control measures provide appropriate protection to the receiving environment, and potential impacts and risks are of an acceptable level.
Legislation and Conventions	Is the impact or risk being managed in compliance with relevant Australian or international environmental management laws or standards (e.g. EPBC Act and Policy Statements, MARPOL, Navigation Act, etc.)?	Control measures to reduce collisions between vessels/towed array and marine fauna are compliant with relevant legislation (see Justification above), such as: • EPBC Regulations • Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations • AMSA Marine Notices. Furthermore, the control measures are consistent with the following recovery and conservation plans: • The *Draft National Strategy for Mitigating Vessel Strike of Marine Mega-fauna* provides guidance on understanding and reducing the risk of vessel collisions and the impacts they may have on marine megafauna. Although specific mitigation measures were not identified, the Strategy highlights the importance for keeping vessels away from whales, slowing vessel speed and avoidance manoeuvres, all of which are implemented in this EP's control measures. • The *Conservation Management Plan for the Blue Whale* identified vessel collisions as an anthropogenic threat with a High Priority for pygmy blue whales. Thus, control measures to prevent collisions between vessels/towed array and marine fauna are consistent with the conservation actions for the blue whale. • The *Conservation Advice for the Humpback Whale* and the *Humpback Whale Recovery Plan* also identified vessel collisions as a significant threat to the species, and the proposed control measures in this EP are consistent with the Recovery Plan's action to minimise vessel collisions, such as reporting incidents in the National Ship Strike Database. • The *Recovery Plan for Marine Turtles in Australia* identified boat strikes as a high priority threat and entanglement (marine debris) as a high to very high priority threats to their recovery, although not shown to cause stock level declines. However, as the Recovery Plan does not have specific restrictions for seismic survey vessels, PGS will apply the EPBC Regulation for interactions with cetaceans to marine turtles as a precautionary and more conservative approach. Thus, the proposed control measures to reduce collisions with vessels/towed array as well as entanglement with the towed array are consistent with the Recovery Plan's objectives. • *Whale shark management – Wildlife Management Program no. 57* identified vessel collisions as an existing and potential pressure facing whale sharks and restricted the number of vessels allowed to interact with a whale shark, vessel speeds (<8 knots) and time limits for interactions with whale sharks. However, as this does not apply to seismic survey vessels, PGS will apply the EPBC Regulation for interactions with cetaceans to whale sharks as a precautionary and more

The potential risk of collision between survey vessels and the towed array and marine fauna is considered 'Broadly Acceptable' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		
		conservative approach. Furthermore, seismic vessels usually travel at ~4 knots, which is slower than and thus compliant with the recommendations of this plan.
Industry Standards and Best Practice	Is the impact or risk being managed in accordance with industry standards, guidelines and best practice (e.g. APPEA Code of Environmental Practice, IAGC guidelines, etc.)?	Control measures to reduce interactions with other maritime users are in accordance with industry standards and best practice: • IAGC Environmental Manual for Worldwide Geophysical Operations identified the use of tail buoy turtle guards on towed streamers to avoid trapping turtles in the equipment. • APPEA Code of Environmental Practice identified ship-strikes as a potential environmental issue for offshore geophysical surveys and recommended the environmental objective to reduce impacts on cetaceans and other marine life to ALARP and acceptable levels.
Comparison between Predicted and Acceptable Levels	Are the predicted environmental impacts and risks within the defined acceptable levels (above)?	With implemented control measures, the predicted environmental impacts and risks are Low, ALARP and within the acceptable levels defined above (i.e. PGS Environment Policy and HSEQ Commitment Statement, external context, legislation, conventions, and industry standards and best practice). The extent, severity and duration of vessel collisions and towed array entanglement will be short-term and localised.
ESD Principles	Is the impact or risk being managed in accordance to the principles of ESD (as per the EPBC Act)?	The ERA presented in this EP demonstrated compliance with the principles of ESD: • decision-making processes integrated both long-term and short-term economic, environmental, social and equitable considerations (e.g. preventing vessel/towed array collisions with marine fauna). • no threats of serious or irreversible environmental damage were identified with the implemented control measures. • the principle of inter-generational equity is maintained for the benefit of future generations. • the conservation of biological diversity and ecological integrity were fundamental considerations in decision-making and development of control measures. • at the approved control measures considered improved valuation, pricing and/or incentive mechanisms.

3.4.2.9 Summary of Environmental Performance

EPO	EPS	Control Measure No.	Measurement Criteria
Zero incidents of serious injury and/or death to marine fauna caused by vessel strike or entanglement in streamers.	Fauna Strike Reporting Requirements Any incidents of vessel or towed array collision with cetaceans, turtles or whale sharks will be reported as per Section 4.11 to NOPSEMA and the Secretary of the Department of Environment and Energy. Any incidents of vessel or towed array collision with cetaceans will be reported via the online National Ship Strike Database.	69	Incident reports to NOPSEMA and DoEE. National Ship Strike Database records.
	EPBC Regulations 2000 - Part 8 Division 8.1 and Marine Notice 15/2016 Vessels will meet the requirements of Part 8 of the EPBC Regulations and Marine Notice 15/2016 specifically: • Travel at less than 6 knots within the caution zone of a cetacean (150 m radius for dolphins, 300 m for whales, whale sharks and turtles). • Do not approach closer than the caution zones for whales, whale sharks, turtles and dolphins. • If whales, whale sharks, turtles or dolphins shows signs of disturbance move away at a constant speed less than 6 knots. • Warn other vessels in the vicinity if whales, whale sharks, turtles or dolphins have been sighted.	70	MFO Reports
	The towed seismic array will be fitted with streamer tail buoys that do not represent an entanglement risk to turtles or fitted with turtle exclusion devices.	71	Confirmation of appropriate streamer specifications to reduce fauna entanglement in Pre-mobilisation audit.
	The will be no seismic surveys: • Within 9 km of the pygmy blue whale migration BIA during June and July. • Within the whale shark migration BIA from 1 August to 30 November • Within 9 km of the humpback whale migration BIA from 15 July to 31 August.	59	Daily reports MFO records Seismic vessel track records

3.4.3 Hydrocarbon Release Caused by Vessel Collision

3.4.3.1 Description of Risk

The hazards associated with fuel and oil spills during individual surveys within the proposed OA (that are considered most credible) are:

- loss of up to 648 litres of diesel during refuelling operations, because of hose failure; and
- larger volume (up to 1,041 m^3) loss of diesel from a ruptured fuel storage tank, resulting from vessel collision.

3.4.3.2 Potential Environmental Impacts

The accidental discharge of fuel and oil has the potential to cause toxic effects to marine fauna and flora and a localised reduction in water quality. Commercial fishers and shipping may need to avoid the area.

As the amount of diesel that could be spilled through a refuelling accident is less than that involved in a vessel collision, modelling results for a vessel collision only are presented and used to determine the area that may be affected (AMBA).

3.4.3.2.1 Assessment of Likelihood

In an ERA, the likelihood component of the assessment is a function of the event occurring and consequently affecting a sensitive resource (i.e. having an impact). For a hydrocarbon spill, the likelihood is a combination of:

- the probability of a spill occurring, and the volume of that spill at source (primary risk).
- the probability of a spill reaching a sensitive part of the environment (secondary risk).

According to DNV (2011), frequency of spills exceeding 1 MT (metric tonne) (per year) can be broken down into eight different accident types. Of all possible accident types, annual spill frequencies are dominated by transfer (19.9%), drift grounding (21.6%) and powered grounding (19.1%), whilst the spill frequency for vessel collisions is 11.6%. Therefore, transfer spills have a much greater potential to cause large spills than do vessel collisions. Vessel collision spill risk levels from the proposed survey are no different from those presented by any other routine shipping operating in waters off the northwest Australian coastline.

Based on a review of the Australian Transport Safety Bureau's marine safety database there are no recorded instances of collisions, grounding or sinking of a seismic vessel or its support vessels in Australian waters in at least the last 30 years.

http://www.atsb.gov.au/publications/safety-investigation-reports.aspx?Mode=Marine

Although there is commercial fishing and shipping activity in the proposed OAs (Section 2.5.5 and Section 2.4.10), a collision between the survey vessel(s) and another vessel unconnected with the activity is unlikely, given the comprehensive control and mitigation measures in place to manage the risk of vessel collisions. However, a possibility remains of a collision occurring between the survey vessel(s) and the support vessel during occasions when the vessels are manoeuvring close to each other.

There is no possibility of the survey or support vessels grounding within the OAs, given the water depths and lack of emergent features.

3.4.3.2.2 Assessment of Consequence

The realistic worst-case volume of diesel spilled during refuelling operations is 648 litres arising from the total loss of the contents of the transfer hose (e.g. 4" hose of 80 m length) during refuelling. Dry break couplings would prevent any more than the hose volume being spilled in the event of hose failure. A more likely scenario is a pin hole leak or a large hole in the hose (from abrasion or mechanical damage), resulting in a

highly visible sheen on the sea surface enabling action to be taken to stop the leak [by the operation supervisor(s)] before more than a few litres had been spilled.

Most seismic vessels operating in Australian waters use MGO or MDO during routine operations. However, for this risk assessment it has been assumed that the seismic vessel will be using MGO. The vessel(s) to be used for individual surveys has not been determined. Consequently, modelling was done on the largest fuel tank in the PGS fleet with a 98% capacity of 1,041 m^3 for MGO. In the event that HFO fuel is proposed to be used for an individual survey PGS will undertake site specific stochastic oil spill modelling, using HFO fuel at 90% capacity of the vessels largest MGO fuel oil tank adjacent to the hull. MGO tanks will not be filled to a level greater than 91% capacity.

Where HFO is proposed for specific surveys, stochastic modelling will be carried out prior to confirming the use of HFO. The defined buffer distances for at sea re-fuelling and close proximity operations will be re-defined such that there is no likelihood of spills reaching emergent features and / or identified sensitive receptors within the same confidence levels as defined for MGO.

Therefore, in the extremely unlikely (improbable) event of a ruptured fuel tank as a result of collision, the maximum spill size possible would be in the order of ~1,041 m^3 (98% maximum capacity) of MGO. However, this could only occur in the event of a rupture of one of the vessels largest MGO fuel oil tanks adjacent to the hull, and complete loss of all of its contents. This is highly unlikely to occur as a result of a vessel collision or grounding incident, given the location of these tanks in the interior of the double bottom, double skin of the Ramform Titan vessel required for the ice-class hull rating (ICE C). Additionally, the volume of the fuel lost to the marine environment would be expected to be less than the total capacity of the tank due to:

- the fuel oil tanks are never filled to maximum capacity;
- if the tank was holed below the water line, then it would only leak down to a level equivalent to the water line, and
- emergency procedures would be carried out to transfer the contents of the tank to other fuel oil tanks aboard the vessel.

It should be noted that while it is not expected the full volume would be released to the marine environment the tank capacity (i.e. 1,041 m^3 (98% capacity) of MGO) was used as the volume to represent an overly conservative and therefore worst case scenario in the spill risk assessment.

3.4.3.2.3 Diesel characteristics

AMOSC (2011) categorises MGO as a Group II hydrocarbon, which generally is a mixture of volatile and persistent hydrocarbons, with a low percentage of volatile C4 to C10 hydrocarbons (~6%) and a greater proportion of moderate to very low volatile C_{11} to C_{20} hydrocarbons (~89%). In the marine environment, a small residual volume (5%) of the total quantity of MGO spilt may remain after the volatilisation and solubilisation processes associated with weathering. The heavier (low volatile) components of the oil have a tendency to entrain into the upper water column due to wind-generated waves, but can consequently resurface if wind waves abate.

Consequently, diesel is expected to evaporate rapidly, depending on prevailing conditions, with further evaporation slowing over time. A total of 95% of the hydrocarbon is available to evaporate over time. The remaining proportion (<5%) would not evaporate under the environmental conditions in the offshore region and may persist in the marine environment for an extended period, until biodegradation occurs.

Given the high energy and warm water environment that prevails in the proposed OA, diesel is expected to:

- undergo rapid dispersion and evaporation;
- spread rapidly in the direction of prevailing wind and current; and
- evaporate rapidly from the sea surface (under calm conditions this will be the dominant process removing oil from the marine environment).

3.4.3.2.4 Spill Modelling

For proposed surveys within the OAs, two oil spill modelling assessments were completed:

1. indicative modelling was undertaken using the ADIOS2 (Automated Data Inquiry for Oil Spills) modelling software.
2. simple vector model assessment of entrained oil dispersion.

3.4.3.2.4.1 Surface Oil

The ADIOS2 oil weathering model was run for both a summer and winter release scenarios with the application of appropriate sea surface temperature, currents and wind speed and direction for summer and winter (worst case scenario due to slower evaporation) periods sourced from the Integrated Marine Observing System (IMOS) Ocean Portal (www.imos.org.au), Bureau of Meteorology (BOM) and Buoyweather historical data sets (Locarnini *et al.* 2009; BoM 2014; Skewes *et al.* 1999; Tangdong *et al.* 2005).

Distance calculated used the following standard assumption: that a surface slick would move at 3% of wind speed, and 100% of current speed.

The spill scenario assessed: 1,041 m^3 surface discharge of MGO over a six hour period resulting from a vessel collision. Results are shown in

Summer

- ~99% of a slick may disperse and evaporate within ~36 hours of the spill in 6 m/s winds, and current speed of 0.04 m/s.
- A surface slick is calculated to travel a maximum distance of 28 km within 36 hours. Therefore, the ZPI for an oil spill occurring during summer could have a potential radius of 29 km.
- After 12 hours, dispersion is likely to account for ~11 % of the loss, and evaporation ~17 %.
- Both dispersion and evaporation will be enhanced due to the warm prevailing air and sea temperatures within the NWS region.

Winter

- ~99% of the slick will either disperse or evaporate within ~30 hours of the spill in 7 m/s winds and a current speed of 0.07 m/s.
- A surface slick is calculated to travel a maximum distance of 30 km within 30 hours. Therefore, the ZPI for an oil spill occurring during winter could have a potential radius of ~30 km (Figure 3-8).
- During winter, after 12 hours, dispersion is likely to account for ~18 % of the loss, and evaporation ~16 % in mild air and sea conditions.

Table 3-39 - ADIOS2 oil budget table for 1,041 m^3 spill of MGO during summer and winter

Summer				
Hours into Spill	**Released (cu m)**	**Evaporated (%)**	**Dispersed (%)**	**Remaining (%)**
1	174	2	0	98
2	347	3	0	97
4	694	4	1	95
6	1,041	6	2	92
8	1,041	10	4	86
10	1,041	13	7	80
12	1,041	17	11	72
14	1,041	20	17	63
16	1,041	23	23	54
22	1,041	30	42	28
24	1,041	31	50	19
26	1,041	32	55	13
28	1,041	33	58	9
34	1,041	34	63	3
36	1,041	34	65	<1
Winter				
Hours into Spill	**Released (cu m)**	**Evaporated (%)**	**Dispersed (%)**	**Remaining (%)**
1	174	2	0	98
2	347	3	1	97
4	694	4	1	95
6	1,041	6	3	92
8	1,041	9	6	85
10	1,041	12	11	77
12	1,041	16	18	66
14	1,041	19	26	55
16	1,041	21	36	43
22	1,041	26	60	14
24	1,041	27	66	7
26	1,041	27	68	5
28	1,041	28	70	2
30	1,041	28	71	1

Notes: Summer
Oil Name = Diesel Fuel Oil (Southern USA 1994)
API = 37.2°; Pour Point = -7°C
Current: 0.04 m/sec to 090°
Wind Speed = constant at 6 m/sec (23 km/hr) from 270°
Wave Height = computed from wind speed and fetch
Water Temperature = 30°C
Time of Initial Release = January 1, 1200 hours
Total Amount of Oil Released = 1,041 cubic metres

Notes: Winter
Oil Name = Diesel Fuel Oil (Southern USA 1994)
API = 37.2°; Pour Point = -7°C
Current: 0.07 m/sec to 045°
Wind Speed = constant at 7 m/sec (25 km/hr) from 135°
Wave Height = computed from wind speed and fetch
Water Temperature = 26°C
Time of Initial Release = July 1, 1200 hours
Total Amount of Oil Released = 1,041 cubic metres

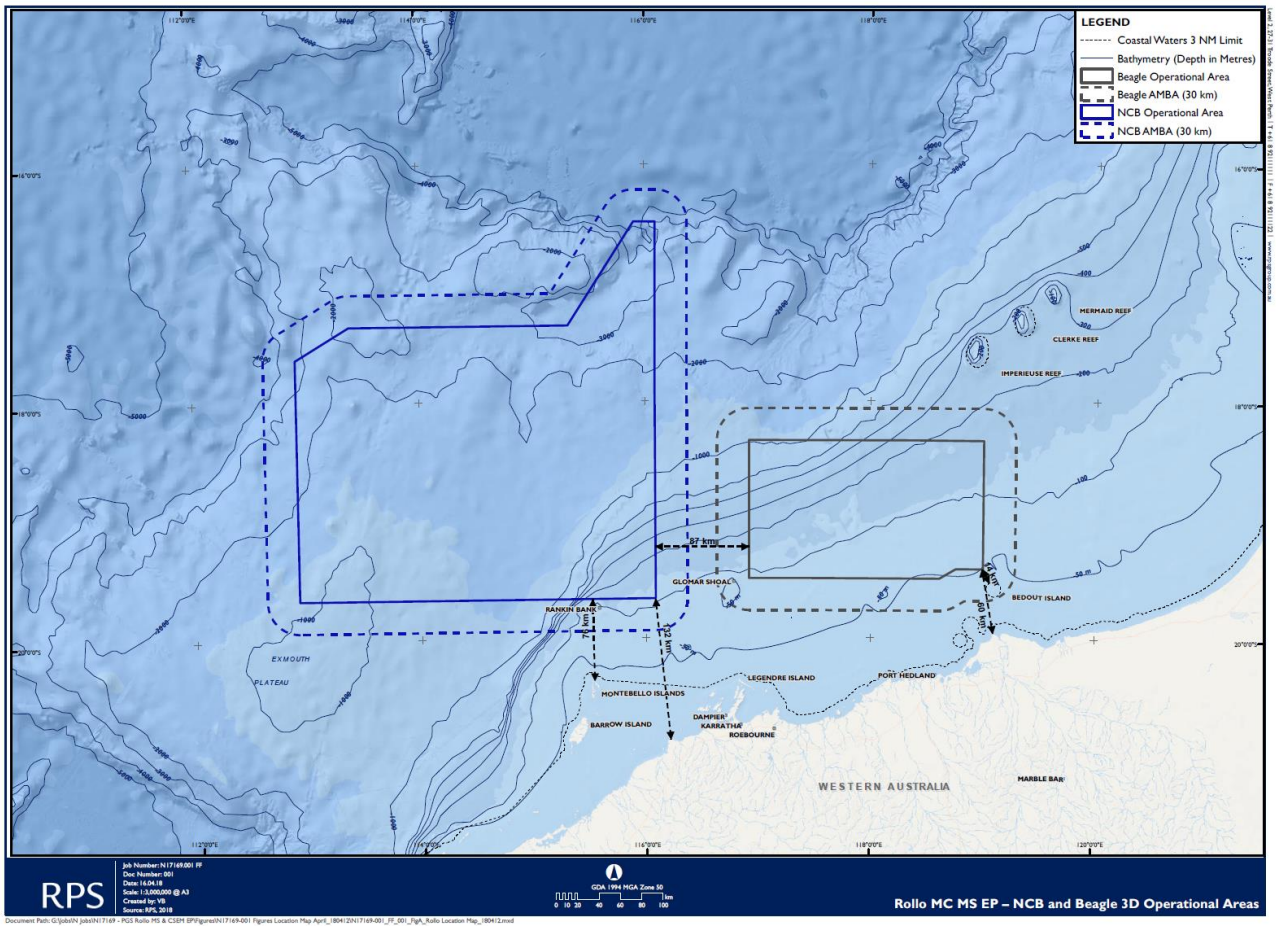


Figure 3-8 - MGO ADIOS2 modelling - hypothetical oil spill in winter for the proposed OA - 30 km AMBA

3.4.3.2.4.2 *Entrained Oil*

Sub-surface exposure to submerged habitats is better represented by estimates for entrained or dissolved hydrocarbons in the water column. The threshold value for species toxicity in the water column is based on global data from French *et al.*, 1999 and French-McCay, 2002, 2003, which showed that species sensitivity (fish and invertebrates) to dissolved aromatics exposure >4 days (96-hour LC50) under different environmental conditions varied from 6 to 400 µg/l (ppb) with an average of 50 ppb. This range covered 95% of aquatic organisms tested, which included species during sensitive life stages (eggs and larvae).

Recently published thresholds for 48 hours of exposure to PAHs oil hydrocarbon concentration in water are 1 ppm lethal and 100 ppb sublethal. For the diesel spill scenario hydrocarbons are predicted to weather within maximum of 36 hrs. Thus, impacts from entrained oil are unlikely to be lethal or sublethal to in water fauna.

Considering that entrained oil has undergone processes analogous to weathering and/or water-washing (i.e., many of the toxic soluble hydrocarbons have been removed through evaporation and/or dissolution), its toxicity is representative of true 'dispersed oil' phase impacts. OSPAR (2012) published predicted no effect concentrations (PNEC) for 'dispersed oil' in produced formation water (PFW) discharges. Dispersed oil in PFW discharges are small, discrete droplets suspended in the discharged water which are very similar to insoluble dispersed oil droplets formed from subsea blowouts. The oil has been partitioned (naturally separated) from gas/oil/water mixture by solubility (water washing) and vapour pressure (evaporation) based on the individual hydrocarbon chemical properties.

Cardno (2017) analysed five years of satellite-derived current data from the Integrated Marine Observing System (IMOS) at twenty, potential spill locations spread across the previous broader Rollo OA (Figure 3-9).

Cardno analysed both the summer (December–February) and winter (June–August) seasons over the five-year period of 2012 to 2016, inclusive. Current speed and direction at each point were analysed. Current roses for both the summer and winter seasons were prepared for each point. This analysis found that there was substantial variation across the potential spill locations as was expected given the large geographical area involved. The mean current speeds were found to be generally in line with the currents speeds applied in the ADIOS2 modelling (above), and so the same current speeds were applied in the simple vector model assessment of entrained oil dispersion.

The results applicable to the NCB and Rollo OAs (Section 3) are presented in Table 3-40 for the winter season which had the greatest AMBA. The AMBA distance for surface oil (30 km) is within the range estimated for 10 ppb entrained oil (26 km).

Table 3-40 - MGO worst case oil spill area may be affected by entrained oil at different thresholds (Cardno 2017)

Section	Season with greatest AMBA	ZPI (km) at >500 ppb	ZPI (km) at >100 ppb	ZPI (km) at >10 ppb
3	Winter	16	23	26

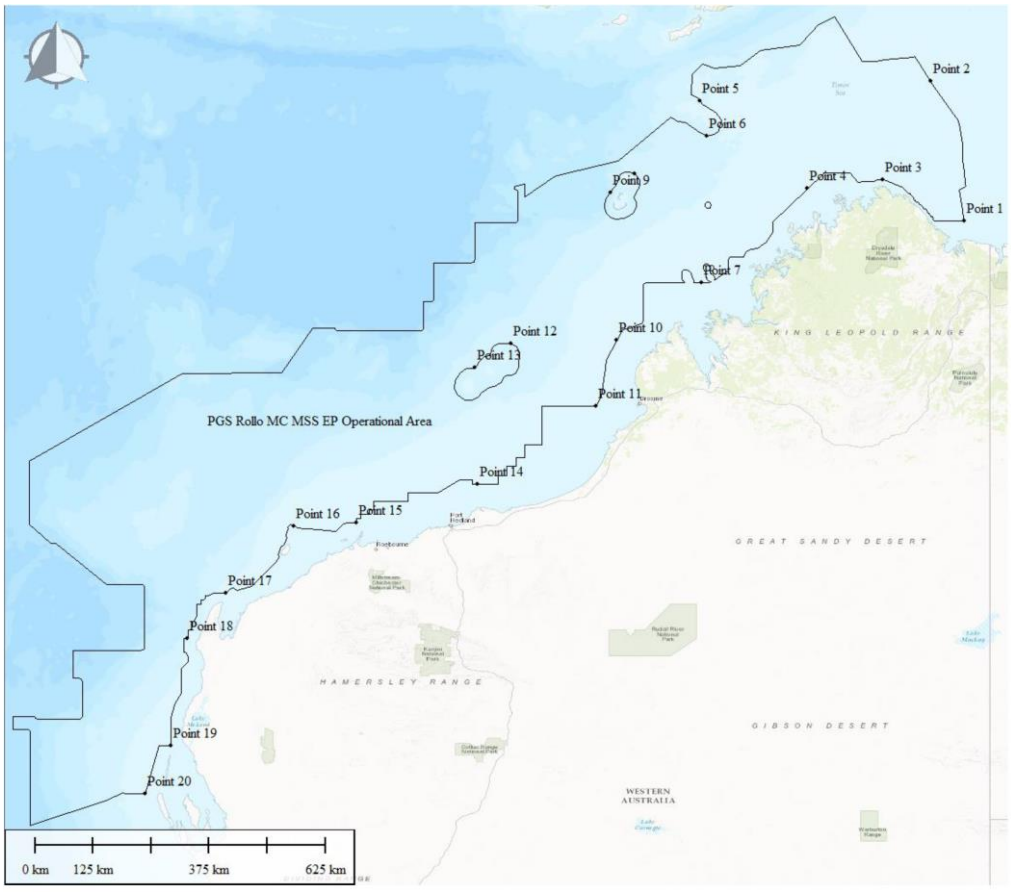


Figure 3-9 – Spill locations assessed for entrained hydrocarbons

3.4.3.3 Receptors

Table 3-41 details the receptors within the 30 km area that maybe affected by a diesel spill.

3.4.3.4 Assessment of Impacts

Shorelines are potentially at risk from surface diesel slicks or entrained hydrocarbons. As diesel is less viscous or sticky when compared to black oils, the diesel tends to penetrate porous sediments quickly but also tends to be washed off quickly by waves and tidal flushing. Diesel oil is readily and completely degraded by naturally occurring microbes in approximately two months (NOAA, 2012). Shorelines exposed to diesel in Norway

resulted in a thickness of 1-10 mm on shore following a diesel spill. Following clean-up, however, no significant difference between contaminated and reference uncontaminated locations were found (SINTEF, 2006).

Entrained hydrocarbons may pose different risks to habitats and fauna compared to a surface slick. MGO contains heavy (low volatile) components of which it is estimated <5% may physically entrain into the water column due to wave and wind action. Due to this dilution of entrained oil in the water column compared to a surface slick, toxic impacts are likely to be less. Entrainment associated with diesel will generally be limited to the top few metres of the water column (depending on conditions). Consequently, benthic environments in deeper waters are not affected.

Table 3-41 provides a summary of the potential impacts of surface slicks and entrained oil receptors identified within the 30 km area that may be affected. Although the amount of entrained oil to be generated is minimal and so its effects negligible, an overview is provided.

Overall, the impact of surface and/or entrained hydrocarbons on receptors is considered Medium; however, the nature of diesel in the marine environment is highly evaporative and dispersive and is not expected to persist for more than 36 hours.

Table 3-41 - Summary of Receptors and Potential Impacts from a Diesel Spill

Receptor	Sensitivities	Potential Impacts	
		Surface Slicks	**Entrained Oil**
Cetaceans	• Humpback whale migration BIA. • Pygmy blue whale migration BIA.	Marine mammals are highly mobile and anecdotal evidence indicates whales and dolphins may be able to detect and avoid surface slicks. Marine mammals that have direct physical contact with surface slicks and entrained oil from surface fouling or through ingestion of hydrocarbons and/or inhalation of toxic vapours. Irritation of sensitive membranes such as the eyes, mouth, digestive and respiratory tracts and organs, impairment of the immune system or neurological damage is likely to occur (Etkins, 1997). Marine mammals are generally able to metabolise and excrete limited amounts of hydrocarbons, but acute or chronic exposure poses greater toxicological risks (Grant and Ross, 2002). Such impacts may include changes in behaviour and reduced activity, including inflammation of the mucous membranes, lung congestion, pneumonia, liver disorders, and neurological damage (Geraci and St. Aubin, 1990).	
		Surfacing within a hydrocarbon slick may lead to a toxic level of exposure. However, cetaceans have a thickened epidermis that greatly reduces the likelihood of hydrocarbon toxicity from skin contact with oiled waters (Geraci, 1990; O'Shea and Aguilar, 2001). For surface oil, inhalation of vapours at the water's surface and ingestion of hydrocarbons during feeding (in particular, surface skimming baleen whales) are more likely pathways of exposure (National Marine Fisheries Service, 2008). <u>Pygmy blue whales</u> Pygmy blue whales that are feeding may be exposed to surface diesel slicks, if the slicks overlap spatially and temporally with feeding activity. <u>Humpback whales</u> Humpback whales migrating north at the start of the northbound season may be exposed to surface diesel slicks. A low number of transient individuals may be present within the area affected by a spill. Humpback and pygmy blue whales are pelagic gulp feeders and therefore are unlikely to ingest large quantities of surface hydrocarbons.	As described for surface oil, acute or chronic exposure, through skin contact, inhalation or ingestion can result in toxicological risks. However, the concentration of entrained hydrocarbons will be less in comparison to surface slicks, due to the effects of dilution with sea water and inability for some hydrocarbon residues to entrain. This behaviour of entrained diesel combined with a thick epidermis layer means cetaceans are unlikely to be affected greatly from skin contact with entrained hydrocarbons. Further, inhalation will not be a significant exposure pathway for entrained oil. However, entrained oil can be ingested during feeding, by gulp feeding whales. <u>Pygmy blue whales</u> Due to the potential for opportunistic feeding during the northbound migration, it is possible that feeding pygmy blue whales could be exposed to entrained oil. <u>Humpback whales</u> It is possible that migrating humpback whales could be exposed to entrained oil. There is no evidence of extensive feeding activity taking place during the migration, although animals could feed on krill swarms if the opportunity arose. Since the humpback and pygmy blue whale are gulp feeders they may be prone to ingestion of entrained oil. However, the amount of entrained oil potential consumed during feeding is likely to be low.

Receptor	Sensitivities	Potential Impacts	
		Surface Slicks	**Entrained Oil**
		Low numbers of humpback and pygmy blue whales may encounter surface slicks and entrained oil. The potential consequences of contact are minor (as assessed above). The potential impacts of surface slicks and entrained oil on these species is considered to be low.	
Turtles	• Flatback, loggerhead, green and hawksbill turtle foraging BIAs. • Flatback internesting buffer.	Marine turtles are vulnerable to the effects of hydrocarbon spills at all life stages (eggs, post hatchlings, juveniles and adults) whilst in the water or onshore (NOAA, 2010a). Contact with hydrocarbons can have lethal or sub-lethal physical or toxic effects or impair mobility. Marine turtles are in frequent contact with the sea surface and they may also feed at or below the water surface or rest at the surface. This frequent contact with the sea surface or oils entrained in the upper surfaces and a lack of avoidance behaviour makes turtles susceptible to coating with spilled hydrocarbons and inhalation of toxic hydrocarbon vapours.	
		The main pathways for hydrocarbon surface slick exposure include ingestion and inhalation of vapours. Turtles are particularly prone to ingestion of surface oil, especially where it forms solid masses such as tar balls. Diesel being a light oil would not have this effect. Marine turtles' diving behaviour also puts them at risk. They rapidly inhale a large volume of air before diving and continually resurface over time, however, prolonged exposure to hydrocarbon vapours is not likely due to the short period that the slick would be present.	Entrained oil presents fewer impacts to turtles. While skin contact with entrained oil may occur, the entrained hydrocarbons will be at lower concentrations, due to dilution with water in the water column, and thus reducing the toxicity. Smaller quantities of hydrocarbons may be ingested, but concentrations, and resulting toxicity, will be less than surface oil. Further, the impacts of inhaling hydrocarbon vapours are not applicable to entrained oil.
		The consequences of marine turtles encountering a surface slick is unlikely to may be severe due to the light nature of diesel and the short duration the slick will be present (max 36 hrs). Impacts to turtle nesting beaches are not predicted. Thus, impacts to turtles are assessed as low.	
Seabirds	• Nesting on Bedout Island. • Brown booby, lesser crested tern, lesser frigatebird, wedge-tailed shearwater and white tailed tropicbird foraging BIA. • Roseate tern breeding area buffer.	Seabirds are particularly vulnerable to surface hydrocarbons. As most fish survive beneath floating slicks, they will continue to attract foraging seabirds, which typically do not exhibit avoidance behaviour. Direct contact with surface hydrocarbons can lead to irritation of skin and eyes. Smothering can lead to reduced water proofing of feathers leading to hypothermia. Smothering of feathers can also lead to excessive preening, diverting time away from other behaviours leading to starvation and dehydration. Preening of oiled feathers will also result in to ingestion of hydrocarbons and the associated impacts of toxicity and potential illness.	Entrained oil does not pose the same high risk of smothering as surface slicks as the effects of smothering on feathers are lower, reducing the amount of hydrocarbons ingested through preening. Seabirds may still encounter entrained hydrocarbons leading to irritation of skin and eyes, and also lower levels via ingestion and the associated toxicity effects.

Receptor	Sensitivities	Potential Impacts	
		Surface Slicks	**Entrained Oil**
		The impacts of surface oil on seabirds can be severe but is unlikely for a diesel spill due to its light nature. The OA overlaps BIA (foraging and breeding area) for a number of seabirds. Therefore, impacts could occur to seabirds of these species foraging in the area of surface slicks.	The effects of entrained oil on seabirds are less severe than those posed by surface slicks. Impacts could occur for those species that plunge feed below the surface where the birds, and the fish they are feeding on, would be exposed to entrained oil.
		Given the overlap of the proposed OA and BIA (foraging) for a number of seabird species, any birds foraging in the area of surface slicks would be exposed to surface oil, and to a lesser extent, entrained oil. Indirect impacts to birds or young from eating fish from within the spill area are unlikely as the short period of time a slick would be present (36 hrs) would not result in toxicity effects to fish. Given the rapid breakdown of the hydrocarbons, impacts to individual birds or at a population level is low.	
Sharks and fish	• Whale shark foraging BIA. • Commercial fish species.	Since fish and sharks do not generally break the sea surface and surface diesel slicks are expected to have dispersed with ~1% remaining within 36 hours, impacts are expected to be minimal. Therefore, significant impacts from surface slicks to shark and fish species are unlikely to occur.	Hydrocarbon droplets can physically affect sharks and fish exposed for an extended duration (weeks to months). Smothering through coating of gills can lead to the lethal and sub-lethal effects of reduced oxygen exchange, and coating of body surfaces may lead to increased incidence of irritation and infection. Fish may also ingest hydrocarbon droplets or contaminated food leading to reduced growth, and hydrocarbon tainting of their flesh, making them unfit for human consumption. There is potential for localised mortality of fish eggs and larva due to reduced water quality and toxicity. Effects will be greatest in the upper 10 m of the water column and areas close to the spill source where hydrocarbon concentrations are likely to be highest.
		Due to the low probability of contact with surface oil, the impact of surface oil on sharks and fish will be negligible.	Although entrained hydrocarbons can have negative impacts on fish and fish eggs/larvae, considering the volume of entrained hydrocarbons potentially encountered, the low persistence of diesel and the large extent of suitable marine habitat, the impact on populations is considered low.
		Due to the short term nature of the diesel slick and low volume of entrained hydrocarbons impacts to whale sharks, commercial fish species and fish eggs/larvae is considered to be low.	
Commercial fisheries	• Pilbara line, trap and trawl. • Mackerel Managed • North West Slope Trawl	Surface hydrocarbons will have negligible impacts on fish (see 'Fish' above) but exclusion zones surrounding a spill can directly impact fisheries by restricting access for fishermen, leading to financial losses. Other impacts can occur via oiling of vessel hulls and trap gear (traps, buoys, lines) if the equipment is deployed or retrieved through surface slicks.	Entrained hydrocarbons can have toxic effects on fish and fish spawning (as outlined in 'Sharks and fish' above) reducing catch rates and rendering fish unsafe for consumption, leading to financial losses. Considering the volume of entrained hydrocarbons potentially encountered and the low persistence

Receptor	Sensitivities	Potential Impacts	
		Surface Slicks	**Entrained Oil**
			of diesel it is unlikely that impacts would result in reduced catch rates and the quality of the fish caught.
		The impact of restricted access for fishermen is considered low as surface diesel slicks would only persist for periods up to 36 hours.	Impacts to fish from entrained oil are unlikely due to the short period of exposure (36 hrs) and low levels of entrained oil. Thus, impacts to catch rates or fish quality is considered low.
	• Pearl oyster broodstock area	There are no pearl oyster harvesting or aquaculture activities in the AMBA for a diesel spill. Impacts to pearl oyster broodstock from entrained oil are unlikely due to effects from entrained will be greatest in the upper 10 m of the water column. Thus, broodstock will not be exposed to oil.	
Shipping	• Commercial shipping routes	Exclusion zones surrounding a spill will reduce access for vessels. Some vessels would have to take large detours leading to potential delays. Based on the modelling, 99% of the slick will either disperse or evaporate within ~36 hours.	Entrained oil will have no impacts on shipping.
		Though there are several shipping routes within the OAs potential impacts to commercial shipping up to 36 hrs and thus low.	The impacts of entrained oil on shipping are negligible.
Scientific Recreation	• Glomar Shoal • Rankin Bank • Bedout Island	Exclusion zones surrounding spills will reduce access for recreational fishing and snorkelling/diving for up to 36 hrs. Stranding of oil on sandy beaches may impact some tourism activities.	Exclusion zones surrounding spills will reduce access for recreational fishing and snorkelling/diving for up to 36 hrs. Impacts to fish are unlikely 'Sharks and fish' above.
		Activities such as diving/snorkelling and recreational fishing occur at Glomar Shoal, Rankin Bank and Bedout Island maybe restricted for up to 36 hrs. However, given the nature and scale of a diesel spill in this area and the limited number of tourists that would be present, the impact would be low.	
Key Ecological Features Submerged features	• Ancient coastline at 125 m depth contour • Continental Slope Demersal Fish Communities • Exmouth Plateau • Glomar Shoal • Rankin Bank	Impacts from diesel to Ancient Coastline (125 m), Glomar Shoal (40m) Exmouth Plateau (> 1000 m), Rankin Bank (20 - 40 m) and Continental Slope Demersal Fish Communities (> 200 m) are not expected due to the water depth in which areas are situated.	
Eighty Mile Beach Commonwealth	• BIAs for dugongs, humpback whales,	The waters off Eighty Mile Beach are important for several species including dugongs, humpback whales, sawfish, turtles and migratory seabirds. The area where a spill may impact the CMP does not contain habitat for sawfish or dugongs. Impacts to humpback whales, turtles and seabirds is assessed as low as detailed in the appropriate sections above. Table 3-42 details the assessment of potential impacts against the values of the marine park.	

Receptor	Sensitivities	Potential Impacts	
		Surface Slicks	Entrained Oil
Marine Park Zone (VI)	sawfish, turtles and migratory seabirds.		
Bedout Island	• State nature reserve. • Seabird foraging and breeding site. • Foraging habitat for flatback, green and hawksbill turtles.	A diesel spill could impact on Bedout Island prior to it weathering. Due to its light nature diesel tends to penetrate porous sediments quickly but also tends to be washed off quickly by waves and tidal flushing. Diesel oil is readily and completely degraded by naturally occurring microbes, under time frames of one to two months NOAA (2018). The waters surrounding Bedout Island are used by foraging turtles but there are no records that nesting occurs on the island. A number of seabirds nest on Bedout Island, however, nests would be above the area of impact for a spill. However, some birds maybe present on the shoreline and could be impacted by diesel on the shoreline. Given that the diesel on the shoreline could take up to 2 months to degrade impact would be medium.	

Table 3-42 - - Eighty Mile Beach Commonwealth Marine Park assessment of impacts against CMP values

	Value	Assessment of Impacts
Statement of significance	The Eighty Mile Beach Marine Park is significant because it contains habitats, species and ecological communities associated with the Northwest Shelf Province and consists of shallow shelf habitats, including terrace, banks and shoals. The Marine Park is adjacent to the Eighty Mile Beach Ramsar site, recognised as one of the most important areas for migratory shorebirds in Australia; and the Western Australian Eighty Mile Beach Marine Park, providing connectivity between offshore and inshore coastal waters of Eighty Mile Beach.	Based on the depth range of <15-70 m and that any diesel spill will evaporative and disperse within 36 hours impacts would be short term and temporary to values of Eighty Mile Beach Marine Park.
Natural values	The Marine Park includes examples of ecosystems representative of the Northwest Shelf Province—a dynamic environment influenced by strong tides, cyclonic storms, long-period swells and internal tides. The bioregion includes diverse benthic and pelagic fish communities, and ancient coastline thought to be an important seafloor feature and migratory pathway for humpback whales. The Marine Park supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. Biologically important areas within the Marine Park include breeding, foraging and resting habitat for seabirds, internesting and nesting habitat for marine turtles, foraging, nursing and pupping habitat for sawfish and a migratory pathway for humpback whales.	Given the overlap of the proposed OA and BIA (foraging) for a number of seabird species, any birds foraging in the area of surface slicks would be exposed to surface oil, and to a lesser extent, entrained oil. Indirect impacts to birds or young from eating fish from within the spill area are unlikely as the short period of time a slick would be present (36 hrs) would not result in toxicity effects to fish. Given the rapid breakdown of the hydrocarbons, impacts to individual birds or at a population level is assessed as low. The consequences of marine turtles encountering a surface slick is unlikely to may be severe due to the light nature of diesel and the short duration the slick will be present (max 36 hrs). Impacts to turtle nesting beaches are not predicted. Thus, impacts to turtles are assessed as low.

		Impacts to foraging, nursing and pupping habitat for sawfish are not predicted. Low numbers of humpback whales may encounter surface slicks and entrained oil. The potential consequences of contact are minor (as assessed above). The potential impacts of surface slicks and entrained oil on these species is assessed as low.
Cultural values	The sea country of the Nyangumarta, Karajarri and Ngarla people extends into Eighty Mile Beach Marine Park. Sea country is culturally significant and important to their identity. Staple foods of living cultural value for the Nyangumarta, Karajarri and Ngarla people 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 nature of diesel in the marine environment is highly evaporative and dispersive and is not expected to persist for more than 36 hours. Impacts to cultural values are not predicted based on the short time period of potential impacts.
Heritage values	No international, Commonwealth or national listings apply to the Marine Park at commencement of this plan. The Marine Park contains three known shipwrecks listed under the Historic Shipwrecks Act 1976: Lorna Doone (wrecked in 1923), Nellie (wrecked in 1908), and Tifera (wrecked in 1923).	No impacts to shipwrecks where identified.
Social and economic values	Tourism, commercial fishing, pearling and recreation are important activities in the Marine Park. These activities contribute to the wellbeing of regional communities and the prosperity of the nation.	The nature of diesel in the marine environment is highly evaporative and dispersive and is not expected to persist for more than 36 hours. Impacts to social and economic values would be es are not predicted based on the short time period of potential impacts.

3.4.3.5 Summary of Environmental Impacts

Potential Environmental Impacts	Environmental Values and Sensitivities Affected	Decision Type
• Toxic effects on marine fauna & communities • Localised and temporary reduction in water quality • Restricted are for other maritime users • Disturbance to key sensitivities of protected areas	• Marine Fauna: cetaceans, turtles, seabirds, sharks and fish • Marine habitats and biological communities • Commercial fisheries • Shipping • Scientific/Recreation • Key ecological feature and submerged features	B

3.4.3.6 Analysis of Additional Control Measures

Additional control measures	Practicable?	Will they be implemented?	Justification
Use of a survey vessel with smaller fuel oil tank sizes	Y	Y	May lead to delay in contracting survey vessel leading to delays in data acquisition. PGS would be unable to meet seismic data delivery requirements of clients. More frequent visits to port for refuelling would be needed, increasing the survey duration and cost and introducing additional risks.
No at-sea bunkering	Y	Y	Returning to port to refuel will increase survey time and associated costs.
Decrease size of the proposed OA to ensure spills do not reach emergent lands	Y	Y	PGS would be unable to deliver data requirements to client. High cost associated with not delivering data when the likelihood of a vessel collision and loss of fuel is extremely unlikely.
Seismic acquisition will only occur outside areas with substantial vessel movements (e.g. recognised shipping routes)	Y	Y	This would create large gaps in survey data coverage. Very substantial additional costs in filling these gaps. Large amounts of infill acquisition required.
Seismic acquisition will only occur during daylight hours	Y	Y	Substantial additional cost - doubling of survey duration. PGS would be unable to meet seismic data delivery requirements of clients.

3.4.3.7 Justification for Implemented Control Measures

No.	Control Measures	Justification
72	Refuelling at sea will be subject to the PGS standard operating procedures, plus the following additional measures:	PGS refuelling at sea procedures will comply with relevant legislation and industry standards and best practice:

No.	Control Measures	Justification
	• refuelling of vessels will be undertaken under favourable wind and sea conditions as determined by the vessel Masters; • refuelling will take place during daylight hours only; • Job Hazard Analysis (JHA) or equivalent in place and reviewed before each fuel transfer; • all valves and flexible transfer hoses checked for integrity prior to use and certified; and • dry break couplings (or similar) in place for all flexible hydrocarbon transfer hoses.	• Under the PSPPS Act Part II, the transfer of oil must be undertaken according to the oil tanker's ship-to-ship operations plan. • Marine Orders are regulations under Australian Commonwealth legislations and apply to Australian and foreign vessels. Marine Order 91 gives effect to MARPOL Annex I, as well as provisions of the PSPPS Act such as requirements for a ship-to-ship operations plan for the transfer of oil to include safety procedures and transfer operations. • IAGC advises that a refuelling procedure is carefully followed, including toolbox meeting and risk reviews to ensure that all precautions were considered, such as: ○ Certified fuel hoses and couplings (dry-break connectors) maintained in good working order ○ a bunkering procedure to ensure safe operations and minimise the risk of spillage ○ Vessel Masters will determine if conditions are suitable • APPEA Code of Environmental Practice recommends that offshore geophysical surveys reduce the impacts from spills and demonstrate that appropriate management procedures were in-place and implemented.
75	Operational Restrictions • No close proximity activities between the survey and support vessel such as bunkering, supply / equipment transfer or crew change, within 30 km of Eighty Mile Beach Marine Park.	Based on the Adios modelling the furthest a spill will travel is 30 km. Eighty Mile Beach Marine Park is 10 km from the OA and surrounds Bedout Island which is 20 km from the OA. PGS will implement additional, pre-cautionary control measures (i.e. operational restrictions) to further reduce potential environmental impacts and risks to Eighty Mile Beach Marine Park and Bedout Island.
78	Response strategy: In accordance with the OPEP, the primary response strategy in the event of a diesel spill to sea from the survey vessel will be to: • Immediate notification to RCC Australia • If spill has potential to impact WA state waters, the DoT will be notified as soon as possible (DoT reporting information www.transport.wa.gov.au/imarine/pollution-emergency-response.asp). • If spill has potential to impact on Eighty Mile Beach Marine Park, the Director of National Parks will be notified as soon as possible. • Allow small diesel spills to disperse and evaporate naturally, and monitor position and trajectory of any surface slicks.	Under the OPGGS(E) Regulations, an EP's implementation strategy must include an OPEP, with adequate arrangements for responding to and monitoring of oil pollution. The OPEP will comprise components of the survey vessel's SOPEP as well as statutory plans by the appropriate Commonwealth and State agencies, such as AMSA and WA DoT. Details of this EP's OPEP are in Chapter 3.

No.	Control Measures	Justification
	• If safe and practicable to do so, the PGS Quality Control Supervisor (PGS QCS) and MFO[13] may be available to monitor and document the progress of the slick, including monitoring of wildlife (wildlife present will be recorded using the DoE Cetacean Sightings Application). • Physical breakup by repeated transits through larger spills as directed by AMSA/DoT. • Should monitoring and evaluation by crew and MFO indicate wildlife are likely to be impacted, the Vessel Master will notify AMSA immediately. The responsibility of assessing the appropriateness of any oiled wildlife response strategy, and its implementation, lies with AMSA as the CA.	
79	In accordance with the OPEP, for individual surveys located near a sensitive area, during the pre-survey planning phase PGS will consult with potential scientific monitoring service providers to ensure they have the appropriate capability to undertake scientific monitoring on their behalf. Prior to survey commencement, PGS will review terms and conditions with these providers to ensure their capability is adequate.	Under the OPGGS(E) Regulations, an EP must contain an Implementation Strategy with an oil spill contingency plan that includes emergency response arrangements. For individual surveys sensitive areas within the spill area that may be affected will be identified during the pre-survey planning phase and PGS will consult with potential scientific monitoring service providers to ensure they have the appropriate capability to undertake scientific monitoring appropriate to the identified sensitivities (Chapter 3). Prior to survey commencement and as a pre-cautionary approach, PGS will review terms and conditions with these providers to ensure their capability is adequate.

80	<u>Spill monitoring:</u>
	• In accordance with the OPEP, in the event of a diesel spill PGS will implement relevant Type I operational monitoring implemented for spill surveillance and tracking.
	• If there is a likelihood of a diesel spill impacting any protected areas (e.g. Eighty Mile Beach Marine Park), and the relevant State agency directs it, PGS will:
	  • Notify DoBCA-PaWs and / or DoEE
	  • implement the appropriate Type II scientific monitoring to understand the effects of the spill and any response activities on the marine environment
		Under the OPGGS(E) Regulations, an EP must contain an Implementation Strategy with an oil spill contingency plan that includes emergency response arrangements. As per AMSA Oil Spill Monitoring Handbook and Background Paper, PGS would be responsible for undertaking Type I Operational Monitoring and Type II Scientific Monitoring (unless AMSA as control agency directs otherwise). Details of the OPEP are in Chapter 3.

81	<u>Stakeholder consultation:</u> • In accordance with the OPEP, pre-survey consultation with AMSA and DoT to ensure agreement in place for SOPEP interface with NATPLAN and WestPlan-MOP.	Under the OPGGS(E) Regulations, an EP must contain an Implementation Strategy with an oil spill contingency plan that includes emergency response arrangements. During pre-survey planning, PGS pre-cautionary

[13] See **Chapter 3** for Roles and Responsibilities.

No.	Control Measures	Justification
	• Consultation in the event of a major diesel spill - relevant stakeholders (apart from Combat Agencies) will be contacted in the event of a large diesel spill occurring during surveys within the proposed OA.	approach will ensure agreement and awareness with appropriate response agencies (Chapter 3): • AMSA is the responsible CA for oil spills from vessels within the Commonwealth jurisdiction and 7 will assume control of the incident (AMSA, 2014). • The WA State DoT is the designated Hazard Management Agency (HMA) for oil spills from vessels within the WA State jurisdiction. In the event of an oil spill, PGS will work with the relevant stakeholders during the initial action and communications (Chapter 3) to develop and implement appropriate Type II Scientific Monitoring to understand the impacts of the spill on the marine environment and any response activities appropriate to the nature and impact of the spill.
82	PGS has financial assurance in place to cover the cost of environmental monitoring or clean-up post spill	Section 571(2) of the OPGGS Act require titleholders to maintain financial assurance sufficient capacity to meet the costs, expenses and liabilities that may result in connection with carrying out the petroleum activity; doing any other thing for the purpose of the petroleum activity; or, complying (or failing to comply) with a requirement under the OPGGS Act in relation to the petroleum activity. Financial assurance must be maintained for the life of the title but need only be accessible when the potential for costs, expenses and liabilities may arise (e.g. accidental hydrocarbon release cause by vessel collision).

3.4.3.8 Summary of Environmental Risk Assessment

Residual Risk Assessment				
Potential Environmental Impact		Consequence	Likelihood	Residual Risk
Toxic effects on marine fauna and biological communities	Cetaceans	Minor	Highly Unlikely	Low
	Marine reptiles	Minor		Low
	Seabirds	Minor		Low
	Sharks and bony fish including eggs/larvae	Slight		Low
Restricted area for other maritime users	Commercial fisheries	Minor	Highly Unlikely	Low
	Shipping	Minor		
	Scientific/Recreation	Minor		Low
	Ancient Coastline at 125 m KEF	Slight	Highly Unlikely	Low

Residual Risk Assessment				
Negative impacts on key sensitivities and values of protected areas (Section 3)	Continental Slope Demersal Fish Communities KEF			
	Exmouth Plateau KEF			
	Glomar Shoal KEF			
	Rankin Bank			
	Eighty Mile Beach CMR	Minor		Low
	Bedout Island	Moderate		Medium

3.4.3.9 Demonstration of ALARP

On the basis of the ERA conducted, the use of relevant decision-making tools appropriate to the decision type and the application of the 'Hierarchy of Controls' philosophy (below), the control measures described above are appropriate to manage the risk of hydrocarbon release caused by a vessel collision and to ensure that reasonable and practicable solutions have not been overlooked. Therefore, the residual risk ranking for this potential impact is considered Low to Medium, as good industry practice or comparable standards have been applied to control the risk, and any further effort towards risk reduction (e.g. additional, alternative or modified control measures) would not provide further environmental benefit and/or is not reasonably practicable without sacrifices that are grossly disproportionate to the benefit gained. The environmental impacts and risk are thus reduced to ALARP.	
Eliminate	The use of survey and support vessels cannot be eliminated. Elimination of a support vessel would increase the risk of additional environmental impacts.
Substitute	The use of a survey vessel to undertake the survey cannot be substituted. Alternative fuels to MGO are Marine Diesel Oil (MDO), Intermediate Fuel Oil (IFO) and Heavy Fuel Oil (HFO), which would result in greater environmental impacts if spilled, due to their more persistent nature.
Engineering	The surveys will implement effective, engineering solutions that help prevent vessel collisions, such as AIS and approved electronic navigation systems and radar on survey vessel.
Isolation	PGS will implement additional control measures to isolate vessel operations from sensitive habitats based on worst-case scenarios of oil spill modelling results. As such, these operations will only occur with a spatial distance from sensitive habitats and as predicted by modelling scenarios throughout the OA.
Administrative	In advance of a survey commencing, PGS will provide updated information of the survey operations to all stakeholders, e.g. AMSA RCC and NTM by AHS (for the issuance of NAVAREA X and AUSCOAST warnings), relevant fisheries, shipping and other petroleum titleholders. PGS will ensure the efficient and timely application of relevant shipboard safety and administrative procedures: • Vessel SOPEPs in accordance with IMO as Resolution MEPC.54(32). • OPEP drill(s), appropriate to the response arrangements and nature and scale of the activity, will be conducted in Australian waters prior to the commencement of the survey and tested at least annually. • Four scheduled SOPEP drills per annum will be undertaken as per the seismic vessel standard operating procedure. • Support vessels will test SOPEP (OPEP) response arrangements prior to the commencement of the survey. • Response arrangements will be tested if they are significantly amended. • All drill tests will be reported as per MARPOL Annex I (Regulation 15) requirements and reviewed as part of the ongoing monitoring and improvement of emergency control measures. • The OPEP will be reviewed annually. All personnel will receive appropriate environmental induction and training (Chapter 3), including emergency response and spill management procedures, reporting procedures for environmental incidents or hazards and roles and environmental responsibilities of key personnel aboard the survey vessel.

3.4.3.10 Demonstration of Acceptability

The potential risk of hydrocarbon release caused by a vessel collision is considered 'Acceptable if ALARP' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		

Internal Context	Is the proposed management of the impact or risk aligned with the PGS Environment Policy and HSEQ Commitment Statement?	The control measures are consistent with the objectives of the PGS Environment Policy and HSEQ Commitment Statement (Chapter 3):
		• PGS Environment Policy
		  ○ Prevent harm to the environment by reducing risk related to the activity
		  ○ Comply with applicable legal and industry standard requirements associated with the activity
		  ○ Achieve continual improvement in environmental performance.
		• HSEQ Commitment Statement (such as):
		  ○ Increase HSEQ awareness and reduce unsafe behaviour
		  ○ Reduce total risk exposure
		  ○ Prevent incidents
		  ○ Minimise harm to the environment and achieve zero spills.
		Thus, the control measures are acceptable to achieve PGS's environmental management requirements for this survey.

External Context – Social Acceptability	Have stakeholders raised any concerns about activity's impacts or risks, and if so, are measures in place to address those concerns?	Chapter 1 included all stakeholder consultation, including PGS' assessment of merits and claims as required by Regulation 16(b), including: • WA Department of Mines and Petroleum (DMP) request for confirmation about environmental impacts to state waters (including zones of potential impact from an oil spill), which were included in the full draft EP provided by PGS. However, the DMP did not require the full EP but rather clarifications about potential impacts via email, which PGS provided. • WA Department of Transport (DoT) requested information around spill risk and mitigation measures as well as confirmation to contact DoT immediately in the event that a spill reach State waters (to which PGS confirmed commitment). No other concerns were raised, and no additional input was provided. Therefore, it is reasonable to conclude that the environmental impacts and risks are acceptable.
External Context – Natural Environment	Are the control measures providing appropriate protection to the receiving environment (e.g. sensitive or unique environmental features) from potential impacts and risks introduced by the activity?	The ERA evaluated the proposed OA overlap of fishing grounds for several commercial fisheries, major routes for shipping traffic, BIAs for protected marine fauna and emergent lands that are important nesting areas and rookeries. The OA was moved further way from sensitive areas (such as Ningaloo coastline, Barrow and Montebello Islands and Dampier Archipelago) to ensure minimum impacts and contact from a hydrocarbon release caused by a vessel collision. Also, based on the worst-case scenarios from site-specific oil spill modelling results, PGS will implement additional, pre-cautionary control measures (i.e. operational restrictions) to further reduce potential environmental impacts and risks to sensitive areas and habitats. Thus, the control

The potential risk of hydrocarbon release caused by a vessel collision is considered 'Acceptable if ALARP' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		
		measures provide appropriate protection to the receiving environment, and potential impacts and risks are of an acceptable level.
Legislation and Conventions	Is the impact or risk being managed in compliance with relevant Australian or international environmental management laws or standards (e.g. EPBC Act and Policy Statements, MARPOL, OPGGS Act, etc.)?	Control measures to reduce impacts from hydrocarbon release caused by a vessel collision are compliant with relevant legislations and conventions (see Justification above), such as: • MARPOL Annex I Regulations for the Prevention of Pollution by Oil • *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* • Marine Order 91 (Marine pollution prevention — oil) 2014 • OPGGS Act • OPGGS Environment Regulations.
Industry Standards and Best Practice	Is the impact or risk being managed in accordance with industry standards, guidelines and best practice (e.g. APPEA Code of Environmental Practice, IAGC guidelines, etc.)?	Control measures to reduce impacts and risks from hydrocarbon release by vessel collisions are in accordance with industry standards and best practice, including: • IAGC Environmental Manual for Worldwide Geophysical Operations recommendations for SOPEPs, mitigation of spills and leaks and incident reporting. • APPEA Code of Environmental Practice recommends geophysical surveys have an environmental objective to reduce impacts from spill events, with evidence of appropriate management procedures and emergency response plan in-place.
Comparison between Predicted and Acceptable Levels	Are the predicted environmental impacts and risks within the defined acceptable levels (above)?	With implemented control measures, the predicted environmental impacts and risks are ALARP and within the acceptable levels defined above (i.e. PGS Environment Policy and HSEQ Commitment Statement, external context, legislation, conventions, and industry standards and best practice). The extent, severity, duration and uncertainty of a hydrocarbon release caused by a vessel collision are of an acceptable level.
ESD Principles	Is the impact or risk being managed in accordance to the principles of ESD (as per the EPBC Act)?	The ERA presented in this EP demonstrated compliance with the principles of ESD: • decision-making processes integrated both long-term and short-term economic, environmental, social and equitable considerations (e.g. reducing impacts from hydrocarbon release caused by a vessel collision). • no threats of serious or irreversible environmental damage were identified. • the principle of inter-generational equity is maintained for the benefit of future generations. • the conservation of biological diversity and ecological integrity were fundamental considerations in decision-making and development of control measures. • cost/benefit evaluation demonstrated that the approved control measures considered improved valuation, pricing and/or incentive mechanisms.

3.4.3.11 Summary of Environmental Performance

EPO	EPS	Control Measure No.	Measurement Criteria
Zero incidents of release of hydrocarbons to the marine environment resulting from vessel collision or fuel transfer spills.	Refuelling at sea will be subject to the PGS standard operating procedures, plus the following additional measures: • refuelling of vessels will be undertaken under favourable wind and sea conditions as determined by the vessel Masters; • refuelling will take place during daylight hours only; • Job Hazard Analysis (JHA) or equivalent in place and reviewed before each fuel transfer; • all valves and flexible transfer hoses checked for integrity prior to use and certified; and • dry break couplings (or similar) in place for all flexible hydrocarbon transfer hoses.	72	• Pre-mobilisation audit • Toolbox/refuelling checklist • Hose certificate • Vessel track log • PGS Incident records • Records of vessel bunkering/close proximity procedures position
	No close proximity activities between the survey and support vessel such as bunkering, supply / equipment transfer or crew change, within 30 km of Eighty Mile Beach Marine Park.	75	
	PGS will ensure compliance with Section 571(2) of the OPGGS Act, which requires titleholders to maintain financial assurance.	82	During pre-mobilisation audit, PGS will confirm financial assurance.
	In accordance with the OPEP, for individual surveys located near a sensitive area, during the pre-survey planning phase PGS will consult with potential scientific monitoring service providers to ensure they have the appropriate capability to undertake scientific monitoring on their behalf. Prior to survey commencement, PGS will review terms and conditions with these providers to ensure their capability is adequate.	79	The pre-mobilisation audit report will contain proof of agreement between PGS and a scientific monitoring service (if required).
Implementation of SOPEP/OPEP for all spills of hydrocarbons to sea.	In the event of a diesel spill to sea from the survey vessel, the primary response strategy will be in accordance with this EP's OPEP and the vessel's SOPEP.	78	If an oil spill event occurred, appropriate procedures would be implemented and documented in: • RCC Notification • SITREP reports • Type I operational monitoring plan and records • Stakeholder consultation records • Type II scientific monitoring plan and records • CSA Database
	In the event of a diesel spill to sea from the survey vessel, PGS will implement relevant Type I operational monitoring implemented for spill surveillance and tracking in accordance with this EP's OPEP and the vessel's SOPEP.	80	

EPO	EPS	Control Measure No.	Measurement Criteria
			• MFO Reports • PGS Incident Reports • NOPSEMA Reports.
	In the event of a diesel spill to sea from the survey vessel, relevant stakeholders (apart from Combat Agencies) will be contacted.	81	If a spill event occurred, stakeholder consultation records will confirm that PGS consulted all relevant persons.

4. IMPLEMENTATION STRATEGY

4.1 RISK ASSESSMENT PROCESS - WHALE SPECIFIC

4.1.1 Dynamic Risk Assessment to Reduce Impacts to Whales

Management measures to ensure that impacts from seismic activities on whales are reduced to ALARP and acceptable levels have been determined for different locations and timings within the operational area, primarily based on sensitive periods for marine fauna. However, there is the possibility that temporal or spatial variations in migrations may occur, and adaptive management measures may be required. As such, if the initiation criteria has been triggered, a dynamic risk assessment must be undertaken to determine if further mitigation is required.

Persons associated with the activity that can supply relevant information and/or decisions must be involved in the risk assessment and at a minimum include:

- PGS Project Manager
- QCS
- MFO

The risk assessment will be undertaken as soon as practicable within 24 hours from the first power-down/shut-down. Prior to the risk assessment, the team above must gather all information required to assess the current situation and to determine any further control measures that may be required. This information may include but is not limited to:

- whale sighting data;
- survey sail plans;
- maps of possible alternate locations;
- client requirements;
- relevant stakeholder information (e.g. fishing pot locations);
- details on other fauna migration/sensitive locations within the operational area (e.g. Recovery Plans, DoE Conservation Advice, BIA maps, scientific reports/publications, etc.);
- Environment Plan; and
- NOPTA SPA information.

Potential management measures to consider include but are not limited to:

- EPBC-B - increased observations periods and shut-down zones;
- extra MFO on-board;
- change sail line;
- move location;
- cease activities/end survey; and
- remain in/hold current position and wait

Decisions made for survey activities must be examined on a case-by-case basis, as each risk assessment will vary significantly based on operational aspects and sources of risk to the decision-making process. Priority actions will ensure that potential impacts to whales are reduced to ALARP and acceptable levels. Final decisions from the dynamic risk assessment will be implemented immediately and documented and retained by PGS through their Management of Change Process. The assessment decision shall be documented in the Annual Report to NOPSEMA. Decisions will be made known to all relevant personnel including stakeholders.

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ROLLO MULTICLIENT
MARINE SEISMIC SURVEYS
ENVIRONMENT PLAN SUMMARY

Chapter 3
Common Seismic Acquisition Environmental Standards

PGS Australia Pty Ltd
October 2018

LIST OF FIGURES

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1. INTRODUCTION

The geophysical company PGS Australia Pty Ltd (PGS) proposes to acquire multi-client (MC) three-dimensional marine seismic surveys (MC3D MSS) within two operational areas (OAs), North Carnarvon Basin (NCB) and Beagle, in the North-west Marine Region (NWMR) offshore from Western Australia.

This Environment Plan (EP) for activities within the proposed OAs has the objective of covering multi-client 3D seismic surveys over specific petroleum titles and adjacent vacant acreage over a period of five years, from the date of acceptance of the EP. The actual timing of individual surveys is not yet defined and will be acquired dependent on client requirements, vessel availability and environmental considerations.

1.1 DOCUMENTATION

Chapter 1 – details stakeholder submissions, meeting summaries, assessments of merit and ongoing consultation requirements. Stakeholder input was considered in developing additional Performance Outcomes, Standards and Measurement Criteria detailed in Chapters 2 and 3.

Chapter 2 (this document) – comprises a review of the Bioregion within which the proposed OAs are located, the North-west Marine Region (NWMR; as defined by the Commonwealth). The outcome of the Bioregion risk evaluation resulted in various temporal and/or spatial exclusion zones being implemented. This Chapter assesses the known potential impacts or risks to stakeholders' activities or interests from the activity. No direct stakeholder feedback / submissions received regarding the Rollo EP are incorporated into this Chapter.

Chapter 3 – deals with many elements that are relatively constant by nature, such as titleholder information, legislative requirements, assessment process, the nature and management of the operating vessels, environmental risk evaluation (including methodology), and implementation strategy.

PGS is confident that the structure defined above will, over time, allow stakeholders to become more familiar with Chapters 2 and 3, and as such not require constant review in their entirety, but rather reviewed as required when considering details contained within the project specific Chapter 1. Revisions or amendments to Chapters 2 and 3 because of the stakeholder engagement process will be highlighted so that the entire contents need not be re-read. The revised version of the Rollo EP will then be submitted to NOPSEMA for acceptance under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS [E] Regs; as amended January 2015).

Both the interim versions of the Environment Plan and the versions submitted to NOPSEMA will be posted on a specific website designed for that purpose. Details of how to access the three chapters of the EP will be contained within the initial stakeholder letters. For stakeholder confidentiality purposes, no direct stakeholder correspondence will be disclosed on the EP website. However, summaries of key points raised will be posted in the interest of transparency, so each individual respondent can verify that respective submissions were accurately captured.

The EP is a large and complex document and may contain errors. Where such errors are noted, and the intent is clear to a reasonable person given the context and general discussion contained within the EP, they shall be amended under Management of Change (MoC) procedures in such a manner that the intended outcome is attained.

1.2 PURPOSE

This EP has been prepared as part of the requirements under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Environment Regulations), as amended December 2011, which are administered by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). It comprises a description of the environmental effects and risks and proposed mitigation measures, as well as details of stakeholder consultation. The EP must be accepted by NOPSEMA prior to any activities being undertaken. A summary of the EP will be made publicly available after acceptance of the EP by NOPSEMA. This will be available for download at:

http://www.nopsema.gov.au/environmental-management/environment-plans/environment-plan-summaries/

The overall purpose of this EP is not only to comply with statutory requirements but also to ensure that seismic acquisition is planned and conducted in line with PGS environmental policies and standards, including the corporate Health, Safety, Environment (HSE) Management System and Environment Policy (Section 1.3.2). It is also intended to serve as a practical environmental management tool that can be used throughout all proposed seismic surveys by the vessel operator to implement targeted environmental control measures.

The objective of this EP is to ensure that potential adverse environmental impacts and risks associated with the proposed activities, during both routine and non-routine operations, are continuously reduced to as low as reasonably practicable (ALARP) and that the environmental performance outcomes (EPO) and environmental performance standards (EPS) included in this EP are met. To facilitate this objective, a comprehensive Environmental Risk Assessment (ERA) has been undertaken to determine those activities and environmental aspects that pose an elevated risk of environmental impact. The outcomes from the ERA form the foundation upon which relevant preventative and mitigation measures can be identified and implemented to ensure that adverse environmental impacts and risks are avoided or minimised.

The proposed activities will be 3D marine seismic surveys like most others conducted in Australian marine waters (in terms of technical methods and procedures). No unique or unusual equipment or operations are proposed. The survey will be conducted using purpose-built seismic survey vessel(s).

1.3 PROPONENT

1.3.1 Description of Titleholder and Liaison Person

PGS offers a broad range of products to assist oil companies to find oil and gas reserves offshore worldwide, including seismic and electromagnetic data acquisition, processing, reservoir analysis/interpretation and multi-client library data. PGS was founded in Norway in 1991, with two seismic vessels. PGS now has:

- seven (7) active offshore seismic vessels.
- 26 offices worldwide, employing 70 nationalities.

PGS has a presence in over 25 countries with regional centres in London, Houston and Kuala Lumpur. The company headquarters are in Oslo, Norway and PGS is listed on the Oslo stock exchange.

1.3.2 Corporate Environmental Policy

PGS is committed to protecting the environment and consequently has a corporate HSE&Q Commitment Statement and an Environment Policy (Appendix 3B) that provide public statements of the company commitment to protecting the environment during offshore operations.

PGS is committed to:

- Preventing harm to the environment by reducing risk related to our activities.
- Complying with applicable legal and industry standard requirements associated with our activities.
- Achieving continual improvement in environmental performance.

1.3.2.1 Details of Titleholder and Liaison Person

As required under Regulation 15, details for PGS as the Titleholder and nominated liaison person are as follows:

Name:	Rick Irving
Business Address:	Level 4, IBM Building 1060 Hay Street West Perth WA, 6005, Australia
Telephone:	+61 8 9320 9000
Fax:	+61 8 9320 9010
Email address:	rick.irving@pgs.com
ACN/ABN:	077 150 415/46 077 150 415

The Regulator will be notified according to the requirements of Regulation 15(3), of changes to the titleholder or nominated liaison.

PGS will submit in writing to the Regulator, within 30 days of the change, information regarding a change in:

- the titleholder
- the titleholder's nominated liaison person
- contact details for the titleholder
- contact details for the liaison person

As per Regulation 17(7) - if a change in titleholder will result in a change in the manner in which the environmental impacts and risks of an activity are managed, the new titleholder must submit a proposed revision of the environment plan as soon as practicable (Section 3.9).

1.4 ENVIRONMENTAL LEGISLATION

All activities conducted within the proposed OAs will comply with legislative requirements established under relevant Commonwealth legislation, and in line with applicable best practice guidelines and management procedures (Appendix 3A and Appendix 3B).

The Commonwealth *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act) controls petroleum exploration and production activities beyond three nautical miles to the outer extent of the Australian Exclusive Economic Zone (EEZ) at 200 nautical miles. The National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) is responsible for administering the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Environment Regulations).

1.5 ASSESSMENT PROCESS

1.5.1 Assessment Under OPGGS Act

The Environment Regulations apply to petroleum exploration and production activities in Commonwealth waters. The regulations are intended to ensure that petroleum activities are consistent with the principles of ecologically sustainable development (ESD), and in accordance with an accepted EP that has appropriate environmental performance outcomes and standards, as well as measurement criteria for determining whether the outcomes and standards are met.

PGS has prepared and submitted this EP to NOPSEMA, for acceptance before commencement of the activities described in this EP.

1.5.2 Assessment Under EPBC Act

The EPBC Act is administered by the Commonwealth Department of Environment and Energy (DoEE) and protects matters of national environmental significance (NES) in relation to Commonwealth actions and actions on (or impacting upon) Commonwealth land or waters.

NOPSEMA is the sole regulator of environmental approvals for offshore petroleum activities in Commonwealth waters. Therefore, the EPBC referral process is not applicable to this project and NOPSEMA has the role to assess whether matters of NES are potentially being impacted upon.

Under streamlining arrangements NOPSEMA requires submissions to demonstrate that environmental impacts and risks from an activity will be of an acceptable level. Recent amendments to the Environment Regulations because of streamlining have made it explicit that submissions must consider the relevant values and sensitivities of matters protected as well as all other values and sensitivities that exist in the environment.

If there is no plan of management for a Commonwealth reserve, then NOPSEMA will ensure that acceptance of an EP is not inconsistent with the International Union for Conservation of Nature (IUCN) reserve management principles.

If there is no plan of management for a Commonwealth Heritage place, then NOPSEMA will take all reasonable steps to ensure that any accepted EP that refers to the place is not inconsistent with the Commonwealth Heritage management principles.

PGS shall have regard to all matters pertaining to the above by ensuring that activities are managed to an ALARP and acceptable level through a robust evaluation process and the implementation of identified control measures and mitigations as identified in this EP. PGS will consider relevant values and sensitivities of matters protected under the EPBC Act (as outlined in sub-regulation 13(3).

2. ENVIRONMENTAL RISK ASSESSMENT

An Environmental Risk Assessment (ERA) has been undertaken to understand and manage the environmental impacts and risks associated for the activities within the NCB and Beagle OAs. See Appendix 3C of this document for the ERA methodology that was applied for the NCB and Beagle OAs. This ERA is designed to provide:

- details of the environmental impacts and risks associated with survey activities;
- an evaluation of all the impacts and risks, appropriate to the nature and scale of each impact or risk;
- details of the control measures that will be used to reduce the impacts and risks of the activity to ALARP and to an acceptable level;

The Chapter 2 ERA includes an assessment of activities associated with 3D MSS surveys within the NCB and OAs. Chapter 2 that are variable i.e. location and timing of individual surveys.

1. Interactions with other mariners.
2. Seismic acoustic emissions.
3. Noise emissions (non-seismic).
4. Vessel light emissions.
5. Physical presence of support vessel, survey vessel and towed array.
6. Non-routine/ accidental hydrocarbon release.

The Chapter 3 ERA (this document) includes an assessment of five aspects associated with 3D MSS surveys within the NCB and Beagle OAs that are relatively constant by nature and relate to the management of the operating vessels.

1. Routine atmospheric emissions.
2. Routine discharges.
3. Physical presence of support vessel, survey vessel and towed array.
4. Waste management.
5. Non-routine/ accidental hydrocarbon release.

The following Sections outline the results of the ERA for Chapter 3 (this document) only.

2.1 PERFORMANCE OUTCOMES, STANDARDS AND MEASUREMENT CRITERIA

Regulation 13(7) of the Environment Regulations requires that an EP include Environmental Performance Outcomes (EPO), Environmental Performance Standards (EPS) and Measurement Criteria (MC) that address legislative and other controls to manage the environmental impacts and risks of the activity.

EPO and EPS for surveys conducted within the NCB and Beagle OAs have been identified for the environmental impacts and risks assessed via the detailed risk evaluation process. These EPS set the standards against which PGS will measure environmental performance and implementation of the control measures identified in this EP. For each EPS, appropriate MC for determining whether the EPO have been met have been identified.

The EPO, EPS and MC specified are consistent with legislative requirements and PGS policies, standards and procedures. They have been developed based on the decision tools outlined in Appendix 3C, as part of the ALARP demonstration process.

A breach of an EPO or EPS constitutes a 'Recordable Incident' under the Environment Regulations.

2.2 PLANNED ACTIVITIES (ROUTINE AND NON-ROUTINE)

2.2.1 Reduced Air Quality from Atmospheric Emissions

2.2.1.1 Description of Risk

Atmospheric emissions from the proposed survey include greenhouse gas (GHG), NOx (nitrogen oxide), SOx (sulphur oxide), CO (carbon monoxide) and particulate matter (dark smoke) emissions from:

- Use of survey and support vessel main engines for propulsion.
- Use of survey and support vessel main and emergency power generation equipment.
- Use of aviation fuel for transport of personnel via helicopters.
- Use of marine diesel by the survey vessel(s) workboat.
- Incineration of oily sludges aboard the survey vessel(s).

2.2.1.2 Potential Impacts

Potential environmental effects from these atmospheric emissions are a contribution to GHG emissions (albeit very minor) that may potentially influence climate change, and a localised reduction in air quality. Atmospheric emissions generated during the survey will result in a localised, temporary reduction in air quality. Incineration of oily sludges is not expected to generate any significant atmospheric emissions, due to the infrequent nature of the activity and the small volumes of material being burnt during each disposal episode.

2.2.1.3 Summary of Environmental Impacts

Potential Environmental Impacts	Environmental Values and Sensitivities Affected	Decision Type
• Localised reduction in air quality • Release of greenhouse gas (GHG) emissions	Atmospheric environment	A

2.2.1.4 Justification for Implemented Control Measures

No.	Control Measures	Justification
1	Survey vessels will comply with MARPOL 73/78 Annex VI specifically: • Sulphur content of fuel oil not to exceed 3.5% thus reducing quantities of sulphur oxides produced. • Vessels with gross tonnage > 400 t have International Air Pollution Certificate (IAPP). If survey vessels use an incinerator it will comply with MARPOL 73/78 Annex VI, Chapter III Regulation 16 and Appendix IV specifically: • The incinerator has an IMO certificate. • Personnel responsible for operation of the incinerator are trained.	• MARPOL is the main international convention covering the protection of pollution of the marine environment by ships from operational or accidental causes. Annex VI Prevention of Air Pollution from Ships sets limits and prohibitions on atmospheric emissions from ship exhausts. • The PSPPS Act Part IIID and the *Maritime Legislation Amendment (Prevention of Air Pollution from Ships) Act 2007* implements MARPOL Annex VI regulations and offences for a ship's atmospheric emissions and fuel oil content. • Marine Orders are regulations under Australian Commonwealth legislations and apply to Australian and foreign vessels. AMSA Marine Order 97 gives effect to MARPOL Annex VI, as well as provisions of the PSPPS Act, such as the requirements to reduce vessel air emissions and pollution. • IAGC Environmental Manual for Worldwide Geophysical Operations, such as: ○ boat engine fuel mixes to be adjusted to maximise clean burning and reduce emissions ○ regular service of exhaust systems to ensure that noise and emissions are kept to appropriate levels (no unburned fuels and exhaust gases to create localised pollution) ○ require low-sulphur MGO. • As implemented by IMO MARPOL Annex VI and the PSPPS Act, PGS will adhere to MARPOL's 2014 Standard Specification for Shipboard Incinerators requirements for vessel combustion equipment and incinerators. • Thus, PGS is confident that these control measures will be effective to reduce impacts and risks from atmospheric emissions.
2	Combustion equipment (generators and engines) maintained in accordance with planned maintenance system (PMS) that aligns with manufacturers' specifications.	• Combustion equipment maintained as per manufacturers' specifications would operate efficiently thus reducing emission to ALARP. • Thus, PGS is confident that this control measure will be effective to reduce impacts and risks from atmospheric emissions.

3	Survey vessel(s) will implement a Ship Energy Efficiency Management Plan (SEEMP) for the survey vessel and undertake quarterly reviews of the SEEMP and energy performance (for vessels > 400 GT).	• As implemented by MARPOL and the PSPPS Act, Annex VI Regulations required ships to keep on-board a SEEMP, which establishes a mechanism for operators to improve efficiency of ships. • Marine Notice 11/2015 Measures to Reduce Greenhouse Gas Emissions from International Shipping provides guidance on technical and operational measures to reduce greenhouse gas emissions from ships, including the requirements for a SEEMP. While they have no legal standing, Marine Notices provide important safety related information, general guidance or details about legislation changes. • As such, PGS will uphold all relevant laws and requirements.

2.2.1.5 Summary of Environmental Risk Assessment

Residual Risk Assessment			
Potential Environmental Impact	**Consequence**	**Likelihood**	**Residual Risk**
Localised reduction in air quality	Slight	Highly Unlikely	Low
Release of GHG emissions			

2.2.1.6 Demonstration of ALARP

On the basis of the ERA conducted, the use of relevant decision-making tools appropriate to the decision type and the application of the 'Hierarchy of Controls' philosophy (below), the control measures described above are appropriate to manage the risk of reduced air quality from atmospheric emissions and to ensure that reasonable and practicable solutions have not been overlooked. Therefore, the residual risk ranking for this potential impact is considered Low, as good industry practice or comparable standards have been applied to control the risk, and any further effort towards risk reduction (e.g. additional, alternative or modified control measures) would not provide further environmental benefit and/or is not reasonably practicable without sacrifices that are grossly disproportionate to the benefit gained. The environmental impacts and risk are thus reduced to ALARP.	
Eliminate	Fuel use cannot be eliminated and is required to power the survey and support vessel engines, mobile plant, power generation equipment and helicopters.
Substitute	The survey and support vessels will use Marine Gas Oil (MGO) rather than IFO or HFO. MGO can cost twice as much as IFO or HFO but has a lower sulphur content. Alternative fuel sources (e.g. solar, wind, biofuels, etc.) have not been commercially-proven for use in large vessels. Where HFO is proposed for specific surveys, stochastic modelling will be carried out prior to confirming the use of HFO.
Engineering	The surveys will implement effective, engineering solutions, including: • low sulphur diesel fuel • vessel combustion equipment (including incinerators) that is compliant with MARPOL 73/78 Annex VI requirement • adjustable, load-limiting device to limit the load on the propulsion motors.
Isolation	From an engineering perspective, isolation options are not relevant to reduce the environmental impacts or risks.

Administrative	Before a survey commences, PGS will ensure that the survey and support vessels comply with MARPOL 73/78 Annex VI (e.g. IAPP and SEEMP). All personnel will receive appropriate environmental induction and training (Section 3.3), including the relevant PGS shipboard safety procedures and environmental management measures.

2.2.1.7 Demonstration of Acceptability

The potential impacts from interactions with other mariners are considered 'Acceptable' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		

Internal Context	Is the proposed management of the impact or risk aligned with the PGS Environment Policy and HSEQ Commitment Statement?	The control measures are consistent with the objectives of the PGS Environment Policy and HSEQ Commitment Statement (Appendix 3B):
		• PGS Environment Policy
		  ○ Prevent harm to the environment by reducing risk related to the activity
		  ○ Comply with applicable legal and industry standard requirements associated with the activity
		  ○ Achieve continual improvement in environmental performance.
		• HSEQ Commitment Statement (such as):
		  ○ Increase HSEQ awareness and reduce unsafe behaviour
		  ○ Reduce total risk exposure
		  ○ Prevent incidents
		  ○ Minimise harm to the environment.
		Thus, the control measures are acceptable to achieve PGS's environmental management requirements for this survey.

External Context – Social Acceptability	Have stakeholders raised any concerns about activity's impacts or risks, and if so, are measures in place to address those concerns?	Chapter 1 included all stakeholder consultation, including PGS' assessment of merits and claims as required by Regulation 16(b), and stakeholders did not raise any concerns or issues regarding atmospheric emissions.
External Context – Natural Environment	Are the control measures providing appropriate protection to the receiving environment (e.g. sensitive or unique environmental features) from potential impacts and risks introduced by the activity?	As the NCB and Beagle OAs are located in an offshore environment, the ERA concluded that offshore winds will assist in the dispersion and diffusion of atmospheric emissions and that no sensitive receptors (e.g. populated areas) will be impacted by reduced air quality from atmospheric emissions. Any impacts or risks from atmospheric emissions will be localised and short-term. All known control measures have been adopted, and additional or alternative control measures would not provide additional environmental protection or benefit. Therefore, the control measures provide appropriate protection to the receiving environment, and potential impacts and risks are of an acceptable level.
Legislation and Conventions	Is the impact or risk being managed in compliance with relevant Australian or international environmental	Control measures to reduce impacts of reduced air quality from atmospheric emissions are compliant with relevant Australian legislation and international conventions (see Justification above), such as: • MARPOL 73/78 Annex VI Prevention of Air Pollution by Ships

	management laws or standards (e.g. EPBC Act and Policy Statements, MARPOL, OPGGS Act, etc.)?	• *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Part IIID Prevention of Air Pollution) • *Maritime Legislation Amendment (Prevention of Air Pollution from Ships) Act 2007* • AMSA Marine Orders - Part 97: Marine pollution prevention - air pollution • Marine Notice 11/2015 Measures to Reduce Greenhouse Gas Emissions from International Shipping.

Industry Standards and Best Practice	Is the impact or risk being managed in accordance with industry standards, guidelines and best practice (e.g. APPEA Code of Environmental Practice, IAGC guidelines, etc.)?	Control measures to reduce impacts of reduced air quality from atmospheric emissions are in accordance with industry standards and best practice, including:
		• IAGC Environmental Manual for Worldwide Geophysical Operations, such as:
		  ○ boat engine fuel mixes to be adjusted to maximise clean burning and reduce emissions
		  ○ regular service of exhaust systems to ensure that noise and emissions are kept to appropriate levels (no unburned fuels and exhaust gases to create localised pollution)
		  ○ require low-sulphur MGO.
		• APPEA Code of Environmental Practice recommends that geophysical surveys have an environmental objective to reduce greenhouse gas emissions to ALARP and acceptable levels, with evidence of a structured assessment of greenhouse emission reduction.

Comparison Between Predicted and Acceptable Levels	Are the predicted environmental impacts and risks within the defined acceptable levels (above)?	With implemented control measures, the predicted environmental impacts and risks are Low, ALARP and within the acceptable levels defined above (i.e. PGS Environment Policy and HSEQ Commitment Statement, external context, legislation, conventions, and industry standards and best practice). The extent, severity and duration of atmospheric emissions will be short-term and localised.
ESD Principles	Is the impact or risk being managed in accordance to the principles of ESD (as per the EPBC Act)?	The ERA presented in this EP demonstrated compliance with the principles of ESD: • decision-making processes integrated both long-term and short-term economic, environmental, social and equitable considerations (e.g. reducing impacts from reduced air quality caused by atmospheric emissions). • no threats of serious or irreversible environmental damage were identified. • the principle of inter-generational equity is maintained for the benefit of future generations. • the conservation of biological diversity and ecological integrity were fundamental considerations in decision-making and development of control measures. • the approved control measures considered improved valuation, pricing and/or incentive mechanisms.

2.2.1.8 Summary of Environmental Performance

EPO	EPS	Control Measure No.	Measurement Criteria
Atmospheric emissions are limited to those necessary for operation to minimise contribution to GHG effect.	Survey vessels will comply with MARPOL 73/78 Annex VI specifically: • Sulphur content of fuel oil not to exceed 3.5%. • Vessels with gross tonnage > 400 t have International Air Pollution Certificate (IAPP).	1	• Valid IAPP Certificate on-board • Fuel specification data confirm Sulphur content of fuel oil not to exceed 3.5% • Daily report includes daily fuel consumption
	If survey vessels use an incinerator it will comply with MARPOL 73/78 Annex VI, Chapter III Regulation 16 and Appendix IV specifically: • The incinerator has an IMO certificate. • Personnel responsible for operation of the incinerator are trained.	1	• Incinerator has an IMO certificate • Training records for incinerator operators
	Combustion equipment (generators and engines) maintained in accordance with planned maintenance system (PMS) that aligns with manufacturers' specifications.	2	• PMS records
	Survey vessel(s) > 400 GT will implement a Ship Energy Efficiency Management Plan (SEEMP) and undertake quarterly reviews of the SEEMP and energy performance.	3	• Quarterly review of SEEMP with relevant regulations

2.2.2 Ballast Water Discharge, and Biofouling of Vessel Hull, Other Niches and Immersible Equipment

2.2.2.1 Description of Risk

Invasive Marine Species (IMS) are marine plants or animals that have been introduced into a region beyond their natural range and can survive, reproduce and establish founder populations.

Species of concern vary from one region to another depending on various environmental factors such as water temperature, salinity, nutrient levels and habitat type. These factors dictate their survival and invasive capabilities. IMS have been introduced and translocated around Australia by a variety of natural and human means including for example, discharge of ballast water, biofouling, aquaculture operations and aquarium imports.

In the case of PGS's proposed activities within the NCB and Beagle OAs, the key vectors requiring management attention include:

- discharge of high risk ballast water taken up at international or domestic sources;
- biofouling on vessel hulls and other external niches (e.g. propulsion units, steering gear and thruster tunnels);
- biofouling of vessel internal niches (e.g. sea chests, strainers, seawater pipe work, anchor cable lockers and bilge spaces etc.); and
- biofouling on equipment that routinely becomes immersed in water.

Once introduced IMS can cause serious environmental, social and economic impacts through predation or displacement of native species. These direct or indirect impacts also have the potential to threaten a range of sectors including:

- commercial fisheries and aquaculture;
- tourism industry;
- human health;
- shipping; and
- infrastructure.

Following their establishment, eradication of IMS populations is often impossible, limiting management options to ongoing control or impact minimisation. For this reason, increased management requirements have been implemented in recent years by Commonwealth and State/Territory regulatory agencies with further legislation currently under development. Reducing the risk of IMS introduction and establishment represents by far the most effective and cost-efficient means of managing the threat of IMS introduction.

2.2.2.2 Potential Environmental Impacts

2.2.2.2.1 Ballast Water

Ballast water which may potentially harbour invasive marine species can be released by seismic and support vessels during marine seismic surveys. Ballast water taken-up at international ports and coastal waters outside Australia's territorial sea is considered a high risk (DAWR, 2016). Vessels that have taken-up high-risk ballast water should only discharge in Australian seas if the biosecurity risk of the ballast water has been managed using an approved method.

The Department of Agriculture and Water Resources (DAWR) is the lead Australian Government agency responsible for regulating the management of ballast water in Australia. Ballast water has been regulated by the Australian Government since 2001 and under the *Biosecurity Act 2015* since 16 June 2016. The Act has a chapter devoted to the management of ballast water and sediments within Australian seas. This chapter provides assessment and management powers to biosecurity officers specific to vessels intending to discharge ballast water. On 17 May 2017, an amendment to the Act relating to ballast water received Royal Assent. The *Biosecurity Amendment (Ballast Water and Other Measures) Act 2017* (amendment Act), strengthens Australia's ability to manage ballast water in ships, and broadens existing powers to destroy

exotic vectors of human disease on vessels and aircraft arriving in Australia. It was also a necessary step in ratifying the *International Convention for the Control and Management of Ships' Ballast Water and Sediments* (Ballast Water Management Convention) on 7 June 2017. The Ballast Water Management Convention came into force internationally and in Australia on 8 September 2017. On this day, the amendment Act and Biosecurity (*Ballast Water and Sediment) Determination 2017* came into effect. The Australian Ballast Water Management Requirements V7 was released in 2017 (DAWR 2017).

The *Biosecurity Act 2015* provides the powers to assess and manage biosecurity risks associated with goods and conveyances (e.g. aircraft and vessels). Chapter 5 Ballast Water and Sediment describes requirements for ballast water management, reporting and offences. Section 267 requires vessel operators to report ballast water discharges in Australian seas. Chapter 5 (Part 4) provides requirements for ballast water management plans. To comply with this Act, the Australian Ballast Water Management Requirements provides guidance on how vessel contractors should manage ballast water, including compliance with IMO conventions and guidelines. For vessels entering Australia, the *Biosecurity Act 2015* (Chapter 4, Part 2) requires pre-arrival reporting in a form approved by the Director of Biosecurity, which is the Maritime Arrivals Reporting System (MARS). MARS is an online portal to submit pre-arrival documents required of all international vessels seeking Australian biosecurity clearance. Ballast water reports should be submitted no later than 12 hours before a vessel intends to discharge ballast water and contain a forward itinerary of subsequent Australian ports where known. Where the vessel continues their voyage to a subsequent port within Australia, the vessel's operator may report any Australian-sourced ballast water operations through the ballast water report in MARS.

PGS will implement all regulations and control measures to reduce impacts and risks from ballast water discharges.

2.2.2.2.2 Biofouling

The growth and accumulation of aquatic organisms (i.e. biofouling on vessel hulls, other external niche areas, on internal niches and on equipment that are routinely-immersed in water) present a potential risk of introducing IMS into Australia. Biofouling on vessels and other movable submerged structures affects their performance and can lead to the spread of invasive aquatic species (DAWR, 2015). Accidental release of biofouling organisms during cleaning operations can facilitate the spread of invasive aquatic species threatening human health, the aquatic environment, and social, cultural and economic values.

The potential biofouling risk presented by the seismic survey and support vessels within the operational area will relate to the length of time that these vessels have already been operating in Australian waters or, operating outside Australian waters, the location(s) of the surveys undertaken, the length of time spent at these location(s) and whether the vessels undergone hull inspections, cleaning and application of new anti-foulant coating prior to operating in Australian waters. Vessels may be contracted from companies operating either within or outside Australia. On this basis, all vessels will have an IMS Risk assessment done prior to arriving in Australia, and all the necessary clearances to operate within Australia waters, as required. This includes meeting the biosecurity standards of the DAWR and the WA Department of Primary Industry and Resource Development (DPIRD), who have significant powers to prevent the arrival and establishment of IMS of concern.

The Anti-fouling and In-water Cleaning Guidelines (DAWR 2015) provide best practice approaches to applying, maintaining, removing and disposing of anti-fouling coatings and managing biofouling and invasive aquatic species on vessels and movable structures in Australia and New Zealand. These guidelines are applicable to all vessels and movable structures in Australian aquatic environments (i.e. marine, estuarine and freshwater), regardless of whether they have an anti-fouling coating. They are recommended for use by resource managers, owners and operators of vessels and movable structures, operators and customers of maintenance facilities, and contractors providing vessel maintenance services.

Furthermore, any vessel or marine infrastructure destined for WA waters is required to meet the aquatic biosecurity standards set out under the *Fisheries Resources Management Act 1994*, including a Marine Biosecurity Inspection for the presence of known and potential IMS to ensure compliance with Regulation 176. No target marine species of concern to Australian waters can be observed during the in-water inspection

in order to ensure that the vessel will be considered to pose a low risk of introducing any IMS of concern to Australian waters. As such, an independent IMS inspection will be undertaken to ensure compliance with the aquatic biosecurity standards set out under this Act:

- Regulation 176 of the Fish Resources Management Regulations 1995 (FRMR) - offence to translocate live non-endemic fish to WA without permission
- Section 105 of the FRMA – offence to bring noxious fish into WA
- Part 16A of the FRMA – gives DPIRD emergency powers to deal with incursions of IMS, which include directing a person to carry out necessary activities to prevent or control the spread of IMS, or to eradicate them in WA waters.
- The DoF Vessel Check is a management tool under the WA Government's Aquatic Biosecurity Policy and the Biofouling Biosecurity Policy and is intended.

Anti-fouling coatings are commonly used to protect submerged surfaces and prevent biofouling accumulation. Application, maintenance and removal of anti-fouling coatings on vessels and movable structures in maintenance facilities or in-water can result in contamination of the aquatic environment. Vessels will be coated in an appropriate antifouling system that is considered suitable for both coastal and deep-sea vessels and is compliant with the International Convention on the Control of Harmful Anti-Fouling Systems on Ships (IMO document AFS/CONF/26). As such, PGS will implement these control measures to reduce environmental impacts and risks from biofouling.

2.2.2.3 Summary of Environmental Impacts

Potential Environmental Impacts	Environmental Values and Sensitivities Affected	Decision Type
Introduction and establishment of IMS	• Other marine users: commercial fisheries, shipping, tourism industry and human health • Native marine species	A

2.2.2.1 Justification for Implemented Control Measures

No.	Control Measures	Justification
4	Australian high-risk ballast water exchange is conducted in areas at least 12 nautical miles from the nearest land and in water at least 50 metres deep. Internationally-sourced ballast water exchange is conducted in areas at least 12 nautical miles from the nearest land and in water at least 50 metres deep.	• The *Biosecurity Act 2015* provides the powers to assess and manage biosecurity risks associated with goods and conveyances (e.g. aircraft and vessels). Chapter 5 Ballast Water and Sediment describes requirements for ballast water management, reporting and offences. The *Biosecurity Act 2015* (Chapter 5, Part 3) defines acceptable ballast water exchange is conducted in accordance with the requirements prescribed by regulations. • Section 267 requires vessel operators to report ballast water discharges in Australian seas. DAWR is the lead Australian Government agency responsible for regulating the management and discharge of international ballast water inside Australian seas. The DAWR Ballast Water Management Requirements (2017) state that vessels arriving in Australia seas from international ports will be required to exchange in accordance with Regulation B-4 of BWM Convention. • As such, PGS are confident that these control measures are effective in reducing impacts and risks from ballast water discharges.
5a	Vessels that carry ballast water will maintain a Ballast Water Record System that complies with Regulation B-2 of the Annex to the Ballast Water Convention.	The DAWR Ballast Water Management Requirements (2017) state that all vessels that carry ballast water must maintain a complete and accurate Ballast Water Record System (Record System). The system may be electronic or in hard copy and should comply with Regulation B-2 of the Annex to the Ballast Water Convention.
5b	Vessels constructed on or after 8 September 2017 will meet Ballast Water Convention Regulation D-2 and have an IMO approved Ballast Water Management System or use one of the other approved methods of management. Vessel constructed before 8 September 2017 will meet the Ballast Water Convention Regulation D-2 implementation requirements of: Vessels must comply with the Regulation D-2 standard by their first renewal survey date, when the first renewal survey takes place:	Australia is implementing the agreed implementation schedule for the Ballast Water Convention that requires vessels to phase out ballast water exchange in favour of a method that is compliant with the Ballast Water Convention D-2 discharge standard. To achieve this, vessels will be required to install an IMO approved BWMS or use one of the other approved methods of management which are: • use of a BWMS • use of low risk ballast water (such as fresh potable water, high seas water or fresh water from an on-board fresh water production facility) • retention of high-risk ballast water on board the vessel • discharge to an approved ballast water reception facility.

No.	**Control Measures**	**Justification**
	• on or after 8 September 2019, or • a renewal survey has been completed on or after 8 September 2014, but prior to 8 September 2017. Vessels must comply with the Regulation D-2 standard by their second renewal survey date, when the first renewal survey takes place: • after 8 September 2017, and • Before 8 September 2019.	
6	Completion the pre-arrival reporting system issued by DAWR prior to arrival in Australian waters.	For vessels entering Australia, the *Biosecurity Act 2015* (Chapter 4, Part 2) requires pre-arrival reporting in a form approved by the Director of Biosecurity, which is the Maritime Arrivals Reporting System (MARS). MARS is an online portal to submit pre-arrival documents required of all international vessels seeking Australian biosecurity clearance. As such, PGS are confident that these control measures are effective in reducing impacts and risks from routine vessel discharges and biofouling.
7	Vessels will have a valid Ballast Water Management Plan consistent with the Ballast Water *Convention's Guidelines for Ballast Water Management and Development of Ballast Water Management Plans.*	The *Biosecurity Act 2015* (Chapter 5, Part 4) provides requirements for ballast water management plans. To comply with this Act, the Australian Ballast Water Management Requirements provides guidance on how vessel contractors should manage ballast water, including compliance with IMO conventions and guidelines. It is a requirement that all vessels must carry a valid Ballast Water Management Plan. As such, PGS are confident that these control measures are effective in reducing impacts and risks from ballast water discharges.
8	• The survey vessel chosen for an individual survey will be assessed using the DoF Vessel Check tool and be assessed as low/acceptable. https://vesselcheck.fish.wa.gov.au • Immersible equipment, including streamers, will be inspected for biofouling and cleaned prior to deployment. • Suspected or confirmed presence of any marine pests or disease must be reported within 24 hours by email (biosecurity@fish.gov.au) or telephone (FishWatch tel: 1800 815 507). This includes any organism listed on the WA Prevention List of Introduced Marine Pests, and any other non-indigenous organism, that demonstrates invasive characteristics.	Any vessel or marine infrastructure destined for WA waters is required to meet the aquatic biosecurity standards set out under the WA *Fisheries Resources Management Act 1994* (FRMA). An independent IMS inspection will be undertaken to ensure compliance with the aquatic biosecurity standards set out under this Act: • Regulation 176 of the Fish Resources Management Regulations 1995 (FRMR) - offence to translocate live non-endemic fish to WA without permission • Section 105 of the FRMA – offence to bring noxious fish into WA • Part 16A of the FRMA – gives DoF emergency powers to deal with incursions of IMS, which include directing a person to carry out necessary activities to prevent or control the spread of IMS, or to eradicate them in WA waters. The DoF Vessel Check is a management tool under the WA Government's Aquatic Biosecurity Policy and the Biofouling Biosecurity Policy and is intended for use by commercial vessels. As such, PGS are confident that these control measures are effective in reducing impacts and risks from biofouling.
9	Vessels will have had a recent dry dock, IMS inspection or anti-foulant application prior to mobilising to Australian waters.	• The DAWR 2015 Guidelines provide guidance on best-practice approaches for anti-fouling coatings and managing biofouling and invasive aquatic species on all vessels and movable

No.	**Control Measures**	**Justification**
		structures in Australia. The DAWR recommends its use by resource managers, owners and operators of vessels and movable structures, operators and customers of maintenance facilities, and contractors providing vessel maintenance services. • The IMO Biofouling Guidelines provide globally-consistent approach to biofouling management, which was a commitment from the BWM Convention. • DAWR requires that all vessels entering Australian territory from international waters undertake routine vessel inspections by a department biosecurity office to ensure that biosecurity risks are identified and treated accordingly. • An IMS inspection will ensure compliance with the aquatic biosecurity standards set out under the *Fisheries Resources Management Act 1994*. • The National Biofouling Management Guidance for the Petroleum Production and Exploration Industry recommends regular dry dock or IMS vessel inspections as a mitigation measure to reduce biofouling risks • AMSA Marine Order 31 (Vessel surveys and certification) 2015 require dry dock inspections of the bottom of vessels. • AMSA Marine Order 98 (Marine Pollution – anti-fouling systems) 2013 describes controls on anti-fouling systems and its associated certification and inspections. • As such, PGS are confident that these control measures are effective in reducing associated impacts and risks.

2.2.2.2 Summary of Environmental Risk Assessment

Residual Risk Assessment				
Potential Environmental Impact		**Consequence**	**Likelihood**	**Residual Risk**
Introduction and establishment of IMS	Other marine users: commercial fisheries, shipping, tourism industry and human health	Slight	Highly Unlikely	Low
	Native marine species			

2.2.2.3 Demonstration of ALARP

On the basis of the ERA conducted, the use of relevant decision-making tools appropriate to the decision type and the application of the 'Hierarchy of Controls' philosophy (below), the control measures described above are appropriate to manage the risk of IMS introduction from ballast water discharge and biofouling and to ensure that reasonable and practicable solutions have not been overlooked. Therefore, the residual risk ranking for this potential impact is considered Low, as good industry practice or comparable standards have been applied to control the risk, and any further effort towards risk reduction (e.g. additional, alternative or modified control measures) would not provide further environmental benefit and/or is not reasonably practicable without sacrifices that are grossly disproportionate to the benefit gained. The environmental impacts and risk are thus reduced to ALARP.	
Eliminate	Seismic surveys cannot eliminate the use of a vessel and immersible equipment (e.g. towed seismic equipment) that remain submerged in water, and thus biofouling of the hull and other niches and the uptake of marine organisms in ballast water exchange can occur. This risk cannot be eliminated.
Substitute	No substitution to the use of survey vessel is possible.
Engineering	PGS will implement effective engineering solutions for seismic surveys, including sufficient storage capacity in ballast water tanks aboard survey vessel to minimise likelihood of ballast water exchange being required during survey and the application of approved anti-foulant coating to survey and support vessel hulls prior to operating in Australian waters.
Isolation	Options to isolate the marine environment from impacts or risks from ballast water discharge or biofouling are not feasible.
Administrative	Before a survey commences, PGS will ensure that vessels have: • compliant Ballast Water Management Plan • DAWR forms and reports (e.g. ballast water management, Maritime Arrivals Reporting System, etc.) • DoF Vessel Check assessment completion • International Antifouling System Certificates for the survey vessel to verify compliance with IMO Antifouling Systems Convention • dry dock or IMS inspection. All personnel will receive appropriate environmental induction and training (Section 3.3), including reporting procedures for environmental incidents or hazards and an overview of waste management requirements.

2.2.2.4 Demonstration of Acceptability

The potential impacts of IMS introduction from ballast water discharge and biofouling are considered 'Broadly Acceptable' in accordance with the Environment Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		

Internal Context	Is the proposed management of the impact or risk aligned with the PGS Environment Policy and HSEQ Commitment Statement?	The control measures are consistent with the objectives of the PGS Environment Policy and HSEQ Commitment Statement (Appendix 3B):
		• PGS Environment Policy
		  ○ Prevent harm to the environment by reducing risk related to the activity
		  ○ Comply with applicable legal and industry standard requirements associated with the activity
		  ○ Achieve continual improvement in environmental performance.
		• HSEQ Commitment Statement (such as):
		  ○ Increase HSEQ awareness and reduce unsafe behaviour
		  ○ Reduce total risk exposure
		  ○ Prevent incidents
		  ○ Minimise harm to the environment.
		Thus, the control measures are acceptable to achieve PGS's environmental management requirements for this survey.

External Context – Social Acceptability	Have stakeholders raised any concerns about activity's impacts or risks, and if so, are measures in place to address those concerns?	Chapter 1 included all stakeholder consultation, including PGS' assessment of merits and claims as required by Regulation 16(b), and stakeholders did not raise any concerns or issues regarding IMS introduction from ballast water discharge or biofouling.
External Context – Natural Environment	Are the control measures providing appropriate protection to the receiving environment (e.g. sensitive or unique environmental features) from potential impacts and risks introduced by the activity?	Based on the ERA of potential impacts and risks of IMS introduction from ballast water discharge and biofouling: • potential IMS translocation would be limited to brief occurrences of the survey vessel in shallow coastal waters or in port • deeper offshore waters in the OAs are unlikely to support the successful colonisation by IMS • vessels will be continually moving, which makes IMS translocation difficult. All known control measures have been adopted, and additional or alternative control measures would not provide additional environmental protection or benefit. Thus, the impacts and risks to the marine environment are reduced to ALARP.
Legislation and Conventions	Is the impact or risk being managed in compliance with relevant Australian or international environmental management laws or standards (e.g. EPBC Act and Policy Statements, MARPOL, OPGGS Act, etc.)?	Control measures to reduce impacts from IMS introduction by ballast water discharge and biofouling are compliant with relevant legislations and conventions (see Justification above), such as: • *Biosecurity Act 2015* • Australian Ballast Water Management Requirements

The potential impacts of IMS introduction from ballast water discharge and biofouling are considered 'Broadly Acceptable' in accordance with the Environment Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		
		• International Convention for Control & Management of Ship Ballast Water & Sediments 2004 • IMO Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species • WA *Fish Resources Management Act 1994* and Fish Resources Management Regulations 1995 • DoF Vessel Check Biofouling Risk Assessment Tool • National System for the Prevention and Management of Marine Pest Incursions
Industry Standards and Best Practice	Is the impact or risk being managed in accordance with industry standards, guidelines and best practice (e.g. APPEA Code of Environmental Practice, IAGC guidelines, etc.)?	Control measures to reduce impacts from IMS introduction by ballast water discharge and biofouling are in accordance with industry standards and best practice, including: • IAGC Environmental Manual for Worldwide Geophysical Operations recommends ballast water management plans to ensure that organisms cannot be transported significant distances by regularly changing the ballast water, cleaning tanks or other approved control plans • APPEA Code of Environmental Practice recommends geophysical surveys have an environmental objective to reduce the risk of marine pest introduction to ALARP and acceptable levels, with evidence of appropriate quarantine management measures.
Comparison of Predicted and Acceptable Levels	Are the predicted environmental impacts and risks within the defined acceptable levels (above)?	With implemented control measures, the predicted environmental impacts and risks are Low, ALARP and within the acceptable levels defined above (i.e. PGS Environment Policy and HSEQ Commitment Statement, external context, legislation, conventions, and industry standards and best practice). The extent, severity and duration of vessel and helicopter noise will be short-term and localised.
ESD Principles	Is the impact or risk being managed in accordance to the principles of ESD (as per the EPBC Act)?	The ERA presented in this EP demonstrated compliance with the principles of ESD: • decision-making processes integrated both long-term and short-term economic, environmental, social and equitable considerations (e.g. reducing impacts of IMS introduction from ballast water discharge and biofouling). • no threats of serious or irreversible environmental damage were identified. • the principle of inter-generational equity is maintained for the benefit of future generations. • the conservation of biological diversity and ecological integrity were fundamental considerations in decision-making and development of control measures. • the approved control measures considered improved valuation, pricing and/or incentive mechanisms.

2.2.2.5 Summary of Environmental Performance

EPO	EPS	Control Measure No.	Measurement Criteria
Zero incidents of IMS introduction from ballast water exchange during surveys within the operational areas.	Ballast water discharges will comply with the relevant requirements of the *Biosecurity Act 2015* and Australian Ballast Water Management Requirements, specifically: • Australian high-risk ballast water exchange is conducted in areas at least 12 nautical miles from the nearest land and in water at least 50 metres deep. • Internationally-sourced ballast water exchange is conducted in areas at least 12 nautical miles from the nearest land and in water at least 50 metres deep. • Vessels that carry ballast water will maintain a Ballast Water Record System that complies with Regulation B-2 of the Annex to the Ballast Water Convention. • Vessels, based on construction date, will meet Ballast Water Convention Regulation D-2 and have an IMO approved Ballast Water Management System or use one of the other approved methods of management. • Vessel will complete pre-arrival reporting system issued by DAWR prior to arrival in Australian waters. • Vessels will have a valid Ballast Water Management Plan consistent with the Ballast Water *Convention's Guidelines for Ballast Water Management and Development of Ballast Water Management Plans.*	4, 5, 6, 7	• Ballast water exchange records • Ballast Water Management Plan • DAWR pre-arrival report • Ballast Water Management System (if required)
Zero incidents of IMS introduction from biofouling of survey and support vessel hulls, other niches and immersible equipment during surveys within the operational areas.	PGS will adhere to the relevant legislation and guidelines regarding biofouling management, specifically: • Vessels will be assessed using the DoF Vessel Check tool and will have a risk status of low/acceptable. • Immersible equipment, including streamers, will be inspected for biofouling and cleaned prior to deployment. • Vessels will have a valid anti-fouling certificate. • Suspected or confirm IMS will be reported to DPIRD-Fisheries.	8, 9	• Completed assessment using the DoF Vessel Check tool. • Immersible equipment inspection records • Anti-fouling certificate • IMS notification report to DPIRD-Fisheries

2.2.3 Discharge of Bilge Water, Sewage and Food Wastes (Putrescibles)

2.2.3.1 Description of Risk

During individual surveys in the NCB and Beagle OAs, the survey and support vessel will routinely discharge (on a daily basis) relatively small volumes of sewage and food wastes to the ocean in accordance with the requirements of the MARPOL 73/78 Convention (as implemented in Commonwealth waters by the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*. Additionally, the survey and support vessel may need to discharge bilge water during the survey.

Routine discharges of bilge water, sewage and food wastes from the survey vessel and support vessel may cause a localised reduction in water quality.

2.2.3.2 Potential Environmental Impacts

Routine discharge of bilge water, sewage and food wastes to the ocean will cause a negligible, localised and temporary increase in nutrient concentrations and reduction in water quality. The total nutrient loading from vessel operations during surveys in the OAs will be insignificant in comparison to the natural daily nutrient flux that occurs in marine waters within the region. No significant impacts are anticipated because of the minor quantities involved, localised area of impact, high level of dilution into deep oceanic waters and high biodegradability/low persistence of the wastes.

Bilge tanks receive fluids from many parts of the vessel. Bilge water can contain water, oil, detergents, solvents, chemicals, particles and other liquids, solids or chemicals. Treatment of bilge water will be conducted using an oily water separator. However, if not treated prior to discharge there would be potential for a negligible and localised increase in nutrient concentrations.

The potential impact from routine discharges of bilge water, treated or untreated sewage, and food wastes is expected to be negligible.

2.2.3.3 Summary of Environmental Impacts

Potential Environmental Impacts	Environmental Values and Sensitivities Affected	Decision Type
Localised eutrophication of the water column	Marine habitats	A

2.2.3.4 Justification for Implemented Control Measures

No.	Control Measures	Justification

10	• Sewage systems must be an IMO-approved/MARPOL-compliant sewage treatment plant.
	• Sewage and putrescible wastes must be passed through a grinder or comminuter and a disinfection system so that the final product is small enough to pass through a screen of less than 25 mm diameter prior to disposal to the sea.
	• Comminuted and disinfected sewage can be discharged if:
	  ○ the vessel is >3 nm from nearest land; and
	  ○ sewage originating from holding tanks is discharged at a moderate rate (as defined in Marine Order 96) while the vessel is proceeding en-route at a speed not less than 4 knots.
	• Sewage that is not comminuted or disinfected can be discharged if:
	  ○ the vessel is >12 nm from nearest land; and
	  ○ sewage originating from holding tanks is discharged at a moderate rate (as defined in Marine Order 96) while the vessel is proceeding en-route at a speed not less than 4 knots.
		• MARPOL is the main international convention covering the protection of pollution of the marine environment by ships from operational or accidental causes. Annex IV contains requirements to control pollution of the sea by sewage, the discharge of which is prohibited except in accordance with these regulations.
		• The PSPPS Act implements:
		  ○ IMO MARPOL (e.g. MARPOL Annex IV)
		  ○ offence provisions for which a person/owner/master of a ship may be liable, particularly Section 26D which prohibits sewage discharge into the sea.
		• Marine Orders are regulations under Australian Commonwealth legislations and apply to Australian and foreign vessels. Marine Order 96 gives effect to MARPOL Annex IV, as well as provisions of the PSPPS Act.
		• Thus, PGS is confident that these control measures are effective in reducing impacts and risks from sewage discharged from ships.

11	Food wastes can be discharged from the survey and support vessel if: • it is comminuted or ground to a particle size <25 mm • the vessel is moving faster than 4 knots • the discharge takes place as far as practicable from the nearest land, but in any case, ≥ 3 nm from the nearest land. Food wastes that are not comminuted or ground can be discharged if: • the vessel is en-route	• MARPOL is the main international convention covering the protection of pollution of the marine environment by ships from operational or accidental causes. Annex V deals with difference types of garbage and disposal regulations. • The PSPPS Act implements IMO MARPOL (e.g. MARPOL Annex V) and offences for which a person/owner/master of a ship may be liable, particularly Section 26F which prohibits garbage disposal into the sea.

No.	Control Measures	Justification
	• the discharge takes place as far as practicable from the nearest land, but in any case, ≥ 12 nm from the nearest land.	• Marine Orders are regulations under Australian Commonwealth legislations and apply to Australian and foreign vessels. Marine Order 95 gives effect to MARPOL Annex V, as well as provisions of the PSPPS Act. • Marine Notice 2017/4 provides guidance on the implementation of MARPOL Annex V, including food wastes from ships. While they have no legal standing, Marine Notices provide important safety related information, general guidance or details about legislation changes. • Thus, PGS is confident that these control measures are effective in reducing impacts and risks from food wastes discharged from ships.
12	• Bilge water discharges can occur only if: ○ the vessel has an IMO-approved/MARPOL-compliant oily water separator (International Oil Pollution Prevention Certificate [IOPPC]) ○ the vessel is proceeding en-route (i.e. is not stationary); and ○ oil content less than 15 parts per million (ppm); and ○ oil discharge monitoring and control system and oil filtering equipment are operating. • If the above cannot be met, oil must be retained aboard for onshore disposal. • Bilge water contaminated with chemicals must be contained and disposed of onshore, except if the chemical is demonstrated to have a low toxicity (as determined by the relevant Material Safety Data Sheet [MSDS]). Discharges of bilge water will be recorded in the survey and support vessel engine room logs.	• MARPOL is the main international convention covering the protection of pollution of the marine environment by ships from operational or accidental causes. Annex I Regulation 15 requires oil content of effluent without dilution does not exceed 15 ppm. • The PSPPS Act implements: ○ IMO MARPOL (e.g. MARPOL Annex I) ○ offence provisions for which a person/owner/master of a ship may be liable, particularly Section 9 which prohibits discharge of oil or oily mixtures into the sea. • Marine Orders are regulations under Australian Commonwealth legislations and apply to Australian and foreign vessels. Marine Order 91 gives effect to MARPOL Annex I, as well as provisions of the PSPPS Act such as IOPP certificate conditions. • IAGC recommends that bilge water and water from covered spaces aboard vessels are processed to remove oil to less than 15 ppm before discharge. • Thus, PGS is confident that these control measures are effective in reducing impacts and risks from bilge water discharged from ships.
13	Incineration of any oil sludge on board, or disposal of any oil sludge/slops in port, must be recorded in the survey vessel Oil Record Book.	• MARPOL is the main international convention covering the protection of pollution of the marine environment by ships from operational or accidental causes. Annex I covers the prevention of pollution by oil from operational and accidental discharges. • The PSPPS Act implements: ○ IMO MARPOL (e.g. MARPOL Annex I) ○ offence provisions for which a person/owner/master of a ship may be liable, particularly Section 12 which describes requirement for Australian ships to carry oil record books.

No.	Control Measures	Justification
		• Marine Orders are regulations under Australian Commonwealth legislations and apply to Australian and foreign vessels. Marine Order 91 gives effect to MARPOL Annex I, as well as provisions of the PSPPS Act such as oil record books. • Marine Notice 2015/09 provides guidance recording of operations in the Oil Record Book Part I – machinery space operations (all ships), prepared and issued by the IMO. While they have no legal standing, Marine Notices provide important safety related information, general guidance or details about legislation changes. • Thus, PGS is confident that these control measures are effective in reducing impacts and risks from oil sludges discharged from ships.

2.2.3.5 Summary of Environmental Risk Assessment

Residual Risk Assessment				
Potential Environmental Impact		**Consequence**	**Likelihood**	**Residual Risk**
Localised eutrophication of the water column	Marine habitats	Slight	Highly Unlikely	Low

2.2.3.6 Demonstration of ALARP

On the basis of the ERA conducted, the use of relevant decision-making tools appropriate to the decision type and the application of the 'Hierarchy of Controls' philosophy (below), the control measures described above are appropriate to manage the impacts from vessel discharges (bilge water, sewage and food wastes) and to ensure that reasonable and practicable solutions have not been overlooked. Therefore, the residual risk ranking for this potential impact is considered Low, as good industry practice or comparable standards have been applied to control the risk, and any further effort towards risk reduction (e.g. additional, alternative or modified control measures) would not provide further environmental benefit and/or is not reasonably practicable without sacrifices that are grossly disproportionate to the benefit gained. The environmental impacts and risk are thus reduced to ALARP.	
Eliminate	Generation of sewage and food wastes by crew aboard the survey and support vessels cannot be eliminated. Generation of oily water mixtures (e.g. machinery space bilges) aboard the vessel and support vessels would be difficult to eliminate without considerable re-engineering of vessel systems.
Substitute	Discharging vessel bilge water, sewage and food wastes could be substituted by storing these wastes on-board. However, storage, subsequent transfer of bilge water, sewage, and putrescible wastes on-shore for treatment and disposal are not viable given the safety, hygiene and health risks involved.
Engineering	The survey will implement effective engineering solutions that reduce the impacts from vessel discharges, including: • IMO-approved/MARPOL-compliant, oily water separator and sewage treatment system. • grinder/comminuter for maceration of putrescible wastes. • appropriate segregation facilities, including integral waste oil tank for oils and sludge, tanks for storage of grey water, black water and bilge water. • routing any machinery space bilge water to MARPOL compliant oily water separator (with alarm fitted) prior to disposal/discharge overboard

	• bunded areas containing drips and minor leaks from fixed equipment (such as engines and generators) and drain to the bilge tank for treatment by the oily water separator.
Isolation	PGS will implement additional control measures that isolate sewage and putrescible wastes, such as no untreated discharge within 12 nm from land and no treated discharge within 3 nm from land.
Administrative	PGS will ensure that the vessels have appropriate certifications (e.g. IOPPC and ISPPC), record books (e.g. Oil Record Book and Garbage Record Book), management plans (e.g. PGS Garbage Management Plan) and documentation (e.g. MSDS). All personnel will receive appropriate environmental induction and training (Section 3.3), including overview of waste management requirements, reporting procedures for environmental incidents or hazards and roles and environmental responsibilities of key personnel on-board the survey vessel.

2.2.3.7 Demonstration of Acceptability

The potential impacts of vessel and helicopter noise emissions are considered 'Broadly Acceptable' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		

Internal Context	Is the proposed management of the impact or risk aligned with the PGS Environment Policy and HSEQ Commitment Statement?	The control measures are consistent with the objectives of the PGS Environment Policy and HSEQ Commitment Statement (Appendix 3B):
		• PGS Environment Policy
		  ○ Prevent harm to the environment by reducing risk related to the activity
		  ○ Comply with applicable legal and industry standard requirements associated with the activity
		  ○ Achieve continual improvement in environmental performance.
		• HSEQ Commitment Statement (such as):
		  ○ Increase HSEQ awareness and reduce unsafe behaviour
		  ○ Reduce total risk exposure
		  ○ Prevent incidents
		  ○ Minimise harm to the environment.
		Thus, the control measures are acceptable to achieve PGS's environmental management requirements for this survey.

External Context – Social Acceptability	Have stakeholders raised any concerns about activity's impacts or risks, and if so, are measures in place to address those concerns?	Chapter 1 included all stakeholder consultation, including PGS' assessment of merits and claims as required by Regulation 16(b), and stakeholders did not raise any concerns or issues regarding environmental impacts and risks from vessel discharges, such as bilge water, sewage and food wastes.
External Context – Natural Environment	Are the control measures providing appropriate protection to the receiving environment (e.g. sensitive or unique environmental features) from potential impacts and risks introduced by the activity?	Based on the ERA of potential impacts from vessel discharges (e.g. bilge water, sewage and food wastes), no sensitive habitats (i.e. emergent features; shallow waters [<20 m depth]; corals, seagrasses, macro algal beds, etc.) are located within in the OAs. Also, compliant discharges of bilge water, sewage, and food wastes will be of short duration with high levels of dispersion, dilution and biodegradation. Therefore, the control measures provide

The potential impacts of vessel and helicopter noise emissions are considered 'Broadly Acceptable' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		
		appropriate protection to the receiving environment from potential impacts and risks introduced by the activity.
Legislation and Conventions	Is the impact or risk being managed in compliance with relevant Australian or international environmental management laws or standards (e.g. EPBC Act and Policy Statements, MARPOL, OPGGS Act, etc.)?	Control measures to reduce impacts from vessel discharges (such as bilge water, sewage and food wastes) are compliant with relevant legislations and conventions (see Justification above), such as: • MARPOL Annex I, Annex IV and Annex V. • *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* • Marine Orders 91, 95 and 96 • Marine Notices 2017/4 and 2017/3.

Industry Standards and Best Practice	Is the impact or risk being managed in accordance with industry standards, guidelines and best practice (e.g. APPEA Code of Environmental Practice, IAGC guidelines, etc.)?	Control measures to reduce impacts from vessel discharges (e.g. bilge water, sewage and food wastes) are in accordance with industry standards and best practice, including:
		• IAGC Environmental Manual for Worldwide Geophysical Operations recommends:
		  ○ vessels to have a waste or garbage management plan to effectively manage waste in-line with the relevant IMO MARPOL regulations as well as local legislation, contractor and client company requirements
		  ○ written procedures for collecting, segregating, storing, processing and disposing of garbage
		  ○ waste that cannot be incinerated will be segregated and stored for disposal ashore
		  ○ sewage handled according to MARPOL
		  ○ bilge water and water from covered spaces aboard vessels are processed to remove oil to less than 15 parts per million before discharge.
		• APPEA Code of Environmental Practice recommends that operations ensure adequate waste management practices are carried out based on the prevention, minimisation, recycling, treatment and disposal of wastes in accordance with statutory requirements and procedures.

Comparison Between Predicted and Acceptable Levels	Are the predicted environmental impacts and risks within the defined acceptable levels (above)?	With implemented control measures, the predicted environmental impacts and risks are Low, ALARP and within the acceptable levels defined above (i.e. PGS Environmental policy, external context, legislation, conventions, and industry standards and best practice). The extent, severity and duration of vessel discharges (such as bilge water, sewage and food wastes) will be short-term and localised.
ESD Principles	Is the impact or risk being managed in accordance to the principles of ESD (as per the EPBC Act)?	The ERA demonstrated compliance with the principles of ESD: • decision-making processes integrated both long-term and short-term economic, environmental, social and equitable considerations (e.g. reducing impacts from vessel discharges such as bilge water, sewage and food wastes).

The potential impacts of vessel and helicopter noise emissions are considered 'Broadly Acceptable' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		
		• no threats of serious or irreversible environmental damage were identified. • the principle of inter-generational equity is maintained for the benefit of future generations. • the conservation of biological diversity and ecological integrity were fundamental considerations in decision-making and development of control measures. • cost/benefit evaluation demonstrated that the approved control measures considered improved valuation, pricing and/or incentive mechanisms.

2.2.3.8 Summary of Environmental Performance

EPO	EPS	Control Measure No.	Measurement Criteria

Zero incidents of non-compliant discharges of bilge water, sewage and putrescible wastes from the survey and support vessels within the OAs.	• Vessel sewage systems must be IMO-approved/MARPOL-compliant.
	• Sewage and putrescible wastes must be passed through a grinder or comminuter and a disinfection system so that the final product is small enough to pass through a screen of less than 25 mm diameter prior to disposal to the sea.
	• Comminuted and disinfected sewage can be discharged if:
	  ○ the vessel is >3 nm from nearest land; and
	  ○ sewage originating from holding tanks is discharged at a moderate rate (as defined in Marine Order 96) while the vessel is proceeding en-route at a speed not less than 4 knots.
	• Sewage that is not comminuted or disinfected can be discharged if:
	  ○ the vessel is >12 nm from nearest land; and
	• Sewage originating from holding tanks is discharged at a moderate rate (as defined in Marine Order 96) while the vessel is proceeding en-route at a speed not less than 4 knots.
		10	• Pre-mobilisation audit/checklist confirms:
			  ○ IMO-approved/MARPOL compliant sewage treatment plant
			  ○ Valid ISPPC certification
			• Sewage discharge records confirm location and movement of vessel is appropriate to the discharge.

	Food wastes can be discharged from the survey and support vessel if: • it is comminuted or ground to a particle size <25 mm • the vessel is moving faster than 4 knots • the discharge takes place as far as practicable from the nearest land, but in any case, ≥ 3 nm from the nearest land. Food wastes that are not comminuted or ground can be discharged if: • the vessel is en-route	11	• Pre-mobilisation audit/checklist confirms: ○ Comminutor operational • Food waste discharge records confirm location and movement of vessel is appropriate to the discharge.

EPO	EPS	Control Measure No.	Measurement Criteria
	• the discharge takes place as far as practicable from the nearest land, but in any case, ≥ 12 nm from the nearest land.		
	Bilge water discharges can occur only if: • the vessel has an IMO-approved/MARPOL-compliant oily water separator (International Oil Pollution Prevention Certificate [IOPPC]) • the vessel is proceeding en-route (i.e. is not stationary); and • oil content less than 15 parts per million (ppm); and • oil discharge monitoring and control system and oil filtering equipment are operating. If the above cannot be met, oil must be retained aboard for onshore disposal. • Bilge water contaminated with chemicals must be contained and disposed of onshore, except if the chemical is demonstrated to have a low toxicity (as determined by the relevant Material Safety Data Sheet [MSDS]).	12	• Pre-mobilisation audit/checklist confirms: ○ IMO-approved/MARPOL compliant oily water separator ○ Valid IOPPC certification. • Bilge discharge records • Bilge/chemical discharge assessment • Oil Record Book detail oil sludge incinerated or disposed in port.
	• Incineration of any oil sludge on board, or disposal of any oil sludge/slops in port, must be recorded in the survey vessel Oil Record Book.	13	

2.3 UNPLANNED ACTIVITIES (ACCIDENTS AND INCIDENTS)

2.3.1 Accidental Release of Hazardous or Non-hazardous Materials

2.3.1.1 Description of Risk

The survey and support vessels will store and use a variety of hazardous materials such as paints, cleaning chemicals and batteries. Vessels will also produce a variety of other non-hazardous solid and liquid wastes, including packaging and domestic wastes, such as aluminium cans, bottles, paper and cardboard.

2.3.1.2 Potential Environmental Impacts

2.3.1.2.1 Hazardous Materials

These materials have the potential to adversely impact the marine environment if accidentally released in significant quantities. The potential effects include a reduction in water quality and toxic effects on marine flora and fauna. Chemicals e.g. solvents and detergents will typically be stored in small containers of 5-25 L capacity and stored / used in internal areas where any leak or spill would be retained on board and cleaned up in accordance with the Shipboard Oil Pollution Emergency Plan (SOPEP; or equivalent for vessels <400 GRT) and associated spill clean-up procedures. Some spills may occur when small containers of chemicals are being used in open areas, where there is a risk of some entering the sea if spilled. The realistic worst-case volume would be 25 L.

2.3.1.2.2 Non-hazardous Materials

These materials could potentially impact the marine environment if accidentally released in significant quantities resulting in a reduction in water quality and physical impacts on marine fauna, such as becoming entangled in waste plastics.

2.3.1.3 Summary of Environmental Impacts

Potential Environmental Impacts	Environmental Values and Sensitivities Affected	Decision Type
Localised, temporary reduction in water quality Entanglement in plastics	• Marine fauna: seabirds & marine turtles • Benthic habitats	A

2.3.1.4 Justification for Implemented Control Measures

No.	Control Measure	Justification
14	• No discharge of plastics or plastic products of any kind • No discharge of domestic wastes or maintenance wastes • All waste receptacles covered with tightly fitting, secure lids to prevent any solid wastes from blowing overboard • All solid, liquid and hazardous wastes (other than bilge water, sewage and food wastes) will be incinerated or compacted (if possible) and stored in designated areas and sent ashore for recycling, disposal or treatment • Any hydrocarbon storage on deck must be designed and maintained to have at least one barrier (i.e. form of bunding) to contain and prevent deck spills entering the marine environment. This can include containment lips on deck (primary bunding) and/or secondary containment measures (bunding, containment pallet, transport packs, absorbent pad barriers) in place. • Correct segregation of solid and hazardous wastes	• MARPOL is the main international convention covering the protection of pollution of the marine environment by ships from operational or accidental causes. ○ Annex III Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form contains general requirements on packaging, marking, labelling, documentation, stowage, quantity limitations, exceptions and notification of harmful substances. ○ Annex V Prevention of Pollution by Garbage from Ships deals with difference types of garbage and disposal regulations, most important of which is the complete ban on the disposal of all forms of plastics into the sea. • The PSPPS Act: ○ Part IIIA implements MARPOL Annex III regulations and prevention of pollution by packaged harmful substances. ○ Part IIIC implements MARPOL Annex V regulations and prevention of pollution by discharge of garbage into the sea, garbage record book, garbage management plan and garbage placards. • Marine Orders are regulations under Australian Commonwealth legislations and apply to Australian and foreign vessels: ○ Marine Order 94 (Marine pollution prevention – packaged harmful substances) 2014 gives effect to MARPOL Annex III, as well as provisions of the PSPPS Act, such as packing, marking, labelling and stowage of packaged harmful substances and incident reporting. ○ Marine Order 95 (Marine pollution prevention – garbage) 2013 gives effect to MARPOL Annex V, including cleaning agents/additives, garbage record book and garbage management plan. • Marine Notice 2017/4 provides guidance on the implementation of MARPOL Annex V, including cleaning agents from ships and display placards. While they have no legal

No.	Control Measure	Justification
		standing, Marine Notices provide important safety related information, general guidance or details about legislation changes. Thus, these Australian and international legislations are required for protecting the marine environment from pollution by oil and other substances discharged from ships and provides legal immunity for persons acting under an AMSA direction. As such, PGS is confident that these control measures are effective in reducing the associated environmental impacts and risks.
15	Vessels > 400 GRT must have a compliant, Shipboard Oil Pollution Emergency Plan (SOPEP) in-place.	• The PSPPS Act Section 11A includes requirements and formats of a SOPEP for all Australian ships. • Marine Orders are regulations under Australian Commonwealth legislations and apply to Australian and foreign vessels. Marine Order 91 gives effect to MARPOL Annex I, as well as provisions of *the Navigation Act 2012* and the *PSPPS Act,* such as the requirements for an approved SOPEP.
16	Vessels <400 GRT that do not have a SOPEP will have a PGS approved spill management plan or equivalent.	
17	All hazardous substances (as defined in the International Maritime Dangerous Goods Code) will have MSDS that are readily available on board.	IAGC Environmental Manual for Worldwide Geophysical Operations recommend that vessels ensure all hazardous materials have an MSDS on file. As such, PGS is confident that this control measure is effective in reducing the associated environmental impacts and risks.
18	Spill response bins/kits will be located in close proximity to hydrocarbon storage areas for prompt response in the event of a spill or leak. The kits will be checked for their adequacy and replenished as necessary prior to the commencement of activities and on a regular basis thereafter.	IAGC Environmental Manual for Worldwide Geophysical Operations recommend that vessels carry a suitable oil spill kit in addition to equipment required in the SOPEP. As such, PGS is confident that this control measure is effective in reducing the associated environmental impacts and risks.

2.3.1.5 Summary of Environmental Risk Assessment

Residual Risk Assessment				
Potential Environmental Impact		**Consequence**	**Likelihood**	**Residual Risk**
Localised, temporary reduction in water quality Entanglement in plastic	Marine fauna Benthic habitats	Slight	Highly Unlikely	Low

2.3.1.6 Demonstration of ALARP

On the basis of the ERA conducted, the use of relevant decision-making tools appropriate to the decision type and the application of the 'Hierarchy of Controls' philosophy (below), the control measures described above are appropriate to manage the impacts and risks from accidental release of hazardous or non-hazardous materials and to ensure that reasonable and practicable solutions have not been overlooked. Therefore, the residual risk ranking for this potential impact is considered to be Low, as good industry practice or comparable standards have been applied to control the risk, and any further effort towards risk reduction (e.g. additional, alternative or modified control measures) would not provide further environmental benefit and/or is not reasonably practicable without sacrifices that are grossly disproportionate to the benefit gained. The environmental impacts and risk are thus reduced to ALARP.	
Eliminate	Due the need for equipment maintenance and safe vessel operations, the use of chemical (i.e. hazardous substances) and consumable products cannot be eliminated.
Substitute	Before operations commence, hazardous substances will be assessed for their suitability and for substitution with alternative options that have better environmental performance characteristics (e.g. biodegradability, ecotoxicity, bioaccumulation and bio concentration potential). Where possible, PGS will choose environmentally friendly alternatives.
Engineering	Survey control measures will include effective, engineering solutions to prevent the accidental release of hazardous/non-hazardous substances, including: • appropriate segregation facilities provided on the survey and support vessel for storage of hazardous wastes • all waste receptacles aboard vessels covered with tightly fitting, secure lids to prevent any solid wastes from blowing overboard.
Isolation	Control measures to isolate the impacts and risks from accidental release of hazardous/non-hazardous substances are not applicable.
Administrative	PGS will ensure that the vessels have appropriate certifications (e.g. IOPPC and ISPPC), record books (e.g. Oil Record Book and Garbage Record Book), management plans (e.g. PGS Garbage Management Plan) and documentation (e.g. MSDS). All personnel will receive appropriate environmental induction and training (Section 3.3), including overview of waste and chemical management requirements, reporting procedures for environmental incidents or hazards and roles and environmental responsibilities of key personnel on-board the survey vessel.

2.3.1.7 Demonstration of Acceptability

The potential impacts and risks from accidental release of hazardous or non-hazardous materials are considered 'Broadly Acceptable' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		

Internal Context	Is the proposed management of the impact or risk aligned with the PGS Environment Policy and HSEQ Commitment Statement?	The control measures are consistent with the objectives of the PGS Environment Policy and HSEQ Commitment Statement (Appendix 3B):
		• PGS Environment Policy
		  ○ Prevent harm to the environment by reducing risk related to the activity
		  ○ Comply with applicable legal and industry standard requirements associated with the activity
		  ○ Achieve continual improvement in environmental performance.
		• HSEQ Commitment Statement (such as):
		  ○ Increase HSEQ awareness and reduce unsafe behaviour

The potential impacts and risks from accidental release of hazardous or non-hazardous materials are considered 'Broadly Acceptable' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		
		○ Reduce total risk exposure ○ Prevent incidents ○ Minimise harm to the environment. Thus, the control measures are acceptable to achieve PGS's environmental management requirements for this survey.
External Context – Social Acceptability	Have stakeholders raised any concerns about activity's impacts or risks, and if so, are measures in place to address those concerns?	Chapter 1 included all stakeholder consultation, including PGS' assessment of merits and claims as required by Regulation 16(b). Stakeholders did not raise any concerns regarding accidental release of hazardous and non-hazardous materials.
External Context – Natural Environment	Are the control measures providing appropriate protection to the receiving environment (e.g. sensitive or unique environmental features) from potential impacts and risks introduced by the activity?	Some spills may occur when small containers of chemicals are being used in open areas, and there is a risk of some chemicals entering the sea if spilled. The realistic worst-case volume would be ~25 L, and as such, accidental releases would be in insignificant quantities. All known control measures have been adopted, and additional or alternative control measures would not provide additional environmental protection or benefit. Thus, the control measures provide appropriate protection to the receiving environment, and potential impacts and risks are of an acceptable level.
Legislation and Conventions	Is the impact or risk being managed in compliance with relevant Australian or international environmental management laws or standards (e.g. EPBC Act and Policy Statements, MARPOL, OPGGS Act, etc.)?	Control measures to reduce impacts from accidental release of hazardous and non-hazardous substances are compliant with relevant legislations and conventions (see Justification above), such as: • MARPOL Annex III Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form • MARPOL Annex V Prevention of Pollution by Garbage from Ships • *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* Part IIIA and IIIC • Marine Order 94 (Marine pollution prevention — packaged harmful substances) 2014 • Marine Order 95 (Marine pollution prevention – garbage) 2013 • Marine Notice 2017/4 MARPOL Annex V Discharges.
Industry Standards and Best Practice	Is the impact or risk being managed in accordance with industry standards, guidelines and best practice (e.g. APPEA Code of Environmental Practice, IAGC guidelines, etc.)?	Control measures to reduce impacts from accidental release of hazardous and non-hazardous substances are compliant with industry standards and best practice: • IAGC Environmental Manual for Worldwide Geophysical Operations recommends for marine surveys, such as but not limited to: ○ No direct discharge of any products into the sea. ○ Vessel have a waste or garbage management plan in line with relevant regulations and providing procedures for collecting, segregating, storing, processing and disposing of garbage.

The potential impacts and risks from accidental release of hazardous or non-hazardous materials are considered 'Broadly Acceptable' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		
		○ Ensure that any hazardous materials used by the crew are handled and stored correctly, and that the safety information provided by the manufacturer is available to the crew. ○ Waste that cannot be disposed by incineration is segregated and stored for disposal ashore. ○ Keep complete records of hazardous material purchases, use, storage, disposal, and spills according to local or company requirements. • APPEA Code of Environmental Practice recommends that operations ensure adequate waste management practices are carried out based on the prevention, minimisation, recycling, treatment and disposal of wastes in accordance with statutory requirements and procedures.
Comparison Between Predicted and Acceptable Levels	Are the predicted environmental impacts and risks within the defined acceptable levels (above)?	With implemented control measures, the predicted environmental impacts and risks are Low, ALARP and within the acceptable levels defined above (i.e. PGS Environment Policy and HSEQ Commitment Statement, external context, legislation, conventions, and industry standards and best practice). The extent, severity and duration of vessel discharges (such as bilge water, sewage and food wastes) will be short-term and localised.
ESD Principles	Is the impact or risk being managed in accordance to the principles of ESD (as per the EPBC Act)?	The ERA demonstrated compliance with the principles of ESD: • decision-making processes integrated both long-term and short-term economic, environmental, social and equitable considerations (e.g. accidental release of hazardous and non-hazardous substances). • no threats of serious or irreversible environmental damage were identified. • the principle of inter-generational equity is maintained for the benefit of future generations. • the conservation of biological diversity and ecological integrity were fundamental considerations in decision-making and development of control measures. • the approved control measures considered improved valuation, pricing and/or incentive mechanisms.

2.3.1.8 Summary of Environmental Performance

EPO	EPS	Control Measure No.	Measurement Criteria
Zero incidents of accidental release of hazardous or non-hazardous material to the sea from the survey and support vessels.	• Solid, liquid and hazardous wastes (other than bilge water, sewage and food wastes) will be incinerated or compacted (if possible) and stored in designated areas and sent ashore for recycling, disposal or treatment. • Waste with the potential to be windblown will be stored in covered containers. • Liquid wastes and hydrocarbons storage on vessel deck will be designed and maintained to have at least one barrier (i.e. form of bunding) including containment lips on deck (primary bunding) and/or secondary containment measures (bunding, containment pallet, transport packs, absorbent pad barriers) in-place. • Wastes will be segregated as per vessel waste management plan.	14	• Pre-mobilisation audit confirms appropriate storage and handling of hazardous and non-hazardous wastes.
	• Vessels > 400 GRT will have a compliant, Shipboard Oil Pollution Emergency Plan (SOPEP) in-place. • Vessels <400 GRT that do not have a SOPEP will have a PGS approved spill management plan or equivalent.	15, 16	Pre-mobilisation audit confirms: • Valid and compliant SOPEP or equivalent on vessels • MSDS available for hazardous substances • Spills kits stored, checked and replenished appropriately.
	All hazardous substances (as defined in the International Maritime Dangerous Goods Code) will have Material Safety Data Sheets (MSDS) that are readily available on board.	17	
	Vessels will have stocked spill kits available in proximity to hydrocarbon storage areas.	18	

2.3.2 Hydrocarbon Release Caused by Topsides (Vessel) Loss of Containment

2.3.2.1 Description of Risk

The survey and support vessels store and use small quantities of lubricating oils and hydraulic fluid, which have the potential to spill if not appropriately managed. Hydraulic fluid may also potentially be spilled from a leak in hoses or lines on hydraulic equipment such as cranes or winches.

2.3.2.2 Potential Environmental Impacts

Hydrocarbons which may be stored on deck (or within below-deck storage) on the survey and support vessel may include lubricating oils or hydraulic fluids. The size of potential spills to deck of these substances are likely to be between 50 and 200 L (0.05 m^3 and 0.2 m^3) based on expected volumes of fluids available on deck typically stored in 50 to 200 L steel drums. Storage of these substances aboard the survey vessel would typically be within a designated storage room or a contained (bunded) area on deck.

Volumes of hydrocarbons greater than 200 L (0.2 m^3) such as main engine lubricating oils, waste engine oil and hydraulic fluid would normally be stored below decks in designated storage tanks and do not represent a direct hazard for deck spills unless smaller volumes are being used on deck directly from a container.

In the event a loss to sea does occur, impacts to the marine environment would be minimal, due to the small potential volumes released, and the fact that spilt hydrocarbons will rapidly evaporate, disperse and weather. The potential environmental impacts are outlined further in Chapter 2.

2.3.2.2.1 Credible spill scenario

Secondary containment measures (i.e. bunds, containment lips, or absorbent booming) will be applied to the storage of drums or containers that are present on deck to prevent direct discharge to the marine environment. In the event of an accidental spill or leaking container, it is most likely that spilled material will be contained aboard (e.g. via use of scupper plugs) and recovered with minimal risk of material entering the marine environment through overboard drains or scuppers. For a spill on deck to result in a release to the marine environment, there would need to be an un-confined spill, which was subsequently allowed to flow overboard and since use of oils or other chemicals on deck would be confined within areas with deck combing or bunds, this is highly unlikely to occur.

Spills or leaks from hydraulic hoses on cranes, winches or other hydraulically operated equipment are also possible, but typically involve only very small volumes of fluid loss (less than 1 L) and are typically contained within a bund or drip tray under the equipment mounted on deck.

A burst hydraulic hose on an extended crane could potentially result in hydraulic fluid being sprayed in a fine jet out over the water however, this would only result in a small volume (less than 1 L to ~25 L) before the problem was noticed, equipment shut down and the leak stopped.

2.3.2.3 Summary of Risk Evaluation

Potential Environmental Impacts	Environmental Values and Sensitivities Affected	Decision Type
Localised, temporary reduction in water quality	• Marine fauna • Marine habitats • Biological communities	A

2.3.2.4 Justification for Implemented Control Measures

No.	Control Measure	Justification
19	Hydrocarbon storage on deck of the survey vessel must be designed and maintained to have at least one barrier (i.e. form of bunding) including containment lips on deck (primary bunding) and/or secondary containment measures (bunding, containment pallet, transport packs, absorbent pad barriers) in-place.	IAGC provides recommendations for fuel and oil storage on vessels, including spill containment pans or bunding. As such, PGS is confident that these control measures are effective in reducing the associated environmental impacts and risks.
20	Equipment located on deck utilising hydrocarbons (e.g. cranes, winches or other hydraulic equipment) will have as a minimum primary bunding (i.e. deck edge lips or up-stands) to prevent loss of hydrocarbons to the marine environment.	
21	• An OPEP drill, appropriate to the response arrangements and nature and scale of the activity, will be conducted in Australian waters prior to the commencement of the survey and tested at least annually. • Response arrangements will be tested if they are significantly amended • All drill tests will be reported as per requirements MARPOL Annex I (Regulation 15) and reviewed as part of the ongoing monitoring and improvement of emergency control measures	• MARPOL is the main international convention covering the protection of pollution of the marine environment by ships from operational or accidental causes. Annex I Regulations for the Prevention of Pollution by Oil requires drill test reports and reviews. • Under the OPGGS(E) Regulations, an EP's implementation strategy must include an OPEP, with adequate arrangements for responding to and monitoring of oil pollution as well as regular tests of the response arrangements. The OPEP will comprise components of the survey vessel's SOPEP as well as statutory plans by the appropriate Commonwealth and State agencies, such as AMSA and WA DoT. Details of this EP's OPEP are in Section 3.8. • IAGC recommends vessel SOPEPs be readily available, reviewed regularly and implement associated spill clean-up drills. • APPEA recommends that all activities require appropriate emergency response plans to be prepared, in place and practised. • Thus, these Australian and international legislations are required for protecting the marine environment from hydrocarbon release by topside (vessel) loss of containment discharged from ships, and PGS is confident that these control measures are effective in reducing the associated environmental impacts and risks.

No.	Control Measure	Justification
22	In the event of a hydrocarbon spill to the sea from topside containment loss: • Implement response procedures in this EP's OPEP and SOPEP accordingly. • Allow small diesel spills to disperse and evaporate naturally, and monitor position and trajectory of any surface slicks • The survey vessel Master will inform the RCC Australia using a POLREP form. • Reporting will be undertaken as per Section 3.11 Reporting Arrangements.	• MARPOL is the main international convention covering the protection of pollution of the marine environment by ships from operational or accidental causes. Annex I Regulations for the Prevention of Pollution by Oil includes requirements for reporting pollution or potential pollution incidents. • The PSPPS Act Section 22 describes duty to report prescribed incidents, such as discharge of a liquid substance. • Marine Orders are regulations under Australian Commonwealth legislations and apply to Australian and foreign vessels. Marine Order 91 gives effect to MARPOL Annex I, as well as provisions of the *Navigation Act 2012* and the PSPPS Act, such as reporting requirements for marine incidents. • OPGGS Environment Regulations describes requirements for reportable and recordable incident notification, details of which are in Section 3.11. • IAGC recommends reporting spill or leaks according to both operator's procedures and local regulations. • Thus, these Australian and international legislations are required for protecting the marine environment from hydrocarbon release by topside (vessel) containment loss, and PGS is confident that these control measures are effective in reducing the associated environmental impacts and risks.

2.3.2.5 Summary of Environmental Risk Assessment

Residual Risk Assessment				
Potential Environmental Impact		**Consequence**	**Likelihood**	**Residual Risk**
Localised, temporary reduction in water quality	Marine fauna	Slight	Unlikely	Low
	Marine habitats			
	Biological communities			

2.3.2.6 Demonstration of ALARP

On the basis of the ERA conducted, the use of relevant decision-making tools appropriate to the decision type and the application of the 'Hierarchy of Controls' philosophy (below), the control measures described above are appropriate to manage the risk of hydrocarbon release cause by topside containment loss and to ensure that reasonable and practicable solutions have not been overlooked. Therefore, the residual risk ranking for this potential impact is considered Low, as good industry practice or comparable standards have been applied to control the risk, and any further effort towards risk reduction (e.g. additional, alternative or modified control measures) would not provide further environmental benefit and/or is not reasonably practicable without sacrifices that are grossly disproportionate to the benefit gained. The environmental impacts and risk are thus reduced to ALARP.	
Eliminate	Materials such as lubricating oils and hydraulic fluid are required routinely for safe and efficient operation of the survey and support vessels. If these materials are eliminated, additional safety risks to personnel (e.g. inability to maintain vessel equipment in good working order etc.) may be introduced. Also, the use of solid streamers eliminates potential impacts and risks from leaks/spills of streamer oil (i.e. Isopar fluid).
Substitute	Substitution of lubricating oils and hydraulic fluid used aboard the survey and support vessels with alternative products with better environmental performance characteristics (e.g. biodegradability; ecotoxicity; bioaccumulation and bioconcentration potential) is not warranted, as an accidental release would contain insignificant quantities and the environmental risk is low. However, before operations commence, hazardous substances will be assessed for their suitability and for substitution with alternative options that have better environmental performance characteristics. Where possible, PGS will choose environmentally friendly alternatives.
Engineering	Survey control measures will include effective, engineering solutions to prevent the hydrocarbon release from topside (vessel) containment loss: • If overfilled, the fuel day-tank will be fitted with an overflow routed to a containment tank to prevent spills. • Pumps will have remote, manually-operated shut-down devices. • Vents will be fitted with mechanical closure devices. • Vessels will have bunding of hazardous material storage areas and drip trays under equipment. • To further contain leaks or spills, hydrocarbons located above deck will be stored with secondary containment (e.g. bund, containment pallet, transport packs, etc.).
Isolation	PGS will implement additional control measures that isolate hydrocarbons stored on vessels, including: • primary bunding of hazardous material storage areas and drip trays under equipment • hydrocarbons located above deck stored with some form of secondary containment to contain leaks or spills (e.g. bund, containment pallet, transport packs, etc.).
Administrative	• PGS will ensure the efficient and timely application of relevant shipboard safety and administrative procedures: o Vessel SOPEPs in accordance with IMO as Resolution MEPC.54(32). o OPEP drill(s), appropriate to the response arrangements and nature and scale of the activity, will be conducted in Australian waters prior to the commencement of the survey and tested at least annually. o Four scheduled SOPEP drills per annum will be undertaken as per the seismic vessel standard operating procedure. o Support vessels will test SOPEP (OPEP) response arrangements prior to the commencement of the survey. o Response arrangements will be tested if they are significantly amended. o All drill tests will be reported as per MARPOL Annex I (Regulation 15) requirements and reviewed as part of the ongoing monitoring and improvement of emergency control measures. o The OPEP will be reviewed annually.

On the basis of the ERA conducted, the use of relevant decision-making tools appropriate to the decision type and the application of the 'Hierarchy of Controls' philosophy (below), the control measures described above are appropriate to manage the risk of hydrocarbon release cause by topside containment loss and to ensure that reasonable and practicable solutions have not been overlooked. Therefore, the residual risk ranking for this potential impact is considered Low, as good industry practice or comparable standards have been applied to control the risk, and any further effort towards risk reduction (e.g. additional, alternative or modified control measures) would not provide further environmental benefit and/or is not reasonably practicable without sacrifices that are grossly disproportionate to the benefit gained. The environmental impacts and risk are thus reduced to ALARP.	
	• In advance of a survey commencing, PGS will provide updated information of the survey operations to all stakeholders, e.g. AMSA RCC and NTM by AHS (for the issuance of NAVAREA X and AUSCOAST warnings), relevant fisheries, shipping and other petroleum titleholders. • All personnel will receive appropriate environmental induction and training (Section 3.3), including emergency response and spill management procedures, reporting procedures for environmental incidents or hazards and roles and environmental responsibilities of key personnel aboard the survey vessel.

2.3.2.7 Demonstration of Acceptability

The potential impacts of hydrocarbon release cause by topside containment loss are considered 'Broadly Acceptable ' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes, and good industry practice.		

Internal Context	Is the proposed management of the impact or risk aligned with the PGS Environment Policy and HSEQ Commitment Statement?	The control measures are consistent with the objectives of the PGS Environment Policy and HSEQ Commitment Statement (Appendix 3B):
		• PGS Environment Policy
		  ○ Prevent harm to the environment by reducing risk related to the activity
		  ○ Comply with applicable legal and industry standard requirements associated with the activity
		  ○ Achieve continual improvement in environmental performance.
		• HSEQ Commitment Statement (such as):
		  ○ Increase HSEQ awareness and reduce unsafe behaviour
		  ○ Reduce total risk exposure
		  ○ Prevent incidents
		  ○ Minimise harm to the environment.
		Thus, the control measures are acceptable to achieve PGS's environmental management requirements for this survey.

External Context – Social Acceptability	Have stakeholders raised any concerns about activity's impacts or risks, and if so, are measures in place to address those concerns?	Chapter 1 included all stakeholder consultation, including PGS' assessment of merits and claims as required by Regulation 16(b). The WA DMP requested further information with a summary of major environmental hazards and confirmation of the potential impact zone from a spill. This information was provided by PGS, as well as access to the full EP. No other stakeholders raised concerns or claims about hydrocarbon release from topside containment loss.

The potential impacts of hydrocarbon release cause by topside containment loss are considered 'Broadly Acceptable ' in accordance with the OPGGS(E) Regulations and based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes, and good industry practice.		
External Context – Natural Environment	Are the control measures providing appropriate protection to the receiving environment (e.g. sensitive or unique environmental features) from potential impacts and risks introduced by the activity?	The ERA concluded that potential spills from topside containment loss are of small quantities and will result in localised and temporary reducing in water quality. However, with control measures in place (i.e. SOPEP/OPEP, containment and bunding), potential spills into the marine environment are unlikely to occur. All known control measures have been adopted, and additional or alternative control measures would not provide additional environmental protection or benefit. Thus, the control measures provide appropriate protection to the receiving environment, and potential impacts and risks are of an acceptable level.
Legislation and Conventions	Is the impact or risk being managed in compliance with relevant Australian or international environmental management laws or standards (e.g. EPBC Act and Policy Statements, MARPOL, Navigation Act, etc.)?	Control measures to reduce impacts from hydrocarbon release caused by topside (vessel) loss of containment are compliant with relevant legislations and conventions, such as: • MARPOL Annex I Regulations for the Prevention of Pollution by Oil • *Navigation Act 2012* and PSPPS Act under Marine Order 91 (Marine pollution prevention — oil) • OPGGS(E) Regulations.
Industry Standards and Best Practice	Is the impact or risk being managed in accordance with industry standards, guidelines and best practice (e.g. APPEA Code of Environmental Practice, IAGC guidelines, etc.)?	Control measures to reduce impacts and risks from accidental hydrocarbon release by topside (vessel) containment loss are in accordance with industry standards and best practice, including: • IAGC Environmental Manual for Worldwide Geophysical Operations recommendations for SOPEPs, mitigation of spills and leaks and incident reporting. • APPEA Code of Environmental Practice recommends geophysical surveys have an environmental objective to reduce impacts from spill events, with evidence of appropriate management procedures and emergency response plan in-place.
Comparison of Predicted and Acceptable Levels	Are the predicted environmental impacts and risks within the defined acceptable levels (above)?	With implemented control measures, the predicted environmental impacts and risks are Low, ALARP and within the acceptable levels defined above (i.e. PGS Environment Policy and HSEQ Commitment Statement, external context, legislation, conventions, and industry standards and best practice). The extent, severity and duration of vessel discharges (such as bilge water, sewage and food wastes) will be short-term and localised.
ESD principles	Is the impact or risk being managed in accordance to the principles of ESD (as per the EPBC Act)?	The ERA presented in this EP demonstrated compliance with the principles of ESD: • decision-making processes integrated both long-term and short-term economic, environmental, social and equitable considerations (e.g. reducing impacts from hydrocarbon release caused by topside containment loss). • no threats of serious or irreversible environmental damage were identified. • the principle of inter-generational equity is maintained for the benefit of future generations. • the conservation of biological diversity and ecological integrity were fundamental considerations in decision-making and development of control measures. • that the approved control measures considered improved valuation, pricing and/or incentive mechanisms.

2.3.2.8 Summary of Environmental Performance

EPO	EPS	Control Measure No.	Measurement Criteria
Zero incidents of release of hydrocarbons to the marine environment resulting from spill to deck.	Hydrocarbon storage on deck of the survey vessel must be designed and maintained to have at least one barrier (i.e. form of bunding) including containment lips on deck (primary bunding) and/or secondary containment measures (bunding, containment pallet, transport packs, absorbent pad barriers) in-place.	19	• Pre-mobilisation audit confirms appropriate storage of hydrocarbons and equipment on deck.
	Equipment located on deck utilising hydrocarbons (e.g. cranes, winches or other hydraulic equipment) will have as a minimum primary bunding (i.e. deck edge lips or up-stands) to prevent loss of hydrocarbons to the marine environment.	20	
	• An OPEP drill, appropriate to the response arrangements and nature and scale of the activity, will be conducted in Australian waters prior to the commencement of the survey and tested at least annually. • Response arrangements will be tested if they are significantly amended. • All drill tests will be reported as per requirements MARPOL Annex I (Regulation 15) and reviewed as part of the ongoing monitoring and improvement of emergency control measures.	21	• OPEP and response arrangement testing reports.
Implementation of SOPEP/OPEP for all spills of hydrocarbons to sea.	In the event of a hydrocarbon spill to the sea from topside containment loss: • Implement response procedures in this EP's OPEP and SOPEP accordingly. • Allow small diesel spills to disperse and evaporate naturally, and monitor position and trajectory of any surface slicks • The survey vessel Master will inform the RCC Australia using a POLREP form. • Reporting will be undertaken as per Section 3.11 Reporting Arrangements.	22	If an oil spill event occurred, appropriate reporting procedures were followed and documented in: • POLREP • PGS Incident Reports • NOPSEMA Reports.

3. IMPLEMENTATION STRATEGY

3.1 ENVIRONMENTAL MANAGEMENT FRAMEWORK

The design and execution of proposed surveys within the NCB and Beagle OAs will be conducted under the framework of the PGS Environment Policy and HSE&Q Management System.

PGS will apply a tiered approach to optimising the environmental performance of the project and ensuring that PGS's environmental management standards and performance outcomes are achieved. The approach involves identification of local and regional environmental sensitivities, prioritisation of risks, determination of appropriate practices and procedures to reduce those risks, and clear designation of roles and responsibilities for implementation.

A series of work instructions, procedures and plans will be used for surveys undertaken within the Rollo OA to ensure that appropriate management measures are applied as required to minimise the risk of environmental disturbance from operations. The work instructions, procedures and plans are documented within corporate systems/manuals developed by PGS as well as documents written specifically for individual surveys undertaken within the NCB and Beagle OAs. Many of the procedures apply to all vessels in the PGS fleet; however, the associated work instructions are generally vessel specific.

Many of the procedures apply to all vessels in the PGS fleet, however the associated work instructions are generally vessel specific.

- HSEQ Management System Manual;
- Crew HSEQ Plan;
- Emergency Response Procedures including Oil Spill Response Procedure and Extreme Weather Procedures;
- HSEQ Management Procedures;
- Hazard Management Procedures;
- Environmental Management Procedures;
- PGS Marine Operations Offshore Bunkering Operations;
- Individual surveys within the NCB or Beagle Project Plan; and
- This EP.

An individual survey specific Project HSE&Q Plan will complement this EP, and will include procedures for the following:

- emergency response;
- waste management;
- hazardous materials and handling; and
- fuel/oil spills.

The Implementation Strategy for this EP includes an outline of:

- Environmental management strategies;
- Roles and responsibilities;
- Training and competency;
- Monitoring;
- Auditing;
- Management of non-conformance;
- Record keeping;
- Emergency response and contingency planning;
- EP review; and
- Stakeholder consultation.

PGS is responsible for ensuring that the proposed activities undertaken within the Rollo OA are managed in accordance with the Implementation Strategy and the PGS Environment Policy and HSE&Q Management System.

3.1.1 Pre-survey planning

At least eight weeks prior to individual surveys, PGS (i.e. PGS Vessel Manager and Environmental Adviser as per Section 3.2.1) shall undertake pre-survey planning that will review and consider the following at a minimum:

- Stakeholder consultation requirements as per Chapter 1 Section 2.3.
- New issues and or concerns raised by stakeholders.
- Changes to all relevant legislation or regulatory guidelines.
- Existing information in relation to any component of the receiving environment described in Chapter 2 (including BIAs, CMPs).
- Information from previous surveys, including but not limited to:
    - Marine fauna migration routes and frequency of sightings.
    - Avoidance of multiple surveys undertaken in same area if less than one year apart.
    - Potential for cumulative impacts from past or proposed surveys, if known.
- Search the NOPSEMA website and consult with geophysical companies and/or titleholders to determine the presence of other seismic operations overlapping the proposed OA.
- Changes to commercial fishery license areas, fishery status, current fishing effort and licence holders overlapping the OA based on:
    - Status reports and available data sources such as Fish Cube, of the fisheries and aquatic resources.
    - Current list of license holders extracts from the Fisheries Public Register.
    - Information provided directly by fishers, DPIRD-Fisheries and AFMA through the stakeholder consultation process.
    - Fishing locations.
    - Spawning areas.
- Potential military activities.
- Newly-available scientific literature.
- New acoustic source technology and justification for or against its implementation.

A summary of the pre-planning process is detailed in Figure 3-1 – PGS Pre-survey Planning Process.

If new information regarding the receiving environment relevant to the NCB and Beagle OAs is present, then an internal risk assessment will be conducted as described in Section 3.10. If sighting data is available from previous PGS surveys, or if new information regarding whale migration periods is available, the information will be used in planning the timing of individual surveys within the NCB and Beagle OAs. Should new technologies emerge during the life of the Rollo EP that would improve mitigations, and assessment of their use be ALARP, and should such technologies be broadly accepted and adopted by industry, then PGS will review and adopt such technologies accordingly.

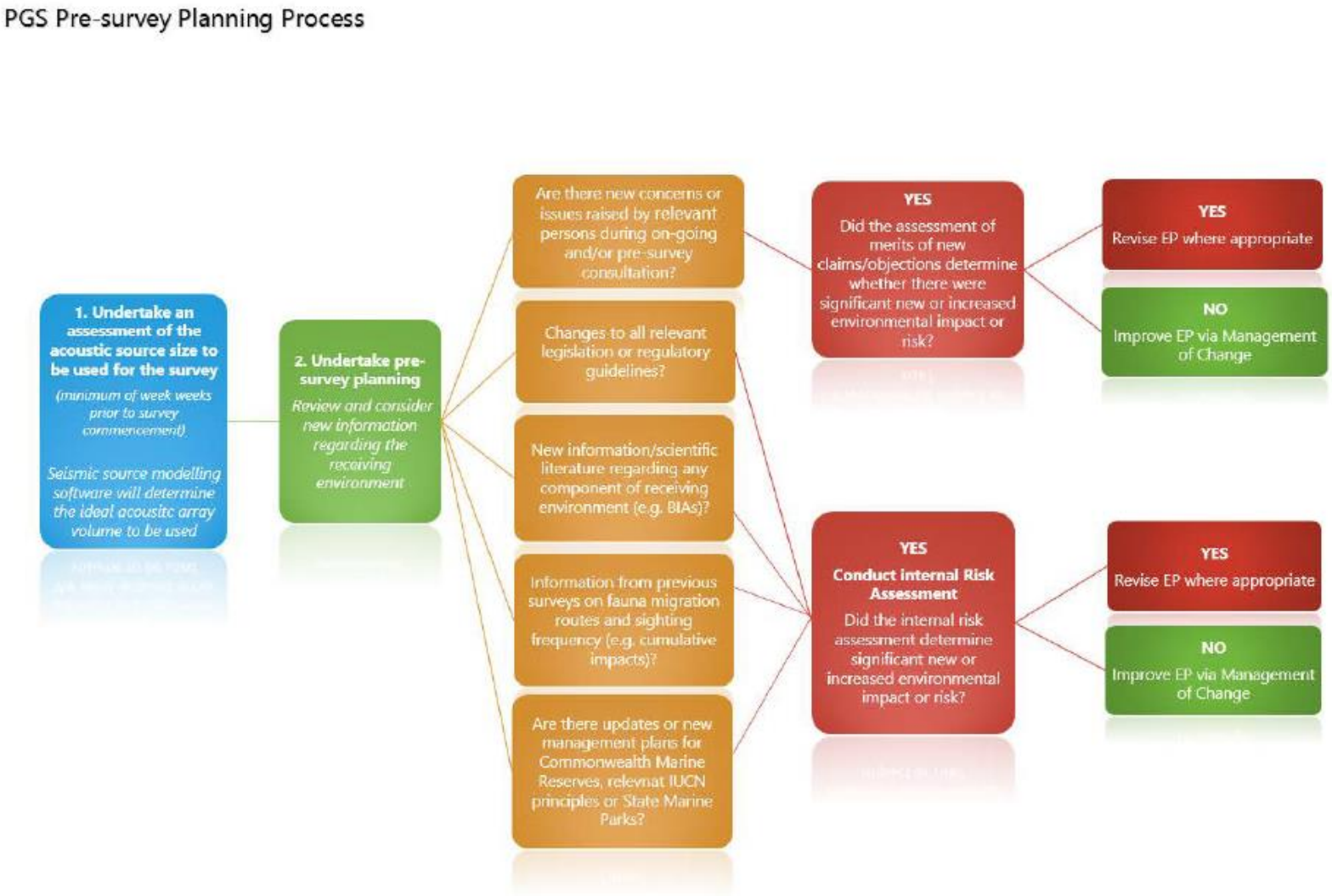

Figure 3-1 – PGS Pre-survey Planning Process

3.2 ROLES AND RESPONSIBILITIES

Key roles and responsibilities for PGS and contractor personnel in relation to implementation, management and review of this EP are described below. PGS' organisation structure and chain of command for the EP during operations is provided in Figure 3-2.

It is the responsibility of PGS's employees and contractors to ensure that the requirements of the corporate Environment Policy (Appendix 3B) are applied in their areas of responsibility and that the personnel are suitably trained and competent in their respective roles.

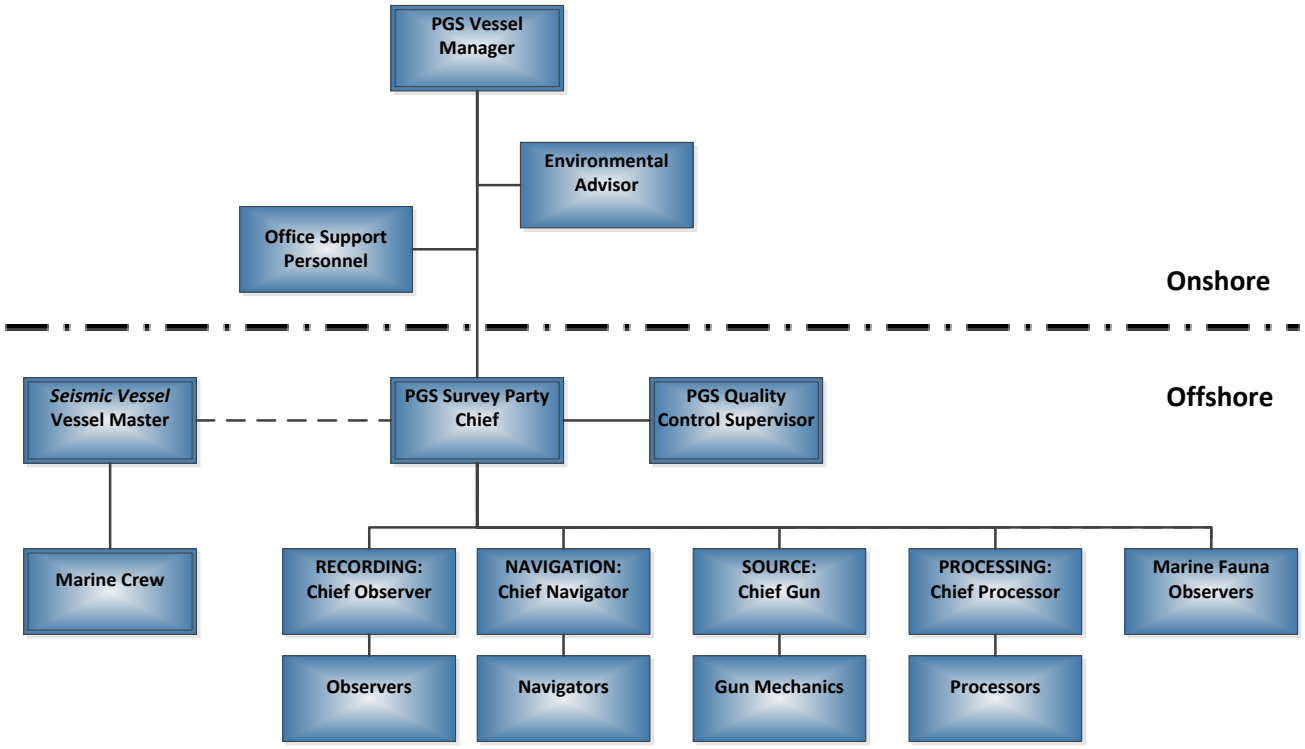

Figure 3-2 - Organisation structure

3.2.1 Shore Based Personnel

PGS Vessel Manager (VM - Primary Onshore Contact)

- Undertake pre-survey planning as defined in Section 3.1.1.
- Undertake risk assessment process as defined in Section 3.10.
- Ensure the activity is undertaken as per the performance outcomes of the EP.
- Provide sufficient resources to implement management measures to achieve the EP performance outcomes.
- Manage change requests for the activity and notifying the PGS QCS and MFOs of any scope changes in a timely manner.
- Liaise with regulatory authorities as required.
- Review the EP as necessary and manage change requests.
- Ensure environmental incident reporting meets regulatory requirements.
- Monitor and close-out corrective actions raised from environmental inspections/audits or incidents.
- Manage company resourcing and compliance with the HSE&Q Commitment Statement and Environment Policy.
- Communicate PGS operating policy and procedures.
- Commit necessary resources to facilitate an emergency response strategy in the event of an incident.
- Manage PGS's emergency response strategy in the event of an incident.

- Review results of compliance audit during the program and make recommendations where required.
- Ensure that all reportable and recordable incidents are reported to NOPSEMA.
- Ensure that a full briefing all project personnel is provided, including details of the environmental sensitivities of the OA and environmental management procedures and EPO detailed in this EP.
- Provide GIS data sets of spatial boundaries and exclusion zones, where appropriate, to seismic navigators and bridge personnel, to enter into navigational systems.
- Inform and advise PGS QCS : If adaptive management procedures have been triggered and operations are to be relocated or ceased.
- Ensure that the Annual Environmental Performance Report is prepared and submitted to NOPSEMA as per Section 3.11.

Environmental Adviser

- Prepare and revise the survey EP as necessary.
- Assist the VM in pre-survey planning process as defined in Section 3.1.1.
- Assist the VM in the risk assessment process as defined in Section 3.10.
- Prepare environmental induction and vessel inspection information.
- Provide a briefing to project personnel and survey vessel crew members of the environmental sensitivities of the OA, spatial boundaries and exclusion zones (where appropriate), environmental management strategies, EPO, and EPS detailed in the EP as part of the environmental induction process.
- Assist with review, investigation and reporting of environmental incidents.
- Ensure environmental inspections/audits are undertaken as per the requirements of the EP.
- Ensure stakeholder consultation is undertaken as per the requirements of the EP.
- Assist in preparation of external regulatory reports required for the survey, in line with environmental approval requirements and PGS incident reporting procedures.
- Assist in the preparation of the Environmental Performance Report (if required).
- Prepare the ECR (if required).

3.2.2 Vessel Based Personnel

Master Survey Vessel

- Ensure the safe execution of all operations of the survey vessel.
- Overall responsibility for HSE&Q management aboard the survey vessel.
- Ensure that appropriate control and mitigation measures are implemented to minimise potential environmental effects resulting from vessel operations (e.g. waste management/disposal; fuel/oil spill response).
- Immediately notify the PGS QCS of any incidents/activities arising from vessel operations that are likely to have a negative impact on the EPO detailed in this EP.
- Support the PGS Site Representative in ensuring that all relevant HSE&Q documents are understood and adhered to.
- Ensure compliance with this EP, and any relevant statutory regulations (e.g. vessel discharges to sea).
- Ensure that vessel procedures and systems comply with PGS standards as outlined in this EP.
- Report hydrocarbon or other chemical spillage to the PGS survey Party Chief.
- Establish and maintain radio contact with other vessels in the OA and adjacent waters.

Survey Vessel Chief Engineer

- Overall responsibility for operation and maintenance of engines, generators and other machinery aboard the survey vessel.
- Verify that the vessel's computerised PMS is used and updated and includes critical components and how to address them.
- Select the correct survey modes for each machinery component with special regard to fuel economy and life time costs for the different components.

- Verify that engine room log, oil record book and other logs are kept according to laws, regulations and vessel contractor's instructions.
- Have the daily supervision of the running of all machinery, including engines, compressors, propulsion and power supplies.
- Responsible for the maintenance in the engine department.
- Responsible for waste management systems dealing with sewage, grey water, putrescible wastes and bilge water.

Survey Party Chief

- Ensure safe execution of all operations carried out by the seismic crew aboard the survey vessel.
- Ensure that the following documents are aboard and in place:
    - HSE&Q Manual;
    - Emergency Response Procedures including Oil Spill Response Procedure and Extreme Weather Procedure;
    - HSE&Q Management Procedures;
    - Hazard Management Procedures;
    - Environmental Management Procedures; and
    - this EP.
- Ensures the seismic operations are consistent with:
    - PGS HSE&Q Commitment Statement and Environment Policy;
    - Project HSE Plan
    - this EP; and
    - relevant environmental legislative requirements or regulatory conditions.
- Provide a daily log of activities and environmental incidents to the PGS QCS.
- Ensure that appropriate control and mitigation measures are implemented to minimise potential environmental impacts resulting from seismic acquisition (e.g. soft start procedures, whale watch and stop work procedures).
- Ensure compliance with all aspects of HSE&Q reporting and for investigations of all incidents and near misses.
- Immediately notify the PGS QCS of any incidents/activities arising from seismic operations that are likely to have a negative impact on the EPO detailed in this EP.
- Liaise with PGS VM: When adaptive management procedures have been triggered and operations are to be relocated or ceased.

PGS Quality Control Supervisor (PGS QCS; Primary Offshore Contact)

- Ensure that the following documents are understood and adhered to:
    - HSE&Q Manual;
    - Emergency Response Procedures including Oil Spill Response Procedure and Extreme Weather Procedure;
    - HSE&Q Management Procedures;
    - Hazard Management Procedures;
    - Environmental Management Procedures; and
    - This EP.
- Facilitate clear communications between the Perth office, the PGS Operations Manager and the survey vessel personnel.
- Investigate any hydrocarbon spills >1 L in size.
- Ensure that, during surveys within the Rollo OA all sub-contractors perform operations in a manner consistent with the EPO and EPS detailed in this EP.
- Ensure that the survey vessel Master and Party Chief are adhering to the requirements of this EP.
- Monitor the implementation of the Part A - Standard Management Procedures for interactions with whales identified in this EP and the EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales (DEWHA, 2008a; DEWHA, 2008b).

- Be fully aware of ongoing operations, particularly for environmentally critical activities.
- Immediately alert the PGS Vessel Manager of any changes in operations that could have a negative impact on environmental performance.
- Immediately report any reportable incidents to the PGS Vessel Manager.
- Maintain records of daily logs, environmental incidents and waste inventory provided by the PGS survey Party Chief.
- Monitor and provide evidence of compliance to the environmental commitments as outlined in this EP and ensure the Environmental Compliance Register (ECR) is updated.
- Record and collate all measurable performance outcomes of the EP within the ECR.
- Assist in the preparation of the Environmental Compliance Register (ECR).
- Maintain the ECR.
- Ensure environmental inspections/audits are undertaken as per the requirements of the EP.
- Conduct a compliance audit during the survey and forward results to the PGS Vessel Manager.
- Assist the MFO team with visual observations for the presence of marine fauna and required EBPC Act - Policy Statement 2.1 reporting for cetacean interactions.
- Assist with review, investigation and reporting of environmental incidents.
- Assist in preparation of external regulatory reports required for the survey, in line with environmental approval requirements and the PGS HSE&Q incident reporting procedures.
- Bring to the immediate attention of the PGS Party Chief and PGS Vessel Manager any actions that are not compliant with the EP. Any recordable incident will be logged within the ECR.
- Prepare a report of the overall environmental performance upon completion of the survey, including the results of audits and any incidents, and forward to the PGS Vessel Manager.
- Perform MFO duties when MFO is unable to.

Marine Fauna Observers

- Maintain watch for cetaceans, whale sharks and turtles during the survey and advise the Master of the survey vessel, or Party Chief, and PAM operator (when PAM implemented) of the presence of these marine fauna.
- Ensure recording and reporting of cetaceans, whale sharks and turtle sightings.
- Monitor the implementation of the EPBC-A and EPBC-B, and adaptive management mitigation procedures identified in this EP.
- Monitor and record any interactions with cetaceans and other marine fauna.
- Provide a briefing to project personnel including details of environmental sensitivities of the individual survey area within the Rollo OA and environmental management procedures and performance objectives detailed in this EP.
- Monitor and provide evidence of compliance to the environmental commitments as outlined in this EP and ensure the environmental Commitments Register (ECR) is completed in conjunction with PGS QCS.
- Assist in the preparation of the MFO Final Report.
- Advise PGS QCS: When adaptive management procedures have been triggered and operations are to be relocated or ceased.

Passive Acoustic Monitoring (PAM) Operator

- Provide briefings to crew members and establish clear lines of communication and procedures for onboard operations.
- On duty watch, continually listening to received signals and/or monitoring PAM display screens to detect vocalising cetaceans.
- Use appropriate sample analysis and filtering techniques.
- Notify Master of the survey vessel, or Party Chief, and MFO when cetaceans identify providing information on distance and type of cetacean.
- Deploy, retrieve, test and optimise hydrophone arrays.

- Record and report all cetacean detections, including, if discernible, identification of species or cetacean group, position, distance and bearing from vessel and acoustic source.
- Record type and nature of sound, time and duration heard.
- Record general environmental conditions.
- Record acoustic source power output while in operation, and any mitigation measures taken.

Seismic Operators, Technicians and Vessel Crew

- Apply operating procedures in letter and in spirit.
- Follow good housekeeping procedures and work practices.
- Encourage improvement in environmental performance wherever possible.
- Immediately report environmental incidents or spillage of >1 L of hydrocarbons or other chemicals to the survey vessel Master and survey Party Chief.
- Vessel crews – monitor and record cetaceans pinnipeds, dolphins and porpoises.

3.3 TRAINING AND COMPETENCIES

3.3.1 Environmental Inductions

All personnel on the survey and support vessels will be given an HSE&Q induction prior to the commencement of individual surveys within the Rollo OA (this can be via a face-to-face presentation, website, or via email). The environmental component of the induction will include information on the following environmental issues.

- Description of the environmental sensitivities, heritage and conservation values of the individual survey area within the Rollo OA and surrounding waters.
- Overview of marine fauna likely to be in the area.
- Overview of spatial boundaries and exclusion zones (where appropriate).
- Procedures for interaction with marine fauna including EPBC 2-1 requirements.
- Importance of following procedures and using JHAs to identify environmental risks and mitigation measures.
- Procedures for reporting of any environmental incidents or hazards.
- Overview of emergency response and spill management procedures.
- Overview of the waste management requirements.
- Roles and environmental responsibilities of key personnel aboard the survey vessel.
- Chemical management requirements.
- Outline of environmental management measures, EPO, EPS and roles / responsibilities detailed in the EP. Identify EP Sections relevant to each department.

All personnel who undertake the induction will be required to sign an attendance sheet which is retained by the PGS VM. All vessel-based personnel will be required to conform to all applicable guidelines and requirements for management of HSE&Q issues. All crew on board the vessel/s will be made aware of and will be required to become familiar with the requirements of both relevant PGS' specific environmental management systems as well as the EP during the activity induction process. In addition, project specific EP requirements will be communicated to the vessel crew by the PGS QCS.

All personnel on the vessel are required to be competent to undertake their assigned positions. Specific responsibilities will be detailed in job descriptions and appropriate training provided to individuals with environmental responsibilities such as waste management measures; routine discharges; and deployment and recovery of streamer procedures. Training may be in the form of inductions, 'on the job' or external courses.

PGS shall ensure the vessel operator provides marine crew who are trained and competent to undertake their respective activities on-board the vessel. All marine personnel will be qualified in accordance with the International Convention on Standards of Training Certification and Watch Keeping for Seafarers (STCW95)

or Elements of Shipboard Safety as relevant. A training, induction and competency matrix will confirm that relevant crew have been trained as necessary for their position.

3.3.2 Vessel Master

The survey vessel Master shall possess appropriate skills, knowledge and qualifications to command the vessel.

3.3.3 Marine Fauna Observers

MFOs will have completed the JNCC Marine Mammal Observer Course or equivalent to meet the EPBC Policy Statement 2.1 requirements, MFOs will have been "*trained and experienced in whale identification and behaviour, distance estimation, and be capable of making accurate identifications and observations of whales in Australian waters*."

The lead MFO will also having a minimum of 10 weeks experience on a seismic survey vessel as an MFO.

3.3.4 Passive Acoustic Monitoring (PAM) Operator

PAM operators will have completed a PAM operator course with the lead PAM operator also having a minimum of 10 weeks experience on a seismic survey vessel as a PAM operator.

At a minimum the PAM operator course will include demonstrating proficiency in the following areas:

- Understanding mitigation and reporting requirements.
- Optimised deployment and configuration of PAM equipment to ensure effective detections of cetaceans for mitigation purposes.
- Detection and identification of vocalising species or cetacean groups.
- Measuring distance and bearing of vocalising cetaceans while accounting for vessel movement.
- Navigation (e.g. true vs magnetic north, course vs heading).
- Plotting positions of cetaceans in relation to vessel and acoustic source.
- Understanding relevant aspects of seismic survey operations.

3.4 MONITORING AND RECORD KEEPING

Environmental and other information will be monitored and recorded during surveys conducted within the Rollo OA.

In addition to the information presented in Chapter 3 - Section 2 & Chapter 2 – Section 2 the following will be monitored:

Parameter	Monitoring	Record Keeping	Frequency
HSE&Q Management System & Environment Policy	PGS's environmental management framework	PGS Internal audit of procedures listed in Section 3.1.	Annually

3.5 AUDITS AND INSPECTIONS

Environmental performance and the implementation strategy of all proposed surveys within the Rollo OA will be reviewed in several ways. These reviews are undertaken to ensure that:

- all significant environmental aspects of the activity are covered in the EP;
- that environmental management measures (including PGS's environmental management framework) to achieve EPO and EPS are being implemented, reviewed and where necessary amended;
- identification of potential non-conformances and opportunities for continuous improvement;
- that all EPO and EPS have been met before completing the activity: and
- that all environmental commitments contained in the Environmental Commitments Register (ECR) have been fulfilled.

The following arrangements will be established to review environmental performance and the implementation strategy of the activity:

- A summary of the EPO, EPS and MC for the activity (ECR) will be distributed aboard the survey vessel(s). These will be monitored on a regular basis for each phase, by the PGS QCS via mechanisms such as audits and inspections.
- An inspection(s) of the vessels will be carried out before or during each phase of the activity to ensure that procedures and equipment for managing routine discharges and emissions are in place to ensure compliance with the EP (Note: this requirement is not required if the same vessel is moving immediately from one survey to another under this EP).
- An inspection(s) of the vessels will be carried out annually or in the event of a contracted vessel; with every new contractor (whichever is more frequent) to ensure that contractor HSE&Q management systems are in accordance with all relevant requirements of PGS's environmental management framework and HSE&Q management system.
- A test of the oil spill emergency response arrangements will be conducted during the mobilisation phase of the survey (unless a test has already been undertaken in Australian waters within a month prior to mobilisation) to ensure vessel SOPEP is current and applicable.

Any non-conformances shall be reported, tracked and closed-out in accordance with Section 3.6.

The collection of data from audits, inspections and response tests will form the basis of demonstration that the EPO and EPS for the Rollo EP are being met, that specified mitigation measures are in place to manage environmental risks, and that they remain working, and contribute to continually reducing risks and impacts to ALARP.

PGS Management will review the environmental management framework, including the environmental performance and implementation strategy, upon completion of each phase of the activity. As part of each review, any new developments in the scientific understanding and knowledge of relevant impact and risks

will be reviewed. The results of the review and any identified improvements or recommendations will be incorporated into processes and procedures for future surveys to help facilitate continuous improvement.

3.6 MANAGEMENT OF NON-CONFORMANCE

Non-conformances from audits, inspections or response testing shall be tracked and monitored by the PGS QCS until closed.

PGS employees and contractors are required to report all environmental incidents and any non-conformance with an EPO or EPS detailed in the EP as well as PGS's environmental management framework and contractor HSE&Q systems as described in Section 3.4.

An internal risk assessment will be carried out where non-conformances suggest that specified mitigation measures no longer adequately demonstrate that the activity is managed to ALARP or where new developments in the scientific understanding and knowledge of impacts and risks is present. Any inadequacies and opportunities for improvements will be amended via a Management of Change process to ensure that environmental impact and risks of the activity are continually identified and reduced to a level that is ALARP and acceptable.

Incidents are reported using the PGS Event Reporting Management procedure using an Incident and Hazard Report Form that includes details of the event, immediate action taken to control the situation, and corrective actions to prevent reoccurrence.

Detailed investigations will be undertaken by PGS for all high potential environmental incidents, and these investigations will include the PGS QCS. The regulatory reporting requirements for this activity are outlined in Section 3.11 of this EP.

In the event of an environmental incident, crew management and relevant shore-based personnel will consult both the vessel specific environmental systems as well as the Rollo EP to determine the appropriate action.

The risk assessment process is outlined in Section 3.10.

3.7 EMERGENCY RESPONSE

3.7.1 Emergency Response Preparation

Survey-specific emergency response procedures for the Rollo OA are included in the individual survey's Project HSE&Q Plan. The Project HSE&Q Plan contains instructions for vessel emergency, medical emergency, search and rescue, reportable incidents, incident notification and contact information. In the event of an emergency of any type the survey vessel Master will assume overall onsite command and act as the Emergency Response Coordinator (ERC). All persons aboard the vessel/s will be required to act under the ERC's directions. The survey vessel will maintain communications with the PGS Vessel Manager and/or other emergency services in the event of an emergency. Emergency response support will be provided by VM if requested by the ERC.

The survey and support vessels will have equipment aboard for responding to emergencies, including but not limited to medical equipment, firefighting equipment and oil spill equipment.

3.7.2 Cyclone and Dangerous Weather Preparation

Tropical cyclones and other severe weather events have the potential to cause damage to survey equipment, risk to the safety and health of survey personnel and potential to cause spills of hazardous materials into the environment from damaged vessels. The proposed timing and duration for the proposed surveys that will be undertaken within the Rollo OA have not been finalised. Therefore, it is possible some surveys may be undertaken during the usual season for cyclones in the northwest of Australia. .

PGS has developed and implemented a cyclone contingency plan for all seismic surveys utilising its vessels, in accordance with the PGS Extreme Weather Procedure. This procedure will be applied during all individual

surveys within the Rollo OA and incorporated into the HSE&Q Plan for any survey. During the survey, the procedure will be implemented in the event of an approaching cyclone. The survey and support vessels will receive regular updates throughout the day via the Bureau of Meteorology (BoM) website (and from other websites), and if a cyclone looks to be forming within the region the vessels will leave the individual survey area within the Rollo OA for safer waters. Depending on the situation, the survey vessel may also retrieve the seismic equipment and in a worst-case scenario proceed to the nearest port.

3.8 OIL POLLUTION EMERGENCY PLAN

The OPEP for individual seismic surveys undertaken within the Rollo OA, considering the nature and scale of the activity and the potential spill risks involved (Chapter 2) comprises components of the survey vessel(s) SOPEP (being all vessels over 400 GRT involved in the survey) that manage the environmental impacts of a spill and operational monitoring, supported as required by applicable established, statutory OPEPs. Support/ chase vessels <400 GRT that are not obligated to have a SOPEP must have a spill response plan (or equivalent) that is accepted by PGS and covers spill response arrangements and spill monitoring. As such, the following plans are in place as a contingency in the unlikely event of an oil spill, which, represent the OPEP for this activity:

- Survey or support vessel(s) >400 GRT SOPEP - deals with spills which are either contained on the vessel or which can be dealt with from / by the vessel.
- Survey or support vessel(s) <400 GRT spill management plan - deals with spills which are either contained on the vessel or which can be dealt with from / by the vessel.
- National Plan for Maritime Environmental Emergencies (NATPLAN): Australian Maritime Safety Authority (AMSA) - is the Jurisdictional Authority (JA) and Control Agency (CA) for spills from vessel which affect Commonwealth waters, i.e. outside of 3 nm from the coast (AMSA, 2014).
- WA State Emergency Management Plan for Marine Oil Pollution (WestPlan-MOP) and DoT Oil Spill Contingency Plan (OSCP) - deals with spills from the vessels which affect WA State waters.

3.8.1 Vessel SOPEPs

The seismic and support vessels (if >400 GRT) SOPEP, which have been prepared in accordance with the IMO guidelines for the development of shipboard oil pollution emergency plans (resolution MEPC.54(32) as amended by resolution MEPC.86(44)), include emergency response arrangements and provisions for testing the SOPEP (oil pollution emergency drills), as required under Regulations 14(8AA), 14(8A) and 14(8B) to 14(8E) of the Environment Regulations.

Vessels <400 GRT that do not have a SOPEP must have a spill response plan that deals with spill response, pollution monitoring and provisions for testing the plan. These vessels shall be included in the survey OPEP drills.

3.8.2 Drills and Training

A drill test of the oil spill emergency response arrangements (OPEP) will be conducted during the mobilisation phase prior to commencement of an individual survey within the OA. Support vessel SOPEP/spill management plans will also be tested during the mobilisation phase as part of the OPEP. Response arrangements shall be tested if they are significantly amended.

All drill tests will be reported and reviewed after each drill as part of the ongoing monitoring and improvement of emergency control measures. Identified improvements or recommendations shall be addressed as outlined in Section 3.6.

The objective of testing is to:

- ensure that the OPEP and vessel SOPEP is current and applicable (including contact details) for dealing with a spill specific to the nature and location associated with an individual survey conducted within the Rollo OA.

- ensure type 1 'operational monitoring', such as spill surveillance and tracking, specific to the nature and location associated with an individual survey conducted within the Rollo OA, is appropriate, understood and practiced.

In compliance with Regulation 14(4) and 14(5), designated personnel will be trained to ensure they are familiar with their tasks and the equipment in the event of an oil spill.

Implementation and testing of the OPEP and survey vessel(s) SOPEP / spill management plan, plus adherence to the additional spill response and reporting measures detailed in Chapter 2, will enable PGS to demonstrate that environmental risks from fuel and oil spills during the proposed survey have been reduced to ALARP.

3.8.3 Initial Actions

As soon as an oil spill has been identified, the vessel Master will immediately initiate the vessel SOPEP/ spill management plan and first strike actions as outlined within it. Due to the nature and scale of the activity, credible spill scenarios and characteristics of diesel, the initial response to any spill will be to monitor and evaluate. The preferred strategy for diesel spills will be to allow small spills to disperse and evaporate naturally, and to monitor the position and trajectory of any surface slicks. Physical break-up using prop wash from the support vessel and repeated transits through the slick may be considered for larger slicks (following consultation with the Combat Agency - AMSA or WA DoT).

Priority actions in the event of a fuel or oil spill are to make the area safe, to stop the leak and to ensure that further spillage is not possible. All deck spills on board vessel(s) will be cleaned-up immediately, using appropriate equipment from the on-board spill response kits (e.g. absorbent materials, etc.) and any likelihood of discharge of spilt hydrocarbons or chemicals to the sea will be minimised. Following clean-up, a planned maintenance system (PMS) will be implemented on the survey vessel(s), to ensure that all equipment used during operations is in full working order and does not represent a hydrocarbon spill risk.

As listed in the SOPEP, the vessels carry spill containment and recovery kits with sufficient absorbent booms and materials to contain small to medium scale deck spills. The vessel Master will be responsible for ensuring that these kits are appropriately stocked throughout the proposed survey. Minor spills will be managed through housekeeping practices and the use of absorbent materials. Deck spills will not be discharged into the ocean.

3.8.3.1 Commonwealth Waters

In the event of an oil spill in Commonwealth waters, initial actions will be undertaken immediately by the survey vessel, and actions determined following immediate contact with relevant persons: AMSA activated as CA (under NATPLAN); PGS QCS; and PGS VM.

AMSA does not require titleholders to directly consult on OPEPs for seismic surveys or those addressing the operations of offshore supply vessels (AMSA, 2014). Such operations are already covered by existing NATPLAN arrangements. AMSA is the responsible CA for oil spills from vessels within the Commonwealth jurisdiction and will respond in accordance with its Marine Pollution Response Plan as approved by the AMSA Executive. Upon immediate notification of an incident, AMSA will assume control of the incident (AMSA, 2014).

If the oil spill is a reportable incident as defined under Regulation 4 of the Environment Regulations the PGS VM will contact NOPSEMA according to the requirements in Section 3.11.4.

If the oil spill impacts or has the potential to impact a Commonwealth Marine Park the Director of National Parks is to be notified via the Marine Reserve Compliance Duty Officer.

3.8.3.2 State Waters

If surface slicks appear likely to enter WA State waters, then subsequent actions will be determined in consultation with the relevant personnel (i.e. AMSA, PGS QCS and PGS VM) and the WA DoT under WestPlan–MOP and the their OSCP. A State DoT are the designated Hazard Management Agency (HMA) for oil spills from vessels within the WA State jurisdiction.

3.8.3.3 WA State Arrangements and DoT's role in Marine Oil Spill Response

The WA State DoT is the designated Hazard Management Agency (HMA) for oil spills from vessels within the WA State jurisdiction. DoT is a signatory to the Inter-governmental agreement under AMSA's NATPLAN. The DoT response network is comprised of two spate units:

- Maritime Environmental Emergency Response (MEER); and
- State Response Team (SRT).

The DoT is the HMA (*Emergency Management Act 2005*) for all Marine Oil Pollution, regardless of the source, in State waters (DoT, 2012). The DoT MEER Unit undertakes work to Prevent, Prepare, Respond and Recover (PPRR) from Marine Oil Pollution in State waters. The MEER coordinates the State Response Team, personnel trained and competent at the team leader level for equipment operations, shoreline clean-up and assessment. They are members of the National Response Team (NRT) and are trained and competent in roles ranging from team leader for equipment operations and shoreline response to Incident Management Team (IMT) roles. The MEER unit has access to AMSA's National Plan equipment to respond to spills in State waters. This equipment is located in Dampier and Fremantle.

In the event that a spill has any potential to enter WA State waters, the following response actions and descriptions are summarised from the DoT's Consultation Guidelines (DoT 2017):

- Report all actual or impending oil spills that are in, or may impact, State waters as soon as reasonably practicable and within two hours to the DoT MEER Duty Officer via the 24-hour reporting number (08) 9480 9924.
- DoT duty officer will advise whether a POLREP and/or SITREP are required.
- Depending on the nature and scale of the spill, the MEER will provide a liaison officer(s) to the PGS to assist with the State marine oil spill response coordination.
- Resources may be allocated from the SRT and equipment stockpiles where possible.

The MEER will work with the CA (AMSA) to determine protection priorities and undertake an initial and ongoing Net Environmental Benefit Analysis (NEBA) to determine the most appropriate response in State waters. These protection priorities determined at the time of a spill may differ from those originally identified in the accepted OPEP.

DoT has the expectation that the titleholder will design, fund and implement a scientific monitoring program to the satisfaction of the State. DoT will act on behalf of the State, providing whole of government advice (including from the Environmental Scientific Coordinator; ESC) to the titleholder that will determine the focus, scope and duration of the program. The titleholder should be sufficiently ready to mount a scientific monitoring program in State waters when required. If any clarification is required during the development of the scientific monitoring program from the State, this should be discussed during consultation with DoT to ensure the titleholder can be sufficiently prepared to mount the program rapidly if required.

3.8.4 Type I Operational Monitoring

In the event of an accidental event that resulted in a diesel spill to the waters surrounding the survey or support vessels, PGS would be responsible for undertaking Type I "Operational Monitoring" (unless AMSA as control agency directs otherwise) with the primary objective of spill surveillance and tracking. This monitoring will be implemented to:

- determine the extent and character of a spill;
- track the movement and trajectory of surface diesel slicks;
- identify areas/ resources / fauna potentially affected by surface slicks; and
- determine sea conditions/ other constraints.

Operational monitoring will commence immediately from the survey and/or support vessel(s) depending on which vessel is not involved in the collision. If safe and practicable to do so, the offshore PGS Representative or Marine Fauna Observer will monitor and document the progress of the oil spill, including location, movement and extent, including monitoring of wildlife. This operational monitoring will continue throughout

the response process until response termination or until advised otherwise by the control agency. (i.e. AMSA or DoT).

This oil spill monitoring will enable the necessary information to be provided to the relevant CA (AMSA or DoT) via a POLREP form to determine and plan appropriate response actions under NATPLAN (if this plan is activated). Operational monitoring and observation in the event of a spill may inform an adaptive spill response and scientific monitoring of relevant key sensitive receptors, including wildlife. Should monitoring indicate wildlife are likely to be impacted, the relevant CA will be notified. All oiled wildlife response strategies will be managed by AMSA as the appropriate CA. The responsibility of assessing the appropriateness of any oiled wildlife response strategy, and its implementation, lies with AMSA as the CA.

In addition, provisions for real-time oil spill monitoring and/or modelling may be undertaken by a third party. Specific monitoring / data requirements are:

- Estimation of sea state.
- Estimation of wind direction and speed.
- Locating and characterising any surface diesel slicks.
- GPS tracking.
- Manual or computer predictions (e.g. using ADIOS2 or real-time oil spill monitoring) of movement of surface slicks.
- GIS mapping.

This Type I monitoring will be restricted to daylight hours only, when surface slicks will be visible from the vessel. The information gathered from this monitoring will be passed on to AMSA, via the POLREP form, but also via ongoing SITREP reports following the initial spill notification to RCC Australia. If it is determined that modelling is required to predict the oil spill movements, this will be initiated within three hours of the spill occurring, particularly if the spill is likely to reach protected areas such as Eighty Mile Beach Commonwealth Marine Park or Bedout Island.

In the event of an oil spill, relevant environmental performance outcomes and standards as well as good industry practice will be adhered to (Chapter 2). PGS will implement, assist with, or contribute to (including funding if required) any other operational monitoring as directed by the CA.

3.8.5 Type II Scientific Monitoring

In the event of an oil spill, PGS will work with the relevant stakeholders during the initial action and communications (Section 3.8.3) to develop and implement appropriate Type II “Scientific Monitoring” to understand the impacts of the spill on the marine environment and any response activities appropriate to the nature and impact of the spill. This scientific monitoring will focus on relevant environmental and social receptors. If it is determined that Type II Scientific Modelling is required to monitor and evaluate the oil spill impacts on the marine environment, this will be initiated within three hours of the spill occurring, particularly if the spill is likely to reach protected areas such as Eighty Mile Beach Commonwealth Marine Park or Bedout Island.

Where a diesel spill enters Eighty Mile Beach Marine Park, the water surrounding Bedout Island, or the shoreline of Bedout Island scientific monitoring will be implemented to determine impacts of the spill on the marine environment and/or fauna. For individual surveys located within 30 km of within Eighty Mile Beach Marine Park or Bedout Island, PGS will consult with scientific monitoring service providers during the pre-survey planning phase to ensure they have the appropriate capability to undertake scientific monitoring applicable to the receptors within these areas. At a minimum this would include sediment and water quality and the capability to support fauna monitoring for whales, turtles and birds if these where identified as being impacted.

The relevant stakeholders for Type II Scientific Monitoring may include, but not be limited to, the following:

- CA (AMSA, WA State DoT)
- Director of National Parks
- Cth DoEE
- NOPSEMA

- Appropriate marine research and monitoring organisations, such as:
  - WA Marine Science Institution (WAMSI)
  - Australian Institute of Marine Science (AIMS)
  - University of Western Australia Oceans Institute
  - Environmental consultancy companies with appropriate expertise and experience in hydrocarbon spill monitoring.
- Marine contractors able to provide appropriate vessels for inshore/shallow water work.
- Key marine users in these protected areas.

The scientific monitoring program will be developed to ensure that it is sufficient to inform any remediation activities, particularly with respect to shoreline environments, and that it meets the monitoring guidelines and methodologies described in the following best practice guidance documents:

- AMSA Oil Spill Monitoring Handbook (AMSA, 2003a).
- Oil Spill Monitoring Background Paper (AMSA, 2003b).

PGS has insurance policies in place that would cover the costs of any Type I Operational Monitoring and Type II Scientific Monitoring required in the event of a large hydrocarbon spill resulting from its' activities or required to cover the costs of any clean-up or remediation activities following a spill. These policies cover activities in Australian Commonwealth and State waters, including the Rollo OA.

3.8.5.1 Requirements of Type II Monitoring Plan

The Type II Scientific Monitoring Plan (SMP) will include general steps for a timely first-strike response and on-going hydrocarbon spill surveillance, commencing as soon as possible, (but within 3 hours) after the oil spill incident has been identified. The key objectives are to gather as much information about the distribution, concentration and consistency of surface hydrocarbons generated during the spill at sea. This information is crucial in providing input to:

- Verification of spill modelling results and recalibrate spill trajectory models (Chapter 2).
- Understand the behaviour, weathering and fate of surface hydrocarbons.
- Identify environmental receptors and locations at risk.
- Inform on-going monitoring by third-party provider (if required) and continually assess the effectiveness of available response options.

The Type II SMP will also support subsequent assessments of the impact and/or recovery of natural resources by ensuring that the visible cause and effect relationships have been observed and recorded during the operational phase. The aim of the SMP is to be able to mobilise resources as soon as practicable, utilising the following methods:

- satellite tracking drifter buoy(s);
- trained observers in aerial platforms; and
- remote sensing imagery (satellite).

In the event of an oil spill, relevant environmental performance outcomes and standards as well as good industry practice have been established for the proposed survey activities (Chapter 2).

3.8.6 Reporting, Maintenance and Review

Any fuel or oil spills aboard either the survey or support vessels must be reported via the internal PGS Event Reporting Management. In the event of spillage of any oil or diesel spills to the sea, AMSA or DoT will be notified by the appropriate Vessel Master immediately (via RCC Australia using a POLREP form) to ensure prompt and appropriate mobilisation of relevant response plans. Any significant spills will be reported to NOPSEMA by PGS, as reportable incidents (Section 3.11.4).

A Planned Maintenance System (PMS) will be implemented on the survey and support vessels, to ensure that all equipment used during operations is in full working order and does not represent a hydrocarbon spill risk. Stocks of absorbent materials aboard the survey vessel will be checked for their adequacy and replenished as necessary prior to the commencement of activities.

The OPEP will be regularly reviewed to ensure it is appropriate to the nature and scale of the activities within its scope and to ensure maintenance of the response capability and the operator's preparedness. In compliance with Regulation 14(8AA) the OPEP will be continuously reviewed and kept up-to-date to ensure new information or improved technology can be incorporated as specified in the SOPEP.

3.9 ENVIRONMENT PLAN REVISION AND RESUBMISSION

The requirement for environment plan revision and resubmission could arise due to:

1) A non-conformance during the survey.
2) A stakeholder issue.
3) Changes to scope.
4) Change in titleholder – changes the manner in which the environmental impacts and risks of an activity are managed (Regulation 17[7]).

As required under Regulation 17 of the Environment Regulations, PGS will submit a revision of this EP to NOPSEMA if any of the following criteria are met:

- The commencement of any new activity, or any significant modification, change, or new stage of an existing activity, not provided for in this EP, [Reg17(5)].
- The occurrence of any [Reg 17(6)]:
    - significant new environmental impact or risk;
    - series of new environmental impacts or risks that collectively add a significant new level of environmental impact or risk;
    - significant increase in an existing environmental impact or risk;
    - series of increases in existing environmental impacts or risks that collectively add a significant new level of environmental impact or risk; and
    - Any significant change to the receiving physical, biological or socio-economic environment within, or immediately adjacent to, the Rollo OA.
- Internal risk assessment results during pre-survey planning as described in Section 3.10 suggest that the residual risk ranking for any part of the activity, has significantly increased, and is no longer ALARP or acceptable.

A risk assessment will be undertaken for all changes in scope to assess potential impacts of the change. If the change meets any of the criteria detailed above, a revision/resubmission of the EP will occur, and the proposed change to the activity will not commence until the revised EP has been accepted by NOPSEMA.

3.10 RISK ASSESSMENT PROCESS

The PGS Vessel Manager and Environmental Adviser (as per Section 3.2.1) will undertake an internal risk assessment will be if:

- Non-conformances suggest that specified mitigation measures no longer adequately demonstrate that the activity is managed to ALARP.
- New developments in the scientific understanding of impacts and risks suggest that risks and impact are no longer acceptable.
- Pre-survey planning confirms that new information regarding the receiving environment relevant to the Rollo EP survey activities.
- Any stakeholder claim or concern received before or during the activity (e.g. during pre-survey planning; see Section 3.1.1).
- The identification of any:
    - KEF not already described in this EP;
    - threatened species of cetacean, marine reptile, sharks and ray-finned fish and seabirds not already described in this EP; or
    - critical habitat/BIA for threatened species not already described in this EP, which has spatial overlap with the Rollo OA.

- A CMP Management Plan is approved while a survey is underway and with implications for the current survey area.
- Scope of EP changes.

The risk assessment methodology outlined in Appendix 3C includes steps to identify, analyse and evaluate the risks and impacts of the activities being undertaken within the Rollo OA. The decision making framework adopted has been designed to ensure that activities do not pose an unacceptable environmental risk, are ALARP and are in line with AS/NZS ISO 31000:2009 Risk management–Principles and guidelines and Oil & Gas UK Guidance on Risk Related Decision Making (2014).

In the event that:

- new information suggests that risks and impacts are no longer reduced to acceptable levels; or
- controls are no longer effective in reducing the risks and impacts to ALARP and acceptable levels;

then the process for identification of further controls through an internal risk assessment will follow that of the risk assessment methodology for this EP (Appendix 3C). Any opportunities for improvements identified through the internal risk assessment (i.e. new controls adopted) will be amended via a Management of Change.

- If, as a result of such a risk assessment, the residual risk ranking has significantly increased and is no longer ALARP or acceptable for a given risk for the activity, a revised EP will be prepared and submitted to NOPSEMA.

Management of Change

When amendments are made to the accepted EP via a Management of Change of PGS will:

- Implement the rigorous methods of environmental assessment as described in Appendix 3C when implementing MoC processes.
- Keep a comprehensive record of the consideration of Regulation 17 for each change.
- Demonstrate continuous reduction of impacts and risks to ALARP and acceptable levels by appropriately applying MoC processes to incremental improvements.
- Implement MoC processes prior to a change occurring to allow for exploration of alternative management options.
- In order to preserve transparency, changes made from the MoC process are to be independently reviewed and agreed by a third party environmental consultant and will be made available via the PGS stakeholder website.

3.11 REPORTING ARRANGEMENTS

3.11.1 Marine Fauna Reporting

A record of marine fauna interaction procedures employed during operations will be maintained. The MFO Final Report on the conduct of an individual survey within the Rollo OA, and any marine fauna sightings/interactions (including any whale-instigated shut-downs of the acoustic source) will be provided to DoEE within two months of the completion of each phase of the activity.

The report will contain:

- the location, date and start-up time of the survey;
- name, qualifications and experience of any MFO involved in the survey;
- the date / times / reasons when observations were hampered by poor visibility or high winds;
- the location and time any start-up delays, power downs or stop work procedures instigated;
- the location, time and distance of any fauna sightings; and
- the date and time of completion of the survey.

The following procedures will be implemented during the survey to ensure all marine fauna sightings are properly recorded and reported:

- detailed reports of all marine fauna sightings (cetaceans, whale sharks, turtles and dugong) and interactions will be recorded and reported and all cetacean sightings will be recorded using the DoEE Cetacean Sightings Application (CSA - Version 3 - BETA; http://data.marinemammals.gov.au/portal/csa/);
- at the completion of the survey, a copy of the report generated by the CSA will be provided to DoE as part of the MFO Final Report.

3.11.2 Environmental Performance Report

Regulation 26C requires that "*the titleholder report to the Regulator in relation to the titleholder's environmental performance for the activity, and provide that the interval between reports will not be more than one (1) year" [14(2)]*.

PGS will submit to NOPSEMA an environmental performance report (EPR) that will comprise a review of the achievements of the EPO and EPS for the relevant period. Environmental Performance Report shall be submitted within two months of completion of an individual survey under the Rollo EP. For surveys that continue for 12 months or more a report will be submitted within 2 months of any 12-month anniversary, followed by a final report on conclusion of the project covering the remaining period. There will be no longer than 12 months in-between reports, which will include:

- A review of the following routine activities and incident records:
  - start-up delays, power downs or stop work procedures instigated because of cetacean, whale shark or turtle sightings;
  - marine fauna sightings (cetaceans, whale sharks etc.) and interactions;
  - vessel/towed equipment and marine fauna interaction records;
  - vessel anchoring and grounding incidents;
  - accidental discharge of hazardous materials;
  - fuel and oil spills;
  - vessel collisions; and
  - negative interactions with other mariners, including commercial, traditional and recreational fisheries, diving vessels, shipping, defence and petroleum service vessels.
- An assessment of adherence to requirements of the EP, including the EPO and EPS.
- A review of all environmental incidents (recordable and reportable) and any other issues.
- Performance in fulfilling all commitments listed on the Environmental Commitments Register (ECR).

Regulation 26(C) requires "a titleholder undertaking an activity must submit a report to the Regulator in relation to the titleholder's environmental performance for the activity, at intervals provided for in the environment plan." The annual report shall be submitted to satisfy this requirement.

3.11.3 Start and end of activity notifications

As required under subregulation 29(1), PGS shall notify NOPSEMA that an activity is to commence, at least 10 days before the activity commences. This pertains to each phase within the survey activity.

As required under subregulation 29(2), PGS shall notify NOPSEMA that an activity is completed within 10 days after the completion. This pertains to each phase within the survey activity.

As required under Regulation 30, PGS shall notify DMP that an activity is to commence. This pertains to each phase within the survey activity.

3.11.4 Incident Reporting

Incidents that impact on the environment or have the potential to impact on the environment are to be reported via the PGS Event Reporting Management procedure using an Incident and Hazard Report Form that includes details of the event, immediate action taken to control the situation, and corrective actions to prevent reoccurrence.

Detailed investigations will be undertaken by PGS for all high potential environmental incidents, and these investigations will include the PGS QCS. The regulatory reporting requirements for this activity are detailed in Table 3-1.

Table 3-1 – Incident Reporting Requirements

Reporting Requirements	To Whom and Timeframes
Incident involving a Cetacean	
Death or injury to a cetacean (whales and dolphins). All cetaceans are protected in Commonwealth waters and, the EPBC Act requires that all collisions with whales in Commonwealth waters are reported and submitted to the National Ship Strike Database.	Secretary of the Cth Department of Environment within seven days. 1800 803 772 protected.species@environment.gov.au DEWLP Cetacean Hotline – 1300 136 017 https://data.marinemammals.gov.au/report/shipstrike
Recordable Incident Reporting	
A recordable incident is a breach of an environmental performance outcome or environmental performance standard, in the environment plan that applies to the activity; and is not a reportable incident.	Submit written report to NOPSEMA by 15th of every month
The recordable incident report must contain: (i) a record of all recordable incidents that occurred during the calendar month; and (ii) all material facts and circumstances concerning the recordable incidents that the operator knows or is able, by reasonable search or enquiry, to find out; and (iii) any action taken to avoid or mitigate any adverse environment impacts of the recordable incidents; and (iv) the corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the recordable incident; and (iv) the corrective action that has been taken, or is proposed to be taken, to prevent similar recordable incident.	

Reporting Requirements	To Whom and Timeframes
Reportable Incident Notification	
A reportable incident is an incident relating to the activity that has caused, or has the potential to cause, moderate to significant environmental damage. Based on the PGS Environment Consequence Categories this is an incident that has an actual or potential consequence of moderate or greater or at a minimum the following incidents: • Injury or death of a protected species. • A level 2/3 spill to the marine environment • Introduction of IMS • A negative interaction with another marine user. Negative interaction is defined in Chapter 2 Section 3.3.1.4.4. Incidents should also be reported to NOPSEMA and WA DMIRS if it has been reported to another government department or agency or there is the potential for media or stakeholder interest.	Report verbally (or by email if phone contact is not possible) to NOPSEMA as soon as practicable and in any case not less than 2 hours. As soon as practicable provide a written record of the notification to NOPSEMA, the Titles Administrator (NOPTA) and WA DMP. NOPSEMA 08-6461 7090 submissions@nopsema.gov.au WA DMIRS 0419 960 621 petroleum.environment@dmp.wa.gov.au NOPTA info@nopta.gov.au
The verbal notification must include: (i) all material facts and circumstances concerning the reportable incident that the titleholder knows or is able, by reasonable search or enquiry, to find out; and (ii) any actions taken to avoid or mitigate any adverse environmental impacts; and (iii) any corrective actions that have been taken, or is proposed to be taken, to stop, control or remedy the reportable incident. Written notification: The titleholder is not required to include in the record anything that was not included in the notification.	
Reportable Incident Reporting	
The initial notification of a reportable incident must be followed up by a written report. As a minimum, the written incident report will include: (i) all material facts and circumstances concerning the reportable incident that the titleholder knows or is able, by reasonable search or enquiry, to find out; and (ii) any actions taken to avoid or mitigate any adverse environmental impacts; and (iii) the corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the reportable incident; and (iv) the action that has been taken, or is proposed to be taken, to prevent a similar incident occurring in the future. Within 7 days after giving a copy of the reportable incident report to the NOPSEMA a copy must be given to the Titles Administrator and WA DMIRS.	As soon as practicable, and not later than 3 days following the incident NOPSEMA submissions@nopsema.gov.au WA DMIRS 0419 960 621 petroleum.environment@dmp.wa.gov.au NOPTA info@nopta.gov.au
Vessel Based Oil Spill in Commonwealth Waters	
AMSA must be notified immediately of a vessel-based oil spill incident in Commonwealth waters.	AMSA Marine Pollution Incidents: 1800 641 792Oil

Reporting Requirements	To Whom and Timeframes
Any spills greater than 10 tonnes in Commonwealth waters must be reported to AMSA within one hour. A pollution report (POLREP) should accompany the notification as soon as practicable	Online POLREP https://amsa-forms.nogginoca.com/public/polrep.html
An oil spill that has or has the potential to impact on WA state waters must also be reported to the WA Department of Transport Maritime Environmental Emergency Response (MEER).	WA DoT MEER: 08 9480 9924
DNP must be notified as soon as possible of a vessel based oil spill incident within the Oceanic Shoals Marine Park. Notification should include: • Titleholder details • Time and location of the incident • Proposed response strategies as per OPEP • Contact details for the response.	Marine Reserve Compliance Duty Officer Telephone: 0419 293 465.
Marine Pests	
Suspected or confirmed presence of any marine pests or disease must be reported to DPIRD-Fisheries within 24 hours by email This includes any organism listed on the WA Prevention List of Introduced Marine Pests, and any other non-indigenous organism, that demonstrates invasive characteristics.	biosecurity@fish.gov.au FishWatch tel: 1800 815 507

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APPENDIX 3A. LEGISLATION

Commonwealth legislation	Summary
Aboriginal and Torres Strait Islander Heritage Protection Act 1984	This Act provides for the preservation and protection from injury or desecration areas and objects that are of significance to Aboriginal people, under which the Minister may make a declaration to protect such areas and objects. The Act also requires the discovery of Aboriginal remains to be reported to the Minister.
Australian Heritage Council Act 2003	This Act identifies areas of heritage value listed on the Register of the National Estate and sets up the Australian Heritage Council and its functions.
Australian Maritime Safety Authority Act 1990	This Act specifies that the Australian Maritime Safety Authority's (AMSA) role includes protection of the marine environment from pollution from ships and other environmental damage caused by shipping. AMSA is responsible for administering the Marine Orders in Commonwealth waters.
Biosecurity Act 2015	The *Biosecurity Act 2015* provides the powers to assess and manage biosecurity risks associated with goods and conveyances (for example, aircraft and vessels). The Assessment and Management Regulation prescribes: • amounts for high-value goods and conveyances • an additional biosecurity measure that may be applied relating to goods – isolation • the kinds of goods that, if exposed to, would cause a conveyance to be subject to biosecurity control • who will be required to provide information to support an assessment of the level of biosecurity risk on an incoming aircraft or vessel • an additional biosecurity measure that may be applied to goods or conveyances – export.
Environment Protection and Biodiversity Conservation Act 1999 Environment Protection and Biodiversity Conservation Regulations 2000 Environment Protection and Biodiversity Conservation Amendment Regulations 2006	While the Environment Regulations under the OPGGS Act (see below) manage day to day petroleum activities and apply to any activity that may have an impact on the environment, the EPBC Act (Chapter 4) regulates assessment and approval of proposed actions that are likely to have a significant impact on a matter of National Environmental Significance (NES). Actions that are likely to have a significant impact on a matter of NES require approval by the Commonwealth Environment Minister; the assessment process is administered by the Department of Environment and Energy. The EPBC Act does not replace the need for an Environment Plan to be approved under the OPGGS (Environment) Regulations before an action can proceed. Schedule 8 of the EPBC Regulations outlines the Australian IUCN Reserve Management Principles. PGS shall have regard to these principles.
Historic Shipwrecks Act 1976 Historic Shipwrecks Regulations 1978	This Act protects shipwrecks that have lain in territorial waters for 75 years or more. It is an offence to interfere with any shipwreck covered by the Act.
Maritime Legislation Amendment (Prevention of Air Pollution from Ships) Act 2007	This Act implements the requirements of MARPOL 73/78 Annex VI for shipping in Commonwealth waters.
Navigation Act 2012	An act regulating navigation and shipping including Safety of Life at Sea (SOLAS). A number of Marine Orders enacted under this Act apply directly to offshore petroleum exploration and production activities:

Commonwealth legislation	Summary
	• Marine Order 17: Liquefied gas carriers and chemical tankers • Marine Order 21: Safety of navigation and emergency procedures • Marine Order 30: Prevention of collisions • Marine Order 47: Mobile Offshore Drilling Units • Marine Order 50: Special purpose ships • Marine Order 57: Helicopter Operations • Marine Order 59: Off-shore industry vessel operations • Marine Order 60: Floating Offshore facilities
Offshore Petroleum and Greenhouse Gas Storage Act 2006 Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (as amended January 2015)	Petroleum exploration and development activities in Australia's offshore areas are subject to the environmental requirements specified in the OPGGS Act and associated Regulations. The OPGGS Act contains a broad requirement for titleholders to operate in accordance with "good oil-field practice". Specific environmental provisions relating to work practices essentially require titleholders to control and prevent the escape of wastes and petroleum. The Act also requires that activities are carried out in a manner that does not unduly interfere with other rights or interests, including the conservation of the resources of the sea and sea-bed, such as fishing or shipping. In some cases, where there are particular environmental sensitivities or multiple use issues it may be necessary to apply special conditions to an exploration permit area. The holder of a petroleum title must maintain adequate insurance against expenses or liabilities arising from activities in the title, including expenses relating to clean-up or other remedying of the effects of the escape of petroleum. The OPGGS Environment Regulations provide an outcome based regime for the management of environmental performance for Australian offshore petroleum exploration and production activities in areas of Commonwealth jurisdiction. Key outcomes of the Environment Regulations include: • To ensure operations are carried out in a way that is consistent with the principles of ecologically sustainable development; • To adopt best practice to achieve agreed environment protection standards in industry operations; and • To encourage industry to continuously improve its environmental performance.
Ozone Protection Act 1989	This Act regulates the import, export and manufacture of ozone depleting substances such as firefighting equipment and refrigerants.
Protection of the Sea (Powers of Intervention) Act 1981 Protection of the Sea (Powers of Intervention) Regulations 1983	The Act authorises the Commonwealth to take measures for the purpose of protecting the sea from pollution by oil and other noxious substances discharged from ships and provides legal immunity for persons acting under an AMSA direction.
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 Protection of the Sea (Prevention of Pollution from Ships; Orders) Regulations 1994	This Act relates to the protection of the sea from pollution by oil and other harmful substances discharged from ships. This Act disallows any harmful discharge of sewage, oil and noxious substances into the sea and sets the requirements for a shipboard waste management plan. The following Marine Orders relating to marine pollution prevention have been put in place to give effect to relevant regulations of Annexes I, II, III, IV, V and VI of MARPOL 73/78: • Marine Order 91: Marine Pollution Prevention - Oil • Marine Order 93: Marine Pollution Prevention - Noxious Liquid Substances • Marine Order 94: Marine Pollution Prevention - Harmful Substances in Packaged Forms • Marine Order 95: Marine Pollution Prevention - Garbage

Commonwealth legislation	Summary
	• Marine Order 96: Marine Pollution Prevention - Sewage • Marine Order 98: Marine Pollution - Anti-fouling Systems • Marine Orders 97: Marine pollution Prevention - Air pollution
Protection of the Sea (Harmful Antifouling Systems) Act 2006	This Act relates to the protection of the sea from the effects of harmful anti-fouling systems. It prohibits the use of harmful organotins in ant-fouling paints used on ships.
Quarantine Act 1908 Quarantine Regulations 2000	This Act implements mandatory controls in the use of seawater as ballast in ships and the declaration of sea vessels voyaging out of and into Commonwealth waters. The regulations stipulate that all information regarding the voyage of the vessel and the ballast water is declared correctly to the quarantine officers.

APPENDIX 3B. PGS ENVIRONMENT POLICY & HSE&Q COMMITMENT

Environment Policy

BU: Corporate [COR] **Scope:** PGS Group [PGS] **Subject:** HSEQ **Doc Number:** POL-COR-PGS-071

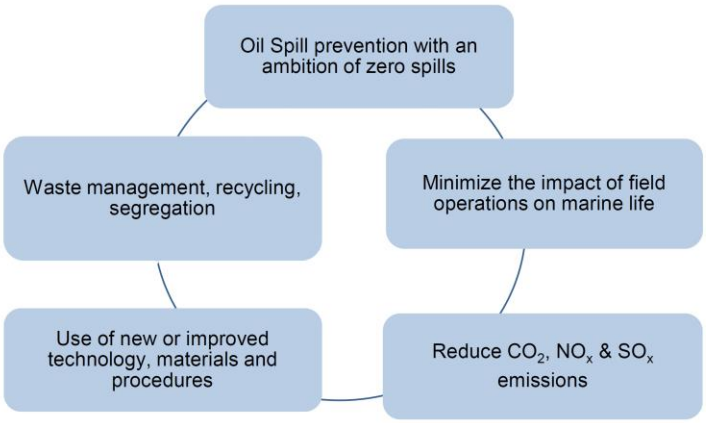
PGS RECOGNIZES THAT PROTECTION OF THE ENVIRONMENT IS OUR RESPONSIBILITY

We are committed to:

- Preventing harm to the environment by reducing risk related to our activities.
- Complying with applicable legal and industry standard requirements associated with our activities.
- Achieving continual improvement in environmental performance.

We are working in accordance with the ISO 14001 standard for environmental management in order to continuously improve how we measure, monitor and assess our environmental performance.

Key companywide environmental focus areas have been identified for monitoring environmental performance and achieving continual improvement.



Senior management participates in the review process and is responsible for resources being made available to maintain and communicate activities related to environment management within PGS.

This document applies to all employees, contractors, visitors and third parties.

PER ARILD REKSNES
EXECUTIVE VICE PRESIDENT
OPERATIONS

MAGNE REIERSGÅRD
EXECUTIVE VICE PRESIDENT
MARINE CONTRACT

SVERRE STRANDENES
EXECUTIVE VICE PRESIDENT
MULTICLIENT

GUILLAUME CAMBOIS
EXECUTIVE VICE PRESIDENT
IMAGING & ENGINEERING

RUNE OLAV PEDERSEN
CEO

GOTTFRED LANGSETH
CFO

*PGS SVP Joanna Oustad is appointed as the management representative with responsibility and authority to ensure that the Environment Management System is implemented and maintained.

Revision: 12 **Valid from:** 22/09/2017 **Author:** Joanna Oustad **Owner:** Rune Olav Pedersen **Page** 1 of 1

Our HSEQ Commitment

BU: Corporate [COR] **Scope:** PGS Group [PGS] **Subject:** HSEQ **Doc Number:** POL-COR-PGS-070

Ambition
Our ambition is to cause zero injury to people and minimum harm to the environment. To achieve this we are committed to be **safe, responsible, and productive. This applies to everyone, all the time.**

Policy
Health, Safety, Security, Quality and protection of the Environment are line management responsibilities fully endorsed and supported by senior management.

We commit to:

- living our HSEQ commitment at all times
- empowering our colleagues to lead by example and promote safe behavior
- acting responsibly and being accountable for our actions
- stopping any unsafe activity, intervening and welcoming intervention
- meeting customer expectations with high quality services
- complying with all applicable legal and other requirements
- ensuring continuous improvement

We shall identify, assess, mitigate and manage risks to employees, contractors, assets and the environment. This is in the best interest of all PGS stakeholders and essential for our long term business success.

Objectives

- Increase HSEQ awareness and reduce unsafe behavior
- Reduce total risk exposure
- Prevent incidents and personal injuries
- Minimize harm to the environment and achieve zero spills

This document applies to all employees, contractors, visitors and third parties.

PER ARILD REKSNES
EXECUTIVE VICE PRESIDENT
OPERATIONS

MAGNE REIERSGÅRD
EXECUTIVE VICE PRESIDENT
MARINE CONTRACT

SVERRE STRANDENES
EXECUTIVE VICE PRESIDENT
MULTICLIENT

GUILLAUME CAMBOIS
EXECUTIVE VICE PRESIDENT
IMAGING & ENGINEERING

RUNE OLAV PEDERSEN
CEO

GOTTFRED LANGSETH
CFO

*The SVP HSEQ Joanna Oustad is appointed as the management representative with responsibility and authority to ensure that the management system is implemented and maintained.

APPENDIX 3C. ENVIRONMENTAL RISK ASSESSMENT METHODOLOGY

1. ENVIRONMENTAL RISK ASSESSMENT

1.1.1 Risk Assessment Methodology

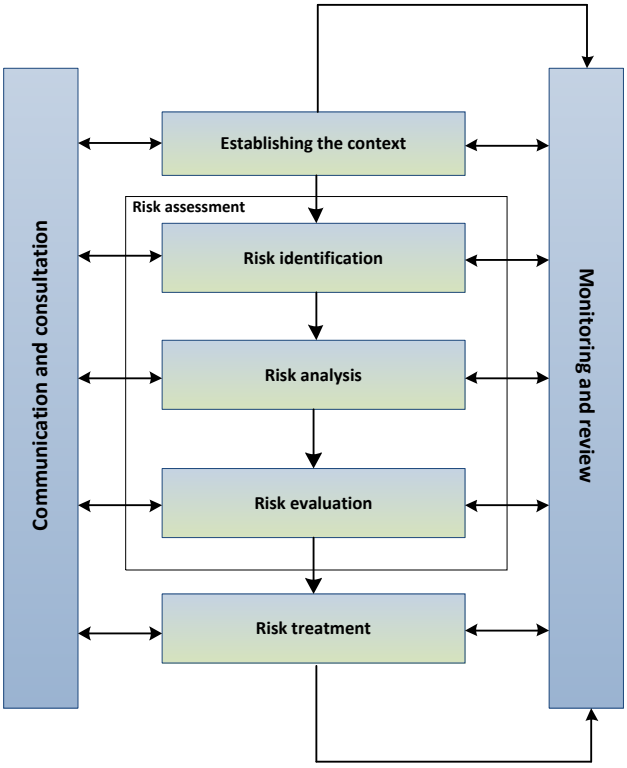
The ERA methodology applied is consistent with the Australian/New Zealand Standard AS/NZS ISO 31000:2009 Risk management–Principles and guidelines, Handbook HB 203:2012 Managing environment-related risk, and Handbook HB 89-2012 Risk management - Guidelines on risk assessment techniques. The risk assessment has been undertaken to identify the sources of risk (aspects) and potential environmental impacts associated with the activity and to assign a level of significance or risk to each impact.

The risk management methodology provides a framework to demonstrate:

- that the identified impacts and risks are reduced to ALARP; and
- the acceptability of impacts and risks.

The risk has been measured in terms of likelihood and consequence, where consequence is defined as the outcome or impact of an event, and likelihood as a description of the probability or frequency of the identified consequence occurring.

The key steps used for the risk assessment are shown in **Figure 1-1**.



Source: modified from AS/NZS ISO 31000:2009 Risk management

Figure 1-1 - Key steps used for risk assessment

1.1.2 Risk Identification and Analysis

The environmental risks associated with the proposed MS within the operational area have been assessed by a methodology that:

- identifies the activities and the environmental aspects associated with them;
- identifies the values/attributes at risk within and adjacent to the polygon;
- defines the potential environmental effects of the activities;

- identifies the likelihood of occurrence and potential consequences; and
- determines overall environmental risk levels using a likelihood and consequence matrix.

Risks were identified during the ERA for both planned (routine and non-routine) and unplanned (accidents/incidents) activities. Potential environmental impacts are then determined based on the stressor type.

Risk analysis further develops the understanding of a risk by defining the impacts and assessing appropriate controls. The risk analysis for MS within the operational area considered previous risk assessments for similar activities, review of relevant studies, review of past performance, external stakeholder consultation feedback and review of the existing environment and key sensitivities/values.

The following key steps were undertaken for each identified risk during the risk assessment:

- identification of decision type in accordance with the decision support framework (Section 1.1.3);
- identification of appropriate control measures (preventative and mitigation) aligned with the decision type; and
- determination of the residual risk rating (Section 1.1.4).

These steps have been described in the following sections.

1.1.3 Decision Making Framework

To support the risk assessment process, the Guidance on Risk Related Decision Making (Oil & Gas UK, 2014) has been utilized to determine the level of supporting evidence that may be required to draw sound conclusions regarding risk level and whether the risk is ALARP and acceptable.

This is to ensure:

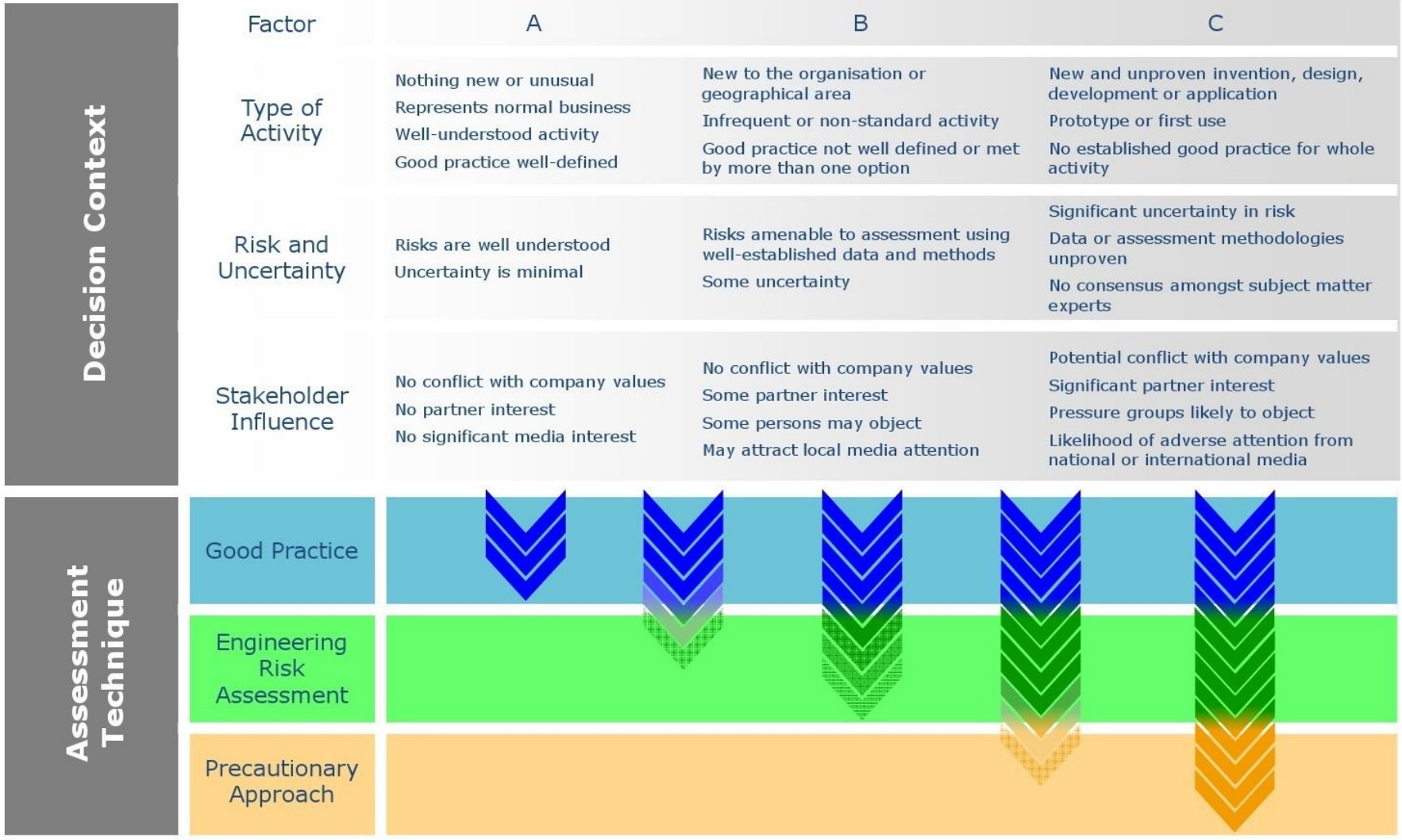
- activities do not pose an unacceptable environmental risk;
- appropriate focus is placed on activities where the risk is demonstrated to be ALARP and is anticipated to be acceptable; and
- appropriate effort is applied to the management of risks based on the uncertainty of the risk, the complexity and residual risk rating.

Determining whether risks have been reduced to ALARP requires an understanding of the nature and cause of the risk to be avoided and the sacrifice (in terms of safety, time, effort and cost) involved in avoiding that risk. The hierarchy of decision tools used in this case (from lowest risk to highest risk) has been adapted from the Guidance on Risk Related Decision Making (Oil & Gas UK, 2014; see Section 1.1.4).

Within the context of a specific decision situation, the framework provides a means to:

- Determine the relative importance of the various methods of assessing risk (e.g. by reference to standards, cost benefit analysis (CBA), or societal values).
- Judge which of these methods is best placed to determine whether the risks are tolerable and ALARP.

The framework provides appropriate tools, commensurate to the level of uncertainty or novelty associated with the risk (referred to as the Decision Type A, B or C - see Figure 1-2). The decision type is selected based on an informed decision around the uncertainty of the risk. This framework enables an appropriate understanding of a risk, and determination if the risk can be demonstrated to be ALARP and is acceptable.



Source: Oil & Gas UK (2014).

Figure 1-2 - Risk Related Decision Making Framework

Decision Type A

Risks classified as a Decision Type A are well-understood and established practice, they generally consider:

- legislation, codes and standards;
- good industry practice; and
- professional judgement.

Decision Type B

Risks classified as a Decision Type B are typically in areas of increased environmental sensitivity with some stakeholder concerns. These risks may deviate from established practice or have some life-cycle implications and therefore require further analysis using the following tools in addition to those described for a Decision Type A:

- risk-based tools such as cost based analysis or modelling; and
- company values.

Decision Type C

Risks classified as a Decision Type C will typically have significant risks related to environmental performance. The risks may result in significant environmental impact; significant project risk/ exposure; or may elicit strong stakeholder awareness and negative perception. For these risks, in addition to Decision Type A and B tools, company and societal values need to be considered by undertaking broader internal and external stakeholder consultation as part of the risk assessment process.

Decision Making Tools

The following framework tools are applied, as appropriate, to assist with identifying control measures based on the decision type described above:

- **Legislation, Codes and Standards (LCS)** - identifies the requirements of legislation, codes and standards which are to be complied with for the activity.
- **Good Industry Practice (GIP)** - identifies further engineering control standards and guidelines which may be applied over and above that required to meet the legislation, codes and standards.
- **Professional Judgement (PJ)** - uses relevant personnel with the knowledge and experience to identify alternative controls. When formulating control measures for each environmental impact or risk, the 'Hierarchy of Controls' philosophy, which is a system used in the industry to minimise or eliminate exposure to impacts or risks, is applied. The Hierarchy of Controls are, in order of effectiveness (**Figure 1-3**):
    - Eliminate;
    - Substitute;
    - Engineer;
    - Isolate;
    - Administrative; and
    - Protection.
- **Risk Based Analysis (RBA)** - assesses the results of probabilistic analyses such as modelling, quantitative risk assessment and/or cost benefit analysis to support the selection of control measures identified during the risk assessment process.
- **Company Values (CV)** - identifies values identified in PGS's HSEQ Policy.

- **Societal Values (SV)** - identifies the views, concerns and perceptions of relevant stakeholders and addresses relevant stakeholder concerns as gathered through consultation.

Note: administrative controls are included, where applicable, under Legislation, Codes and Standards and Good Industry Practice.

Although commonly used in the evaluation of occupational health and safety (OHS) hazard control, the Hierarchy of Controls philosophy is also a useful framework to evaluate potential environmental controls to ensure reasonable and practicable solutions have not been overlooked (**Figure 1-3**).

Control	Effectiveness	Seismic survey examples
Eliminate		Get rid of the impact or risk. Excess chemicals are returned to shore rather than discharged overboard.
Substitute		Change the impact or risk for a lower one. Substitute a large airgun array for a smaller one.
Engineering		Engineer out the impact or risk. Use solid streamers rather than fluid-filled streamers.
Isolation		Isolate people or the environment from the impact or risk. Avoid acquiring data near sensitive turtle nesting beaches during nesting season.
Administrative		Provide instructions or training to people to lower impact or the risk. The use of procedures (e.g. at sea refuelling procedures) and pre-work job hazard analysis (JHAs) to assess and minimise the environmental impacts or risks of an activity.

Figure 1-3 - Hierarchy of Controls

1.1.4 Residual Risk Rating Process

The residual risk rating process is undertaken to assign a level of risk to each impact measured in terms of consequence and likelihood. The assigned risk level is the residual risk (i.e. risk with controls in place) and is therefore determined following the identification of the decision type and appropriate control measures. The risk rating process considers the environmental impacts and where applicable, the social and cultural impacts of the risk.

1.1.5 Categorisation of Environmental Consequences

Environmental consequences arising from potential environmental aspects of the MSS have been categorised from Slight to Catastrophic (**Table 1.1**).

1.1.6 Assessment of Likelihood of Occurrence

The next step in the risk analysis process is to identify the likelihood of occurrence for the potential environmental impacts and risks according to the qualitative description in **Table 1.2**. The likelihood of occurrence (from Remote to Highly Likely) for the potential environmental impacts from the proposed MSS have been estimated based on industry incident reporting, previous ERA and professional judgement.

Table 1.1 - Environmental consequence categories

Consequence Category	Biodiversity and Ecosystem Function			Environmental Quality			Social	
	Protected Species	**Marine Primary Producer Habitat**	**Ecological Diversity**	**Water Quality**	**Sediment Quality**	**Air Quality**	**Protected Areas**	**Cultural**
Catastrophic	Local population eradication and/or loss of critical habitats/activities	Permanent eradication at regional scale	Permanent effects at regional scale	Permanent reduction in water quality. Known biological effect on a regional scale	Permanent contamination with known biological on a regional scale	Continuous damage to the environment and/or human health	Significant permanent effects on one or more of protected areas values	Significant, permanent effects on aesthetic, economic or recreational values. Overall societal benefits do not outweigh impacts
Massive	Extensive population-level effects. Significant effect on critical habitats/activities	Large-scale, long term effects. Recovery >10 years, or effects permanent	Large-scale, long term effects. Recovery >10 years or effects permanent	Continuous or regular discharge. Known biological effect concentrations on large scale (1-100 km²)	Long term contamination above background. Known biological effect concentrations on large scale	Sustained, exceedance over national/international air quality standards. Potential harm to the environment or human health	Significant long term effects on one or more of protected areas values	Significant long term effects on aesthetic, economic or recreational values. Overall societal benefits do not outweigh impacts
Major	Minor disruption to significant portion of population. Minor effects on critical habitats/activities. No threats to population viability	Localised but long term effects. Recovery >10 years, or effects permanent	Localised, long term effects. Community maintains ecological integrity with significant change in composition	Continuous or regular discharge. Known biological effect concentrations on medium scale (1-10 km²)	Short to medium-term contamination above background. Known biological effect concentrations on large scale	Major and temporary exceedance over national/international air quality standards. Potential harm to the environment or human health	Minor but long term or permanent effects on one or more of protected areas values	Major effects on aesthetic, economic or recreational values. Overall societal benefits do not outweigh impacts
Moderate	Minor disruption to small portion of population. Minor, temporary effects on critical habitats/activities. No threat to population viability	Localised, medium-term effects. Recovery 5-10 years	Localised, medium-term effects. Ecological integrity maintained with insignificant change to species composition	Continuous or regular discharge. Known biological effect concentrations on small scale (<1 km²)	Short to medium-term contamination above background. Known biological effect concentrations on medium scale	Moderate and temporary exceedance over national/international air quality standards. No harm to the environment or human health expected	Minor and medium-term effects on one or more of protected areas values. Full recovery expected	Moderate effects on aesthetic, economic or recreational values but overall societal benefits outweigh impacts
Minor	Minor and temporary disruption to small portion of population. No effects on critical habitats/activities	Localised, short term effects. Recovery in the timescale of months to <5 years	Localised, short to medium-term effects. Full recovery expected	Temporary discharge with contamination above background levels. Known biological effect concentrations on medium scale (<10 km²)	Temporary contamination above background. Known biological effect concentrations on medium scale	Minor and temporary exceedance over national/international air quality standards. No harm to the environment or human health expected	Minor and short term effects on one or more of protected areas values. Full recovery expected	Minor and temporary effects on aesthetic, economic or recreational values
Slight	Possible incidental effects to flora and fauna in a locally affected environmental setting	Localised, temporary effects. Recovery in the timescale of days to weeks	Localised, temporary effects. Slight impact on ecological integrity or species composition	Temporary discharge with contamination above background levels. Known biological effect concentrations on small scale (<1 km²)	Temporary contamination above background. Known biological effect concentrations on small scale	Slight, temporary exceedance over national/international air quality standards. No harm to the environment or human health expected	Slight to negligible effects on any protected area values	Slight to negligible effects on aesthetic, economic or recreational values

Table 1.2 - Operational likelihood categories

Categories	Likelihood Description		
	Definition	**Probability**	**Experience History of occurrence in Company or industry**
Remote	Once every 10,000-100,000 years at location	1 in 100,000-1,000,000	Unheard of in the industry
Highly Unlikely	Once every 1,000-10,000 years at location	1 in 10,000-100,000	Has occurred once or twice in the industry
Unlikely	Once every 100-1,000 years at location	1 in 1,000-10,000	Has occurred many times in the industry, but not in the Company
Possible	Once every 10-100 years at location	1 in 100-1,000	Has occurred once or twice in the Company
Likely	Once every 1-10 years at location	1 in 10-100	Has occurred frequently in the Company
Highly Likely	More than once a year at location or continuously	>1 in 10	Has occurred frequently at the location

Table 1.3 - Environmental event potential matrix

		LIKELIHOOD LEVEL					
		Remote	**Highly Unlikely**	**Unlikely**	**Possible**	**Likely**	**Highly Likely**
CONSEQUENCE LEVEL	**Catastrophic**	**2**	**2**	**1**	**1**	**1**	**1**
	Massive	**3**	**2**	**2**	**1**	**1**	**1**
	Major	**3**	**3**	**2**	**2**	**1**	**1**
	Moderate	**4**	**3**	**3**	**2**	**2**	**1**
	Minor	**4**	**4**	**3**	**3**	**2**	**2**
	Slight	**4**	**4**	**4**	**3**	**3**	**2**

Operational Risk Levels

Risk Level 1: **SEVERE** risk, apply strict Precautionary Principle.

Risk Level 2: **HIGH** risk, apply industry best practice to reduce to ALARP.

Risk Level 3: **MEDIUM** risk, apply standard cost-benefit approach to reduce risk to ALARP.

Risk Level 4: **LOW** risk, apply normal business management practice to avoid impact.

The residual risk rating process is performed using the following steps:

Select the Consequence Level:

- Determine the worst case credible outcome (**Table 1.1**) associated with the selected event assuming some controls (prevention and mitigation) have failed. Where more than one impact applies (e.g. environmental and social/cultural), the consequence level for the highest severity impact is selected.

Select the Likelihood Level:

- Select the likelihood level (**Table 1.2**) from the description that best fits the chance of the selected consequence actually occurring, assuming reasonable effectiveness of the prevention and mitigation controls (i.e. the likelihood is a combination of the chance of the incident actually occurring, and the selected consequence actually occurring.

Calculation of the Residual Risk Rating:

The residual risk rating is then determined by a comparison of the selected consequence and likelihood levels using the environmental event potential matrix shown in Table 5.3, and an assignment of a level of residual risk.

1.2 RISK EVALUATION

Environmental risks cover a wider range of issues, multiple species, persistence, reversibility, resilience, cumulative effects and variability in severity. The degree of environmental risk and the corresponding threshold for acceptability has been adapted to include principles of ecological sustainability (given as an objective in the Environment Regulations and defined in the EPBC Act), the Precautionary Principle and the corresponding environmental risk threshold decision-making principles used to determine acceptability.

1.2.1 Demonstration of ALARP

As outlined in Appendix 3C-Section 1.1.3, impacts and risks are reduced to ALARP where:

- The residual risk is **LOW**:
    - good industry practice or comparable standards have been applied to control the risk, because any further effort towards risk reduction is not reasonably practicable without sacrifices grossly disproportionate to the benefit gained.
- The residual risk is **MEDIUM** or **HIGH**:
    - good industry practice is applied for the situation/ risk; or
    - alternatives have been identified and the control measures selected to reduce the impacts and risks to ALARP. This may require assessment of Company and industry benchmarking, review of local and international codes and standards, consultation with stakeholders etc.

1.2.2 Demonstration of Acceptability

The following process has been applied to demonstrate acceptability (as illustrated in Table 1.5):

- **LOW** residual risks are 'Broadly Acceptable', if they meet legislative requirements, industry codes and standards, regulator expectations, the PGS Environment Policy and industry guidelines.
- **MEDIUM** and **HIGH** residual risks are 'Broadly Acceptable' if ALARP can be demonstrated using good industry practice, risk based analysis, if societal concerns are accounted for and the alternative control measures are disproportionate to the benefit gained.
- **SEVERE** residual risks are 'Intolerable' and therefore 'Unacceptable'. Risks will require further investigation and mitigation to reduce the risk to a lower and more acceptable level. If after further investigation the risk remains in the severe category, the risk requires appropriate business sign-off to accept the risk.

Table 1.4 - Residual risk levels and associated decision making tools and principles

Residual Risk Level	Environmental Threshold	Decision Making Tools	Environmental Decision Principles
LOW Broadly Acceptable Zone	No substantial risk (i.e. negligible risk) of harm to species or communities	Comparison to codes and standards, good oilfield practice and professional judgement are used to assess risk acceptability	If the environmental risk of the hazard has been found to be 'Broadly Acceptable' and the control measures are consistent with applicable standards and good industry practice, then no further action is required to reduce the risk further. However, if a control measure that would further reduce the impact or risk is readily available, and the cost of implementation is not disproportionate to the benefit gained, then it is considered 'reasonably practicable' and should be implemented.
MEDIUM / HIGH ALARP Zone	Likely to cause, or substantial risk of causing serious harm to non-listed species or communities	Risk based analysis are used in addition to comparison to codes and standards, good oilfield practice and professional judgement to assess risk acceptability.	An iterative process to identify alternative / additional control mechanisms has been conducted to reduce the risk to the 'Broadly Acceptable' zone. However, if the risk cannot be reasonably reduced to the 'Broadly Acceptable' zone without grossly disproportionate sacrifice; then the mitigated environmental risk is considered to be ALARP.
SEVERE Intolerable Zone	Likely to cause, or substantial risk of causing significant impact to protected species or communities	All of above decision making tools apply plus consideration of company values and societal values	If the environmental impact or risk has been found to fall within this zone then the activity should not be carried out. Work to reduce the level of risk should be assessed against the Precautionary Principle with the burden of proof requiring demonstration that the risk has been reduced to the ALARP Zone before the activity can be commenced.

Table 1.5 - Acceptability criteria

Criteria	Question	Acceptability demonstrated
Policy compliance	Is the proposed management of the impact or risk aligned with the PGS Environment Policy?	The impact or risk must be compliant with the objectives of the company policies.
Management System compliance	Is the proposed management of the impact or risk aligned with the PGS HSEQ Management System?	Where specific PGS procedures and work instructions are in place for management of the impact or risk in question, acceptability is demonstrated.
Social acceptability	Have stakeholders raised any concerns about activity impacts or risks, and if so, are measures in place to manage those concerns?	Stakeholder concerns must have been adequately addressed and closed out.
Laws and standards	Is the impact or risk being managed in accordance with existing Australian or international laws or standards, such as EPBC Policy Statements, MARPOL, AMSA Marine Orders, Marine Notices etc.?	Compliance with specific laws or standards is demonstrated.
Industry best practice	Is the impact or risk being managed in line with industry best practice, such as APPEA Code of Environmental Practice, IAGC guidelines etc.?	Management of the impact or risk complies with relevant industry best practice.
Environmental context	Is the impact or risk being managed pursuant to the nature of the receiving environment (e.g. sensitive or unique environmental features generally require more management measures to protect them than environments widely represented in a region)?	The proposed impact or risk controls, EPO and EPS must be consistent with the nature of the receiving environment.
Environmentally Sustainable Development (ESD) Principles	Does the proposed impact or risk comply with the APPEA Principles of Conduct (APPEA 2003), which includes that ESD principles be integrated into company decision-making.	Acquisition of 2D and 3D MS and CSEM surveys within the operational area is consistent with the APPEA Principles of Conduct.
ALARP	Are there any further reasonable and practicable controls that can be implemented to further reduce the impact or risk?	There is a consensus that residual risk has been demonstrated to be ALARP.

1.3 ENVIRONMENTAL RISK EVALUATION

The EP describes the results of the risk evaluation for proposed MS within the operational area using the methodology in this appendix. As required by the Environment Regulations, this evaluation demonstrates that the impacts and risks associated with proposed MS within the operational area will be reduced to as low as reasonably practicable (ALARP) and will be of an acceptable level.

The risks identified during the ERA process (including Decision Type, residual risk level and acceptability of residual risk; refer Table 1.1) have been divided into two broad categories: Planned (routine and non-routine); and Unplanned (accidents or incidents) activities. Both of these categories have then been further divided into impact assessment groupings based on stressor type e.g. noise, equipment loss etc.

The risk evaluation in Chapter 3 and Chapter 2 is presented in the following way:

- Description of Risk - a description of the identified risk including sources or threats that may lead to the risk or identified event.
- Potential Environmental Impacts - a discussion and assessment of the potential environmental impacts.
- **Environmental Performance Outcomes** - a description of a measurable level of performance required for the management of environmental aspects of the activities to ensure that the environmental impacts and risks will be of an acceptable level.

- **Environmental Performance Standards** - a statement of performance required of a control measure. This includes a description of the control measures in place to reduce the impact and control the risk. These control measures have been presented according to the methodology described in Section 1.
- Demonstration of ALARP and Acceptability - a demonstration that the environmental impacts and risks will be reduced to ALARP and will be of an acceptable level, and the rationale for these statements.
- EPS Documentation - links to any legislation, standards, codes, good industry practice guidelines etc., and internal management procedures referred to in each individual EPS.