

The CarbonNet Project



Pelican 3D Marine Seismic Survey

Environment Plan Summary

16 January 2018 (Rev 1)



Economic Development
Jobs, Transport
and Resources

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This is Revision 1 of the CarbonNet Pelican 3D Marine Seismic Survey (3DMSS) Environment Plan (EP) Summary.

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PREPARED FOR ACCEPTANCE

DATE: 18/12/2017

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APPROVED FOR RELEASE

DATE: 19/12/2017

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BUILD STATUS

Rev	Date	Author	Reason	Reviewers
1	19/01/2018		Final EP Summary accepted by NOPSEMA and DEDJTR (ERR)	
1	16/01/2018	MB	To address comments from NOPSEMA and DEDJTR (ERR)	NOPSEMA, DEDJTR (ERR)
0	19/12/2017	GP	Issue to regulators	NOPSEMA, DEDJTR (ERR)
A	18/12/2017	GP	Internal review of draft	IF, VMDC

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Acronyms

Acronym	Definition
2D	Two-dimensional
3D	Three-dimensional
AASM	Airgun Array Source Model
ABS	Australian Bureau of Statistics
ACCOBAMS	Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area
AFMA	Australian Fisheries Management Authority
AHO	Australian Hydrographic Office
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
AMOSC	Australian Marine Oil Spill Centre
AMSA	Australian Maritime Safety Authority
APPEA	Australian Petroleum Production and Exploration Association
AS/NZS	Australian Standard/New Zealand Standard
ASBTIA	Australian Southern Bluefin Tuna Industry Association
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic and Neath Seas
BACI	Bore-After-Control-Impact
BIA	Biologically Important Area
BMG	Baska-Manta-Gummy
BOD	Biological Oxygen Demand
BOEM	Bureau of Ocean Energy Management
BPEM	Best Practice Environmental Management
CAMBA	Agreement between the Government and Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment
CCS	Carbon Capture and Storage
CER	Commission for Energy Regulation (UK)
CFA	Commonwealth Fisheries Association
CFSR	National Centre for Environmental Prediction Climate Forecast System Reanalysis
CHARM	Chemical Hazard And Risk Management
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMID	Common Marine Inspection Document
CMR	Commonwealth Marine Reserve
CO ₂	Carbon Dioxide

CoEP	Code of Environmental Practice
COLREG	Convention on the International Regulations for Preventing Collisions at Sea
CPUE	Catch Per Unit Effort
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAWR	Department of Agriculture and Water Resources (Cth)
DEDJTR	Victorian Department of Economic Development, Jobs, Transport and Resources (Vic)
DELWP	Department of Environment, Land, Water and Planning (Vic)
DGPS	Differential Global Positioning System
DIIS	Department of Industry, Innovation and Science (Cth)
DoD	Department of Defence (Cth)
DoE	Department of the Environment (Cth) (<i>former</i>)
DoEE	Department of Environment and Energy (Cth)
DoF	Department of Fisheries (WA)
DP	Dynamic Positioning
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities (Cth) (<i>former</i>)
EAC	East Australian Current
EARPL	Esso Australia Resources Pty Ltd
EEZ	Exclusive Economic Zone
EGCMA	East Gippsland Catchment Management Authority
EIA	Environmental Impact Assessment
EIAPP	Engine International Air Pollution Prevention
EMBA	Environment that May Be Affected
EMD	Emergency Management Division (of DEDJTR)
EMS	Environmental Management System
EP	Environment Plan
EPA	Environment Protection Authority (Vic)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Cth)
EPO	Environmental Performance Outcome
EPS	Environmental Performance Standard
ERC	Emergency Response Coordinator
ERP	Emergency Response Plan
ERR	Earth Resources Regulation (division of DEDJTR)
ESD	Environmentally Sustainable Development
FAQ	Frequently Asked Questions
FEED	Front End Engineering and Design
FFG Act	Flora and Fauna Guarantee Act 1988 (Vic)

FPSO	Floating Production Storage Offloading
FRC	Fast Rescue Craft
FRDC	Fisheries Research Development Corporation
GA	Geoscience Australia
GAB	Great Australian Bight
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIS	Geographic Information System
GLaWAC	Gunaikurnai Land & Waters Aboriginal Corporation
GMDSS	Global Maritime Distress Safety System
GMEM	Gippsland Marine Environmental Monitoring
GMP	Garbage Management Plan
GoM	Gulf of Mexico
GPS	Global Positioning System
GPBRA	Golden Paradise Beach Rate Payers Association
HFC	High Frequency Cetacean
HFO	Heavy Fuel Oil
HSE	Health, Safety and Environment
HSSE	Health, Safety, Security and Environment
IAGC	International Association of Geophysical Contractors
IAP	Incident Action Plan
IAP2	International Association for Public Participation
IAPP	International Air Pollution Prevention
IBAs	Important Bird Areas
ICC	Incident Control Centre
IEE	International Energy Efficiency
ILUA	Indigenous Land Use Agreements
IMAS	Institute for Marine and Antarctic Studies
IMCA	International Marine Contractors Association
IMO	International Maritime Organisation
IMS	Invasive Marine Species
IMT	Incident Management Team
IOPP	International Oil Pollution Prevention
IPP	International Pollution Prevention
ISB	In-situ burning
ISPP	International Sewage Pollution Prevention
ITT	Invite To Tender
JAMBA	Agreement between the Government and Australia and the

	Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment
LCC	Latrobe City Council
LEFCOL	Lakes Entrance Fisherman's Cooperative
LFC	Low Frequency Cetacean
LiDAR	Light Detection and Ranging
MARPOL	International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978
MDO	Marine Diesel Oil
MFC	Mid Frequency Cetacean
MGO	Marine Gas Oil
MMO	Marine Mammal Observer
MMV	Measurement, Monitoring and Verification
MNES	Matter/s of National Environmental Significance
MNP	Marine National Park
MO	Marine Order
MoC	Management of Change
MoU	Memorandum of Understanding
MSV	Maritime Safety Victoria
NEBA	Net Environmental Benefit Analysis
NGOs	Non-Government Organisation
NNTT	National Native Title Tribunal
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Authority
NRT	National Response Team
OBN	Ocean Bottom Node
OCIMF	Oil Companies International Marine Forum
OCNS	Offshore Chemical Notification Scheme
ODS	Ozone-Depleting Substance
OHS	Occupational Health and Safety
OIW	Oil-in-Water
OPEP	Oil Pollution Emergency Plan
OPGGs Act	Offshore Petroleum and Greenhouse Gas Storage Act (Cth & Vic)
OPGGs Regulations	Offshore Petroleum and Greenhouse Gas Storage Regulations (Vic)
OSMP	Oil Spill Monitoring Program
OSPAR	Oslo-Paris Conventions
OSRA	Oil Spill Response Atlas
OVID	Offshore Vessel Inspection Document

OWR	Oiled Wildlife Response
OWS	Oily Water Separator
PAH	Polyaromatic Hydrocarbon
PAM	Passive Acoustic Monitoring
PCBs	Polychlorinated Biphenyls
PFW	Produced Formation Water
PMM	Project Management Manual
PMS	Planned Maintenance System
PNEC	Predicted No Effect Concentration
POWBONS	Pollution of Waters by Oil and Noxious Substances
PPE	Personal Protective Equipment
PPV	Peak Particle Velocity
PTS	Permanent Threshold Shift
PVCs	Polyvinyl Chloride
RAMSAR	Convention on Wetlands of International Importance especially as Waterfowl Habitat
RO	Reverse Osmosis
ROKAMBA	Republic of Korea Migratory Birds Agreement
ROS	Regional Outfall Sewer
SA	South Australia/n
SCAT	Shoreline Clean-up and Assessment Technique
SEEMP	Ship Energy Efficiency Management Plan
SEP	Stakeholder Engagement Plan
SES	State Emergency Service (Vic)
SESS	Southern and Eastern Scalefish and Shark
SETFIA	South-East Trawl Fishing Industry Association
SHS	Scalefish Hook Sector
SIMOPS	Simultaneous Operations
SIV	Seafood Industry Victoria
SMPEP	Shipboard Marine Pollution Emergency Plan
SOLAS	International Convention for the Safety of Life at Sea
SOP	Standard Operating Procedure
SOPEP	Shipboard Oil Pollution Emergency Plan
SORF	Soil and Organic Recycling Facility
SRT	State Response Team
SSFAssn	Sustainable Shark Fishing Association
SSIA	Southern Shark Industry Alliance
STCW	International Convention on Standards of Training, Certification and

	Watchkeeping for Seafarers
STLM	Sound Transmission Loss Modelling
STP	Sewage Treatment Plant
SWOP	Saline Wastewater Outfall Pipeline
SWOT	Strength-Weaknesses-Opportunities-Threats
TACC	Total Allowable Commercial Catch
TEC	Threatened Ecological Community
THC	Total Hydrocarbons
TSV	Transport Safety Victoria
TTS	Temporary Threshold Shift
UAV	Underwater Autonomous Vehicle
UHF	Ultra High Frequency
UNCLOS	United Nations Convention on the Law of the Sea
UNEP IE	United Nations Environment Programme Industry and Environment
VADA	Victorian Abalone Divers Association
VBA	Victorian Biodiversity Atlas
VFA	Victorian Fisheries Association
VGRMF	Victorian Government Risk Management Framework
VHF	Very High Frequency
VNPA	Victorian National Parks Association
VoO	Vessel/s of Opportunity
VRLA	Victorian Rock Lobster Association
VSFA	Victorian Scallop Fisherman's Association
WA	Western Australia/n

Units of Measurement

°C	Degrees Celcius
bbbl	Barrel
cui	Cubic Inches
dB	Decibel/s
Hz	Hertz
kHz	Kilohertz
km	Kilometre/s
km/hr	Kilometres per hour
m	Metre/s
MMbbl	Million barrels
MMscf	Million Standard Cubic Feet
nm	Nautical mile/s
PK	Peak
PK-PK	Peak-to-Peak
psi	Pounds per Square Inch
RMS	Root Mean Square
SEL	Sound Exposure Level
SEL _{24h}	Sound Exposure Level over 24 hours
SPL	Sound Pressure Level

1. Introduction

1.1. Background

The CarbonNet project (the 'Project') is investigating the potential for establishing a world class, commercial scale carbon capture and storage (CCS) network in Gippsland. The network would bring together multiple carbon dioxide (CO₂) capture projects in Victoria's Latrobe Valley, transporting CO₂ via a shared pipeline and injecting it into deep underground, offshore storage sites in the Gippsland region of Victoria.

It is envisaged that the Project will capture and store between 1 and 5 million tonnes of CO₂ per annum and have the potential to expand to 20 million tonnes per annum or more.

1.2. Purpose

The Crown in right of Victoria is proposing to conduct the Pelican three-dimensional (3D) marine seismic survey ('Pelican 3DMSS') in the Gippsland Basin off eastern Victoria in Greenhouse Gas Assessment Permits VIC-GIP-002 (Commonwealth waters) and GGAP006386(V) (Victorian state waters) (Figure 1.1).

The full fold coverage area for the proposed survey (the 'acquisition' area) will cover approximately 166 km² (~64% in Commonwealth waters and 36% in Victorian state waters), ranging in water depths from 15 m to 40 m.

The Pelican 3DMSS acquisition is expected to take place over approximately 13 to 16 days (but up to 27 days depending on vessel selection) commencing between the end of January and the end of March 2018). The exact timing of the project is contingent on fair sea state conditions suitable for marine seismic survey (MSS) acquisition.

Given that the Pelican 3DMSS will be conducted in Commonwealth and Victorian waters, it will be undertaken in accordance with their respective legislation, being the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGGS Act 2006) (Cth) and the *Offshore Petroleum and Greenhouse Gas Storage Act (Vic)* (OPGGGS Act 2010).

1.3. Proponent

The CarbonNet Project was established in 2009 by the Victorian Government to investigate the potential for a large-scale CCS network in the Gippsland region, and was awarded Commonwealth CCS Flagship status in 2012. Since this time, CarbonNet has conducted a thorough evaluation of the Gippsland nearshore region to identify and assess possible CO₂ storage formations. The Project is managed by the Victorian Department of Economic Development, Jobs, Transport and Resources (DEDJTR) (Resources Division, Low Emissions Resources Branch).

The State of Victoria currently holds five greenhouse gas (GHG) assessment permits in Commonwealth and Victorian waters that are managed by CarbonNet. The first Commonwealth permit was awarded in 2012, and a further three Commonwealth permits were awarded in 2015 (including VIC-GIP-002). In September 2016, a GHG assessment permit GGAP006386(V) was awarded in Victorian waters.

All the permits were awarded following competitive bidding processes and are for a period of six years. The Project manages the permits on behalf of Victoria, which allows the project to explore for GHG storage within the permit areas.

CarbonNet has identified three contingent CO₂ storage formations that it wishes to investigate further as part of a portfolio approach to CCS in the Gippsland region. CarbonNet's preferred contingent storage formation, Pelican, is located in the VIC-GIP-002 GHG and GGAP006386(V) assessment permits.

1.4. Titleholder and Liaison Person Details

In accordance with Regulation 18(2) of the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (hereafter referred to as OPGGS(E)) and Regulation 15 of the Victorian Offshore Petroleum and Greenhouse Gas Storage Regulations 2011 (hereafter referred to as OPGGS Regulations), the Titleholder and nominated liaison contact details are provided below:

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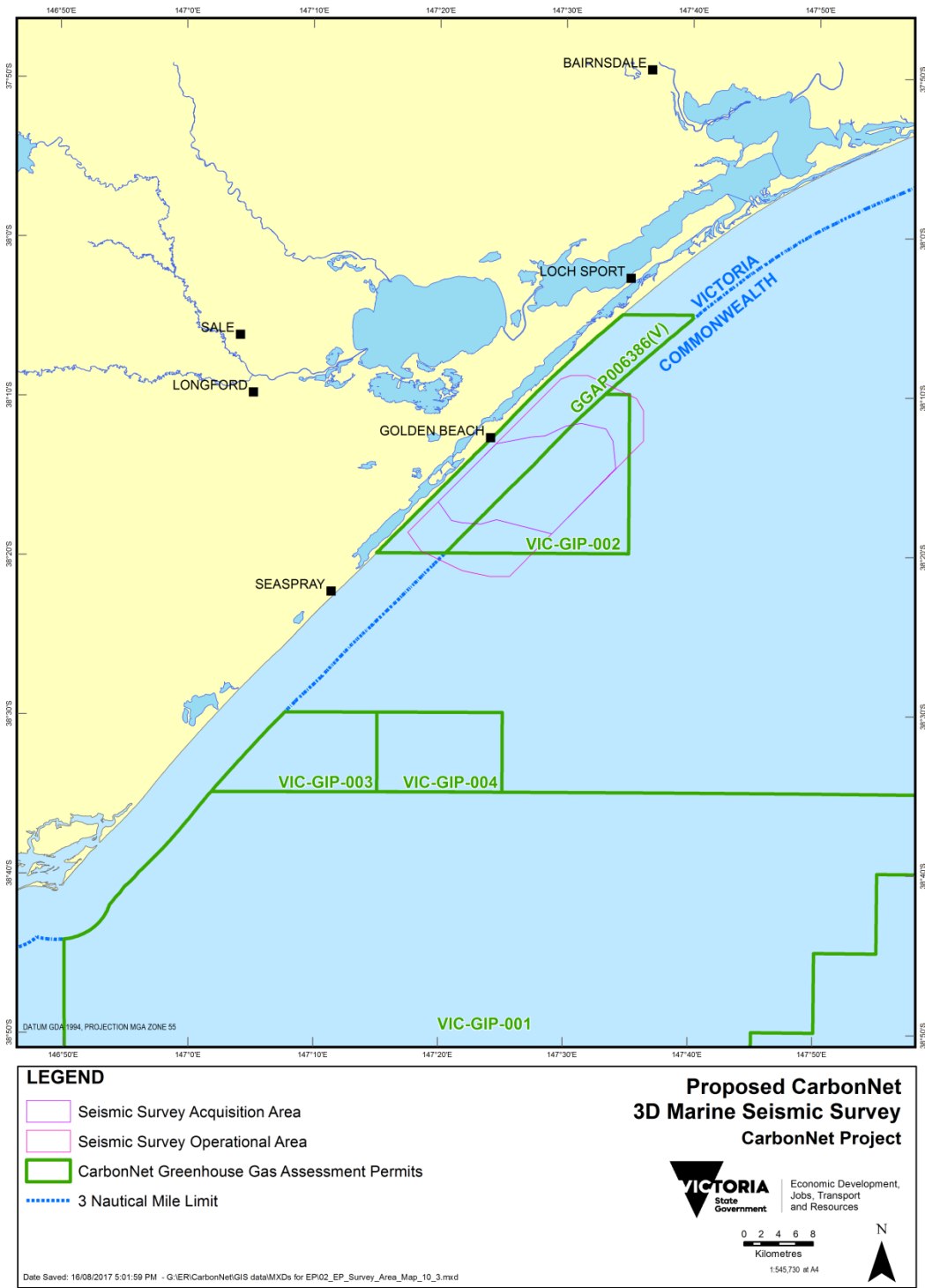


Figure 1.1 Location of the proposed Pelican 3DMSS

1.5. Scope of this Plan

For this survey, the GHG activity (as defined in Regulation 6 of the OPGGS(E) and Regulation 4 of the OPGGS Regulations) is defined as:

'the acquisition of seismic data, from the time that the survey vessel first deploys the seismic source and receiver equipment within the acquisition area, until the time the vessel retrieves the equipment and departs the acquisition area for the last time.'

This Environment Plan (EP) Summary has been prepared in accordance with subregulations 11(3)(4) of the OPGGS(E) and subregulations 13E(3)(4) of the OPGGS Regulations.

The complete EP was submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) and the Earth Resources Regulation (ERR) branch of the DEDJTR for assessment and acceptance. The EP was accepted by both regulators in December 2017.

In brief, this EP Summary includes a description of:

- The nature of the activity (location, layout, operational details);
- Stakeholder consultation activities;
- The environment affected by the activity;
- Environmental impacts and risks (including emergency incidents);
- Mitigation and management measures;
- Environmental performance objectives, standards and measurement criteria;
- The implementation strategy to ensure that the environmental impacts and risks are managed in a systematic manner; and
- Reporting arrangements.

2. Project Description

2.1. Project Location

The GGAP006386(V) GHG assessment permit is located in Victorian State waters, covering an area of 225 km² in water depths ranging from 0 m to 22 m Lowest Astronomical Tide (LAT).

The VIC-GIP-002 GHG assessment permit is located in Commonwealth waters (adjacent to and contiguous with the state permit), covering an area of 223 km² in water depths ranging between 22 m and 40 m LAT.

The proposed Pelican 3DMSS is divided into two areas (Figure 2.1), these being the:

- 'Acquisition area' - the physical area in which the seismic source will operate, occurring over both GHG assessment permit areas and covering an area of 166 km²; and
- 'Operational area' - the physical area in which operations ancillary to achieving survey coverage will take place. This includes vessel approach, vessel line turns, testing of the seismic source and miscellaneous maintenance operations.

The acquisition and operational areas combined are simply referred to as the proposed survey area.

The proposed survey area is located between 1 and 13 km from the shoreline off the township of Golden Beach, midway along the Ninety Mile Beach between Loch Sport and Seaspray in south Gippsland. The coordinates of the acquisition and operational areas are provided in Table 2.1 and distances from the acquisition area to nearby features are provided in Table 2.2.

2.2. Project Objective

The purpose of the proposed Pelican 3DMSS is to gain deeper knowledge of the subsurface geology of the area. This will help inform the potential for CO₂ storage in the survey area.

2.3. Project Development

The CarbonNet Project has been developed using a stage-gated process and is currently in Stage 3 (Project Development and Commercial Establishment).

CarbonNet is uniquely placed to assess the suitability of GGAP006386(V) and VIC-GIP-002 for CO₂ storage as it has invested over four years undertaking feasibility studies with a particular focus on the Pelican formation.

CarbonNet has a high degree of confidence in the potential for the Pelican storage formation to safely and securely store commercial volumes of CO₂.

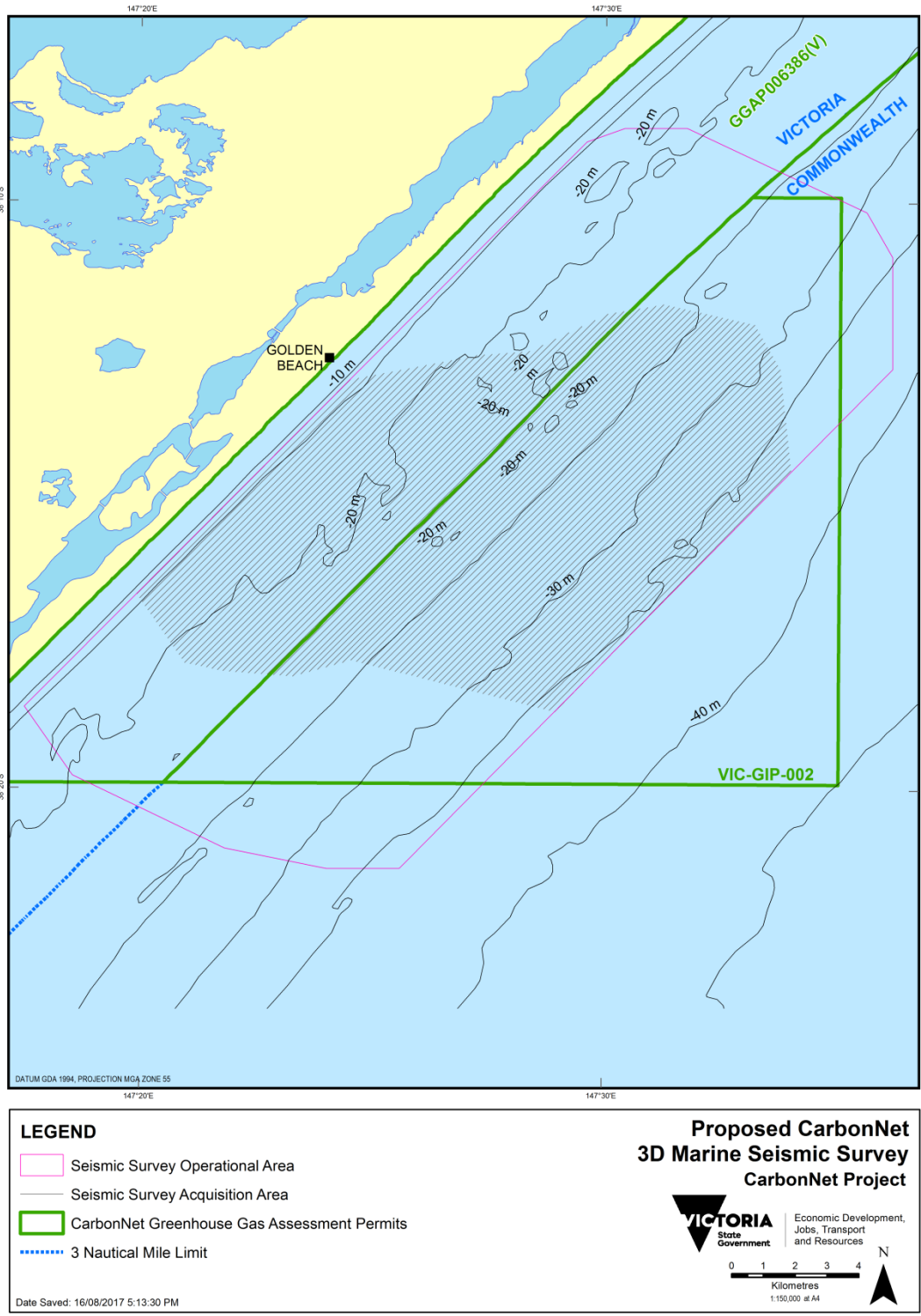


Figure 2.1. The proposed Pelican 3DMSS acquisition and operational areas

Table 2.1. Coordinates of the survey acquisition and operational areas

Acquisition area		Operational area	
Latitude	Longitude	Latitude	Longitude
147° 19' 56"	-38° 16' 42"	147° 17' 30"	-38° 18' 37"
147° 20' 58"	-38° 17' 52"	147° 29' 35"	-38° 08' 58"
147° 21' 47"	-38° 18' 00"	147° 30' 24"	-38° 08' 44"
147° 23' 18"	-38° 18' 06"	147° 31' 45"	-38° 08' 44"
147° 24' 33"	-38° 17' 49"	147° 35' 37"	-38° 10' 09"
147° 28' 32"	-38° 18' 57"	147° 36' 11"	-38° 10' 54"
147° 34' 01"	-38° 14' 33"	147° 36' 12"	-38° 12' 49"
147° 33' 47"	-38° 12' 50"	147° 25' 36"	-38° 21' 21"
147° 33' 14"	-38° 12' 05"	147° 24' 02"	-38° 21' 21"
147° 31' 16"	-38° 11' 44"	147° 21' 50"	-38° 21' 01"
147° 30' 04"	-38° 11' 54"	147° 18' 32"	-38° 19' 47"
147° 28' 23"	-38° 12' 33"		
147° 27' 14"	-38° 12' 37"		
147° 24' 31"	-38° 13' 02"		

Table 2.2 Distance to key features in the region from the proposed acquisition area

Feature	Distance and direction from the nearest point of the acquisition area
Towns	
Golden Beach	1 km north
Paradise Beach	1.8 km northeast
Honeysuckles	12 km southwest
Loch Sport	16.4 km northeast
Seaspray	16.5 km southwest
Longford	25 km north-northwest
Sale	30 km northwest
Metung	43.5 km northeast
Lakes Entrance	52 km northeast
Oil and gas infrastructure	
Bream to shore pipeline (Vic/PL32 & Vic/PL233)	Overlapped
Barracouta to shore pipeline (Vic/PL1 pipeline and Vic/PL4 pipeline)	Overlapped
Seahorse subsea wells (nearest)	2.5 km east
Tarwhine to Barracouta A pipeline	10.2 km southeast

Feature	Distance and direction from the nearest point of the acquisition area
Seahorse to Barracouta A pipeline	10.7 km southeast
Barracouta platform	11.3 km southeast
Tarwhine subsea well	12 km southwest
Dolphin to shore pipeline	13.7 km
Tasmanian gas pipeline	15.5 km southwest
Dolphin monopod	20.1 km southwest
Other infrastructure	
Regional Outfall Sewer (ROS) (Delray Beach)	1 km north
Saline Wastewater Outfall Pipeline (SWOP) (McGaurans Beach)	25 km southwest
Basslink electricity interconnector cable	34 km southwest
Commonwealth Marine Reserves	
Beagle	91 km southwest
East Gippsland	202 km east
State marine parks	
Ninety Mile Beach Marine National Park	15.7 km southwest
Nooramunga Marine and Coastal Park	47 km southwest
Corner Inlet Marine Park	94 km southwest
Wilson's Promontory Marine Park	97 km west
Wilson's Promontory Marine National Park	115 km southwest
Point Hicks Marine National Park	151 km east
Natural features	
Hogan Island group	106 km southwest
Beware Reef (off Cape Conran)	116 km east
Wilson's Promontory (southern tip)	124 km southwest
Westernport Bay (western entrance)	176 km west
Port Phillip Bay (entrance)	235 km west

2.4. Project Timing

The Pelican 3DMSS is scheduled to commence between the end of January and the end of March 2018. The survey is expected to take between 13 and 16 days, but could take up to 27 days.

The proposed MSS was originally scheduled to commence between the start of November 2017 and the end of March 2018. Addressing the concerns of various stakeholders (particularly commercial fishers and local communities) has narrowed

the survey timing window. Based on feedback from stakeholder consultation, CarbonNet has committed to:

- Avoid undertaking the MSS during the months of November and December 2017, taking into account advice and a request from Victoria's peak fishing industry representative. In so doing (along with avoiding January, as outlined in the following point), the survey will avoid overlapping with the key spawning periods of up to 13 species of interest to the commercial and recreational fishing sectors.
- Not undertaking the survey between the Christmas holiday period (24th December 2017 through to the Australia Day long weekend, ending 28th January 2018) – due to the popularity of that part of the coastline with holiday makers and swimmers; and
- Endeavouring to avoid survey acquisition during the Easter long weekend (30th March to 2nd April 2018) – due to the Golden Beach Surf Fishing Competition taking place between Seaspray and Loch Sport. As a result of discussions with the organisers of the fishing competition, CarbonNet will endeavour to commence the survey in February (subject to vessel availability and sea state conditions).

In Bass Strait, the summer weather window is the most suitable for acquiring seismic survey data, since storms and high seas (waves greater than 1.5 m) can lead to poor quality data or completely prevent achieving the desired images of the subsurface. Although in Bass Strait the weather can be unpredictable at any time of year, the summer season is distinctly better on average. Wave noise can occur during any season but tends to be more prolonged between May and the end of September (Figure 2.2).

CarbonNet has selected a survey 'window of opportunity' that it believes balances operational requirements with environmental and socio-economic constraints. Figure 2.3 outlines the key ecological process and species presence in the nearshore Gippsland Basin throughout the year that supports the selection of this window of opportunity. This figure indicates:

- Sea state conditions optimal for survey occur during the summer (and the spring and autumn shoulders), when the sound interference created by strong winds and waves is less than that in winter, and when sea state conditions are more favourable for vessel movements.
- The overlap between the nearshore commercial fisheries (such as the scallop, rock lobster and shark, gillnet and hook fisheries) means there is no period of time in which at least one fishery is not potentially affected by the survey operations. Spawning periods for many commercially important fish species occur throughout most of the year, making avoidance of any one species' spawning period unachievable. It is noted that autumn and winter are seasons when many of these species do not spawn, but this period is unsuitable for survey acquisition (as previously outlined).
- Australian fur-seals breed and feed during the proposed survey window, but this occurs onshore. No breeding colonies of Australian fur-seals occur along the Ninety Mile Beach.
- Little penguins are present in the region year-round. While breeding occurs over the summer months and therefore overlaps the proposed survey window, this species is not listed as threatened and their numbers in Victoria

remain strong. They only briefly swim through nearshore waters, in between their offshore feeding and onshore roosting.

CarbonNet believes that these factors combine to make summer (and the shoulder periods) the most suitable time to conduct the Pelican 3DMSS.

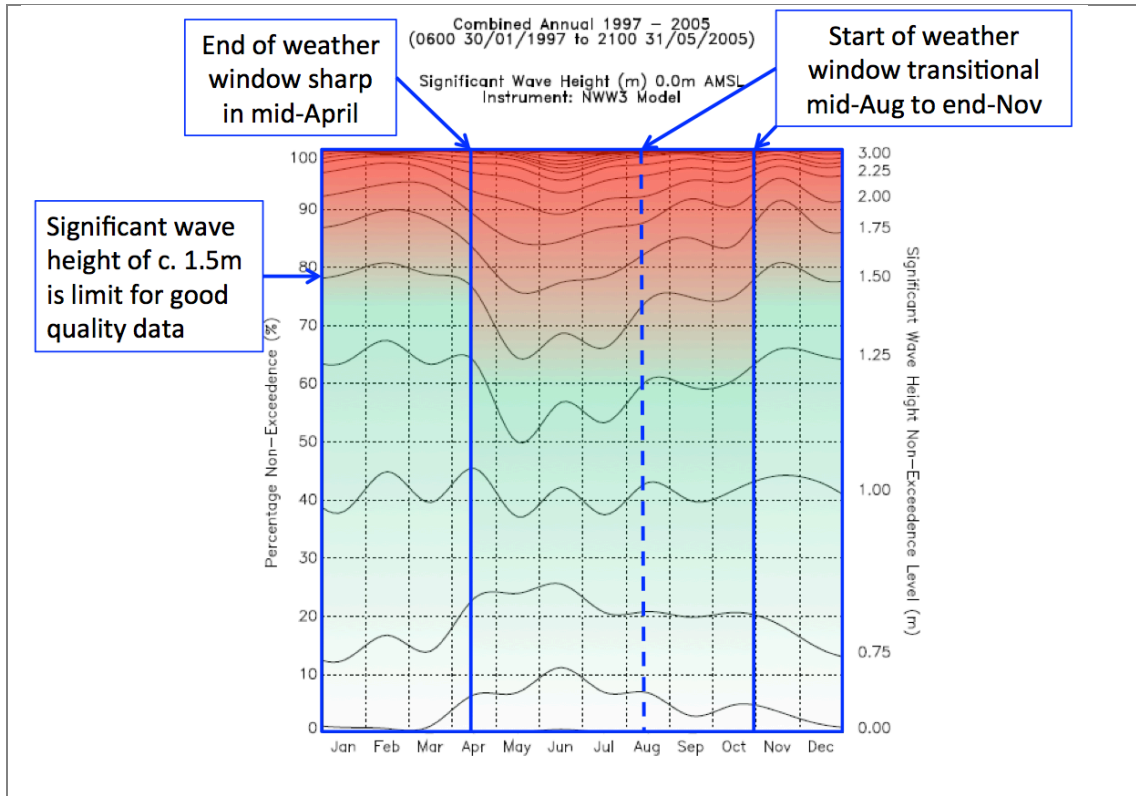


Figure 2.2. Significant wave height data for the proposed survey area

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Threatened cetacean species activities												
Pygmy blue whale - foraging and migration	No defined migration route through eastern Bass Strait											
Southern right whale - migration					Nearest coastal aggregation areas are in southwest Victoria							
Humpback whale - migration (mainly eastern Bass Strait)				Northern migration - no feeding, resting or calving known to occur				Southern migration				
Other key species activities												
Great white shark - migration			Moving north along the east coast									Returning south
Great white shark - congregation of juveniles	From Corner Inlet to Lakes Entrance											
Australian fur-seal - breeding											Occurs on islands, largest colonies in SW Vic	
Australian fur-seal - travel between Vic & Tas islands												
Australian fur-seal - foraging												
New Zealand fur-seal - foraging	Note: no breeding in Victoria											
Little penguins		Mating: Feb-Apr (onshore)				Burrow renovation and large foraging distance: May-July		Mating: Aug - Oct		Egg laying: Sept - Oct		
Seabird foraging (principally albatross and petrels)						in deeper offshore waters						
Southern rock lobster - mating												
Southern rock lobster - spawning												
Abalone - spawning												
Scallop - spawning												
Blue warehou - spawning												
Jackass morwong - spawning		Batch spawning										
Sardines - spawning											Anecdotal	
Australian salmon	Batch spawning											
Mackerel												
Key commercial fishing periods												
<i>Victorian fisheries</i>												
Scallop				Season begins 1st April								
Southern rock lobster - eastern zone							Season begins 1st July					
Abalone - eastern zone				Season begins 1st April								
Wrasse												
Ocean access												
Ocean purse seine												
Inshore trawl												
<i>Commonwealth fisheries</i>												
SESS - Gillnet and shark hook					Season begins 1st May							
SESS - Commonwealth trawl sector					Season begins 1st May							
SESS - Scalefish hook sector					Season begins 1st May							
Weather window												
Poor sea state												
Project												
Nominated survey commencement window												
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec

SESS: Southern and Eastern Scalefish and Shark fishery

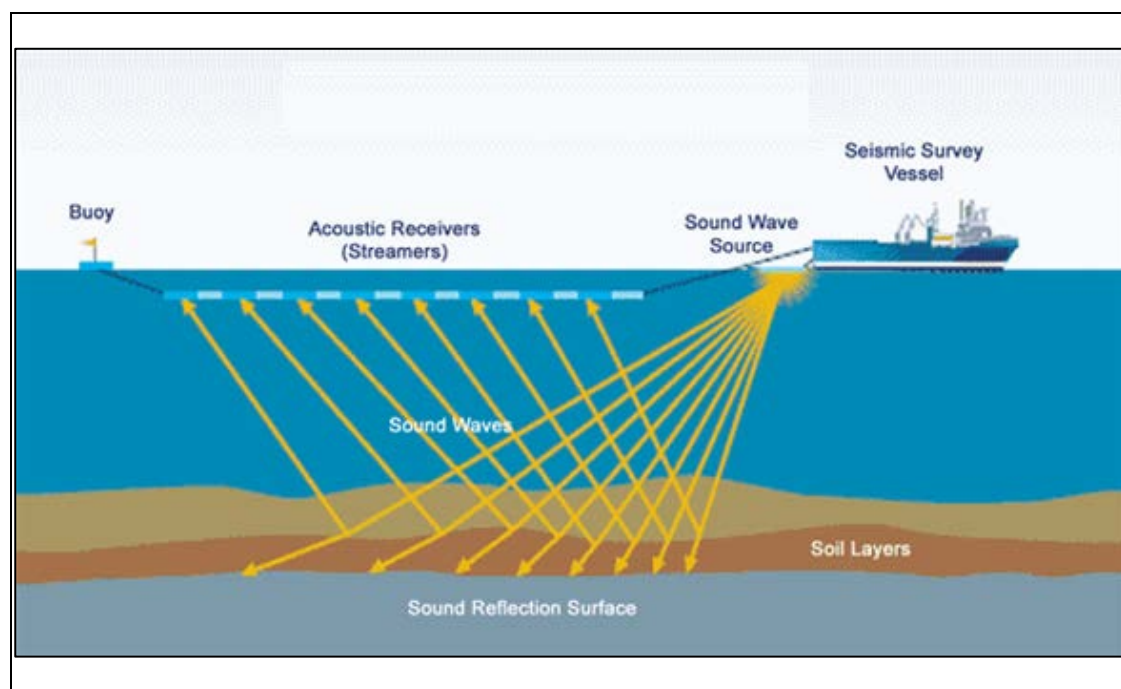
Biology/ecology:
 Non-peak period - activity known to occur in lower densities/concentrations, or sporadically, or may occur
 Peak period - activity known to occur

Figure 2.3. Key ecological and socio-economic activities in the nearshore Gippsland Basin

2.5. Survey Program

The Pelican 3DMSS will be a typical 3D survey similar to most others conducted in Australian marine waters (in terms of technical methods and procedures) (Figure 2.4). No unique or unusual equipment or operations are proposed. Seismic surveying is a widely-used exploration method used to define and analyse subsurface geological structures in the marine environment. Seismic surveying uses a technique that directs acoustic energy into these subsurface geological structures beneath the seafloor from equipment deployed by vessel.

The survey vessel will acquire the seismic data by towing two acoustic source arrays operating alternatively, one discharging as the other recompresses. The source volume will be a maximum of 2,800 cubic inches (cui) with an operating pressure of 2,000 pounds per square inch (psi) (see Section 2.5.1). There will be between four and 10 hydrophone 'streamer' cables approximately 4,000 m long and 50 m apart towed behind the vessel at 5 m (\pm 1 m) below the water surface (depending on water depth, testing and weather). The vessel will sail back and forth across the acquisition area along 60 sail lines (nominally) that are approximately 200 m apart (see Section 2.5.2).



Source: FishSAFE Information Project (2017).

Figure 2.4. Typical marine seismic survey reflection schematic

A series of acoustic pulses (discharged every 4 to 8 seconds) will be directed by the source down through the water column and seabed. The released sound will be attenuated and reflected at geological boundaries and the reflected signals are detected using hydrophones arranged along the streamers that are towed behind the vessel. The reflected sound is evaluated to provide information on the structure and composition of the geological formation.

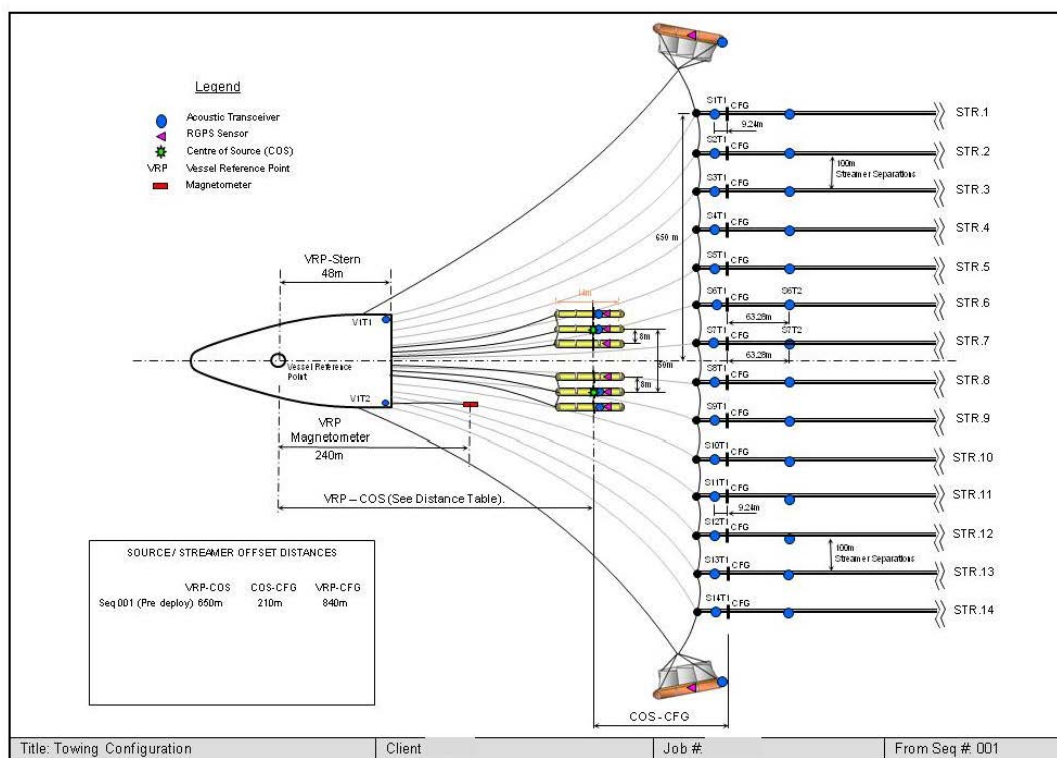
The survey will be conducted 24 hours a day except when sea states exceed operational parameters.

2.5.1. Sound Source

The acoustic source will consist of two air gun arrays spaced 25 m apart.

A minimum 75 bar-m peak-to-peak amplitude is required to undertake the Pelican 3DMSS, which will be sufficient to provide the penetration required to image the deepest target with current technology. This amplitude can be achieved using a seismic source with a maximum sound volume of 2,800 cui and an operating pressure of 2,000 psi.

The array will be towed with the centre approximately 100-150 m astern of the survey vessel at a typical depth range of 5 m (± 1 m) below the sea surface. Figure 2.5 shows a typical towing arrangement.



Source: PGS.

Figure 2.5. Typical towing arrangement

Air gun arrays are strategically arranged to direct most of the energy vertically downward rather than sideways. The shot point interval will be 12.5 m (flip/flop) with a sample rate of 2 milliseconds. The recording length will be 4 seconds. The total number of source pulses is estimated to be 80 per kilometre (or 56,960 based on using 8 streamers).

During line turns, a soft-start procedure will be implemented for 30 minutes prior to starting acquisition of the next survey line in line with EPBC Act Policy Statement 2.1.

For the purposes of underwater Sound Transmission Loss Modelling (STLM) undertaken for the project, a 3,090 cui array has been used.

2.5.2. Sail Lines

Acquisition will be parallel with the coast (running along a 45°/225° axis, in an approximate northeast-southwest direction).

Sixty (60) sail lines are proposed (based on 8 streamers), but this may vary between 48 sail lines (using 10 streamers) and 120 sail lines (using 4 streamers). The average length of each sail line is 11.9 km.

The sail lines will be spaced at approximately 200 m intervals (based on 8 streamers), but may vary between 100 m (using 4 streamers) and 250 m (using 10 streamers).

The total sail line distance will be 712 km (based on 8 streamers), but may vary between 569 km (using 10 streamers) and 1,423 km (using 4 streamers).

2.5.3. Streamers

Eight streamers (nominally) are expected to be used for the survey (with a range of four to 10 being considered). The streamers will be approximately 4,000 m in length with separations of 50 m between each streamer.

Each streamer will be fitted with streamer retrieval devices (SRD) that inflate when the SRD reaches a maximum depth. The tail of each streamer has a Relative Global Positioning System (RGPS) tailbuoy. If a streamer is lost, then the RGPS position of the tailbuoy combined with the visual presence of the SRDs would be used to locate and retrieve it. The sources are all suspended from floats and each float will be fitted with an RGPS unit.

The streamers will be towed at a depth of 5 m (± 1 m) beneath the sea surface (though depth will vary depending on water depth and sea state; generally the worse the sea state, the deeper the streamers). Excellent bathymetry data is available from LiDAR surveys of the seabed flown in 2007-09 by the then Victorian Department of Sustainability and the Environment (DSE) and in 2004 by Fugro LADS.

Spot checks of bathymetry will also be performed using a standard onboard echosounder to validate the accuracy of the LiDAR maps and of the official admiralty charts and ensure that streamer depths are appropriately set to avoid seabed features. The majority of the proposed acquisition area is sandy seabed, with occasional outcrops of discontinuous reef (between 1.0 m and 1.5 m in height). At the shallowest point of the proposed acquisition area (15 m), this means there will be a vertical separation of between 7.5 m and 10 m between the streamers and the highest reef outcrops, depending on streamer depth.

The streamers may be actively steered to improve survey acquisition efficiency and minimise survey time if that technology is available on the contracted vessel.

The streamer medium will be either a solid foam construction or gel-filled (this will only be known once a contractor is selected). The streamers will display appropriate navigational safety measures such as lights and reflective tail buoys.

2.5.4. Data Collection and Analysis

The seismic data is measured by hydrophones in the streamers and transmitted by fibre optics to the recording room on the seismic survey vessel. The data is checked by the processing department for quality control and merged with navigation data to correctly position the data in time and space. The processing methods conducted onboard check that the data has been acquired to a satisfactory quality.

After the data is successfully acquired it will be further processed to obtain a 3D image of the sub-surface geology. The 3D image of the subsurface is then

interpreted by CarbonNet's geoscience team to assess prospectivity for CO₂ injection.

2.5.5. Survey Contractor

Polarcus Seismic Ltd (Polarcus) has recently been appointed as the survey contractor. Polarcus operates a modern fleet of high performance 3D seismic vessels globally, and has conducted numerous surveys in Australian waters in recent years.

2.5.6. Survey Vessel

The survey will be conducted using a purpose-built seismic survey vessel with support duties provided by at least at least two dedicated vessels (see Section 2.5.7). The survey vessel nominated is the *Polarcus Naila* (though this is subject to change) (Plate 2.1). This vessel is 91 m in length and 19 m wide and carry up to a total of 60 persons.



Source: Polarcus.

Plate 2.1. The MV Polarcus Naila seismic survey vessel

Given the short duration of the proposed survey, the survey vessel will not require refuelling on location in order to complete the survey. The survey vessel will bunker with marine diesel only while in port (likely to be an east coast port, such as Eden).

The crew on board the survey vessel will consist of a marine crew and a seismic crew. The marine crew operate the vessel by performing duties in the bridge, engine room, galley and hotel services, internal and external deck areas and safety craft. The marine crew are responsible for the safe navigation, lookout, and communications.

The seismic crew operate and run the survey equipment and are responsible for its deployment and recovery and data acquisition throughout the survey. The seismic crew are responsible for the planned and continued maintenance of all towed equipment to ensure there is minimum risk of electrical or mechanical failure resulting in the damage or loss of equipment during the deployment, acquisition and recovery period of the survey.

The seismic crew consists of four departments (navigation, recording, source and processing) responsible for individual duties during the survey and combining teamwork during the deployment, acquisition and recovery periods.

Vessel Environmental Credentials

The survey vessel will meet pollution prevention requirements under the MARPOL Convention, as enacted by the *Navigation Act 2012* (Cth) and the *Pollution of Waters by Oil and Noxious Substances Act 1986* (Vic) (POWBONS). As such, it will be required to have the following current and valid environmental credentials in place:

- International Oil Pollution Prevention (IOPP) certificate in accordance with MARPOL Annex I (enacted under the Australian Maritime Safety Authority's [AMSA] Marine Orders Part 91, Marine Pollution Prevention – Oil);
- Shipboard Marine Pollution Emergency Plan (SMPEP) in accordance with MARPOL Annex I (enacted under AMSA Marine Orders Part 91, Marine Pollution Prevention – Oil);
- International Pollution Prevention (IPP) certificate in accordance with MARPOL Annex II (enacted under AMSA Marine Orders Part 93, Marine Pollution Prevention – Noxious Liquid Substances);
- International Sewage Pollution Prevention (ISPP) certificate in accordance with MARPOL Annex IV (enacted under AMSA Marine Orders Part 96, Marine Pollution Prevention – Sewage);
- Shipboard Garbage Management Plan in accordance with MARPOL Annex V (enacted under AMSA Marine Orders Part 95, Marine Pollution Prevention – Garbage);
- International Air Pollution Prevention (IAPP), Engine International Air Pollution Prevention (EIAPP), International Energy Efficiency (IEE) certificates and Ship Energy Efficiency Management Plan (SEEMP) in accordance with MARPOL Annex VI (enacted under AMSA Marine Orders Part 97, Marine Pollution Prevention – Air Pollution); and
- International Anti-fouling System certificate in accordance with the International Convention on the Control of Harmful Anti-fouling Systems on Ships 2008 (enacted under AMSA Marine Orders Part 98, Marine Pollution Prevention – Anti-fouling Systems).

In Victorian state waters, the survey vessel will not discharge noxious oil (from bilge tanks), treated or untreated sewage and grey water, or macerated and un-macerated food waste.

CarbonNet has contracted an independent HSE specialist to conduct an audit of Polarcus' HSE management system to ensure that its systems and processes meet legislative and project requirements.

Maritime Safety

The vessel and towed array of equipment will operate in accordance with the Convention on the International Regulations for Preventing Collisions at Sea (COLREG) 1972.

The support vessels will actively monitor around the survey vessel to minimise the potential for interactions with third-party vessels. The survey vessel operator will issue a vessel positioning notification to the Australian Hydrographic Office (AHO) and Transport Safety Victoria (TSV), who will in turn publish the survey location in their respective Notices to Mariners. A daily Auscoast warning of the survey vessel's location will also be issued to all vessels by AMSA through the Global Maritime Distress Safety System (GMDSS) communication network. The warning will provide details of the safe distance to be maintained around the seismic survey vessel and towed equipment.

The Master and Officer of the Watch of the survey vessel are responsible for maintaining control of the seismic fleet vessel operation and for establishing and maintaining communication with other vessels and marine traffic during the survey. The support and guard vessel follow all instructions from the survey vessel and communicate with other marine traffic during the survey.

Supplementary to radar detection, the support and the guard vessels will have additional transmitting beacons fitted for the duration of the survey. The vessels will use either Automatic Identification System (AIS) transponders or radio global positioning system (GPS) transponders. The addition of this equipment and the data it transmits provides accurate real-time updates of the position of all project vessels relative to the survey vessel and the towed seismic spread.

All vessels will be capable of communicating and operating both on dedicated ultra-high frequency (UHF) working channels and or Maritime very high frequency (VHF) working channels (typically monitoring Channel 16 and working on 74).

Lighting

The lighting on the survey vessel will comply with COLREG 1972. During survey deployment, recovery and acquisition, the source vessel will display navigation lights indicating the 'restricted ability to manoeuvre'. In addition to the mandatory navigation lighting, the working deck areas (albeit very small) will be lit as required to provide for safe work.

At night, the vessel stern will be lit to provide sufficient light to be able to view the towed equipment during acquisition, deployment and recovery operations. The floating towed equipment trailing at the tail end of the cables is lit by warning lights flashing the morse code letter 'U' (two short flashes and one long flash). The lights are activated by solar switches at night and the floats are a bright yellow or orange colour for identification during the day. The floats will have radar reflectors to assist with tracking and provide target warning on other vessels' radars.

Bad Weather Shelter

In cases where extreme weather makes it unsafe for the survey vessel to remain on location, it will move towards deeper water and away from the coastline and then either retrieve the in-water equipment, seek alternative safe harbour (for example, leeward of Wilsons Promontory or Flinders Island) or turn into the weather and head into the seas.

2.5.7. Support Vessels

At least two support vessels, comprising a 'guard vessel' and at least one smaller 'scout vessel', will support the survey vessel for the duration of the survey. These vessels will be approximately 20 m in length and 6 m wide, have a rope hauler and carry up to 7 persons. They will assist with scouting, marine mammal observation, fisheries liaison, chase duties and the removal of entanglement hazards as necessary for the safe conduct of the survey.

The operators of the support vessels will be licensed by the Victorian Fisheries Authority (VFA) to move any unattended fishing gear that may have been lost, drifted or been deployed in the Victorian waters portion of the operational area prior to, or during, the survey period. This avoids damaging fishing equipment and lowers risk of entanglement with the towed seismic equipment. The vessels will liaise with any fishermen nearby to minimise interactions between the source vessel and fishers.

The same principles regarding regulatory jurisdiction, environmental credentials, maritime safety, lighting and bad weather shelter as described for the survey vessel in Section 2.5.6 apply to the support vessels. The environmental performance

standards listed throughout the EP apply to the support vessels as well as the survey vessel.

Non-oil tanker vessels less than 400 gross tonnes are not required to carry a SMPEP under Regulation 37 of MARPOL Annex I or International Safety Management or International Ship Security certificates.

2.6. Simultaneous Surveys

There are no other MSS scheduled to occur in the Gippsland Basin at the same time as the proposed Pelican 3DMSS. As such, the potential impacts of simultaneous surveys will not be experienced.

2.7. Associated Field Activities

2.7.1. Habitat Assessment

As part of the Pelican 3DMSS, CarbonNet will undertake a pre- and post-MSS non-invasive habitat assessment (i.e., towed video) within and adjacent to the operational area to re-confirm the presence or absence of commercial scallops and southern rock lobsters.

There will be no seabed disturbance associated with this proposed habitat assessment. The habitat assessment will be facilitated using a small charter vessel, where sewage, grey water and other wastes will be discharged via port facilities rather than at sea.

2.7.2 Underwater Sound Validation

To inform the wider body of scientific knowledge regarding MSS, CarbonNet will validate the STLM prepared for the Pelican 3DMSS. Several sound loggers will be deployed and recovered on the seabed by a small vessel. The loggers will rest on the seabed with the use of weight/s to keep the logger secured stationary. The loggers will be retrieved once the validation study is complete (once the MSS has finished).

2.8. Survey Summary

Table 2.3 summarises the proposed survey parameters.

Table 2.3. Summary of the proposed Pelican 3DMSS parameters

Parameter	Details
Earliest commencement date	29 th January 2018
Latest commencement date	End of March 2018
Duration of survey	13 to 16 days (up to 27 days)
Water depths	15 – 40 m LAT
Acquisition area	166 km ²
Source	
Number of source arrays	2
Source effort	75 bar-m
Total volume	2,800 cui maximum
Operating pressure	2,000 psi

Parameter	Details
Shot point interval	12.5 m horizontal distance
Depth	5 m (\pm 1 m)
Sample rate	2 milliseconds
Record length	4 seconds
Streamers	
Number of streamers	8 (nominal), but may vary between 4 and 10
Length	4,000 m
Depth below sea surface (approx.)	5 m (\pm 1 m)
Horizontal separation (approx.)	50 m
Type	Broadband solution preferred
Sail lines	
Number of sail lines	60 (based on 8 streamers), but may vary between 48 and 120
Orientation	Northwest/southeast
Line separations	200 m (based on 8 streamers), but may vary between 100 and 250 m
Sail line surface	712 km (based on 8 streamers), but may vary between 569 and 1,423 km
Vessel details	
Contractor	Polarcus
Survey vessel	<i>Polarcus Naila</i>
Survey vessel speed	~4.5 knots (8 km/hr)
Refuelling	In port only
Support vessels	At least two
Support vessel contractor	Unknown at time of EP submission, but likely to be locally-based

3. Legislation and Guidelines

The proposed Pelican 3DMSS will be conducted in both Commonwealth and Victorian State waters in Bass Strait in accordance with the OPGGS(E) and the OPGGS Regulations.

Table 3.1 presents a summary of the key Commonwealth legislation and regulations relevant to the environmental management of the activity, while Table 3.2 presents the Victorian equivalent.

3.1. DEDJTR Environment Policy

The DEDJTR's Environment Policy provides a public statement of the Department's commitment to minimise adverse effects on the environment (Box 3.1).

The CarbonNet Project operates under DEDJTR's Environmental Management System (EMS), which aims to minimise and manage the impacts on employees, contractors, the environment and the communities in which the project operates. The EMS has been developed in line with Australian/New Zealand Standard ISO 14001:2004 Environmental Management Systems (described further in Chapter 8).

3.2. Environmental Approvals Processes

3.2.1. Commonwealth Approvals

Offshore Petroleum and Greenhouse Gas Storage Act 2006

The OPGGS Act 2006 (Cth) addresses all licensing, health, safety and environmental issues for offshore GHG activities in Commonwealth waters (generally between the 3 nm mark and the 200 nm limit of Australian seas).

The OPGGS(E) requires the preparation of an EP prior to conducting a GHG activity for acceptance by NOPSEMA.

Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the key legislation regulating projects that may have an impact on a Matter of National Environmental Significance (MNES).

In February 2014, NOPSEMA became the sole designated assessor of petroleum and GHG activities in Commonwealth waters in accordance with the Minister for the Environment's endorsement of NOPSEMA's environmental authorisation process under Part 10, section 146 of the EPBC Act. Under the streamlined arrangements, impacts on the Commonwealth marine area by petroleum and GHG activities are assessed solely through NOPSEMA.

The Commonwealth Department of Environment and Energy (DoEE) is the Regulator for the EPBC Act. While the risk assessment undertaken for this EP indicates that the project is unlikely to have significant impacts on MNES, CarbonNet prepared and submitted an EPBC Referral to the DoEE (to describe and assess the MNES within the state waters portion of the project area) (EPBC 2017/8097).

DEDJTR ENVIRONMENT POLICY

Introduction

This policy aims to reduce both current and future environmental impacts of the Department of Economic Development, Jobs, Transport and Resources (DEDJTR) through both staff behavioural change and infrastructure improvements.

Scope

This policy is applicable to all operations and services of the department at all locations. Agencies linked to the department are expected to comply with the spirit of this policy in the context of the organisation in which they work.

Policy Statement

The Environment Policy has been developed to increase awareness of the environmental impacts that the organisation faces and to demonstrate commitment to further reducing these impacts over time. DEDJTR has responsibility for 70 sites across Victoria.

Staff are required to familiarise themselves and act in accordance with the Environment Policy.

Principles

- *Emissions* – actively identify and implement (where practical) improvements to minimise the production of greenhouse gases through our everyday activities.
- *Consumption* - actively identify and implement (where practical) improvements to minimise consumption and promote efficient use of energy, water, paper and other material inputs.
- *Waste* - strive to reduce the amount of waste produced whilst maximising the amount we reuse and recycle.
- *Procurement* - incorporate environmental principles and, where possible, life cycle costing when procuring goods and services and request that suppliers remove and reuse packaging when goods are procured in bulk.
- *Transport* - consider environmental factors when purchasing and using fleet vehicles and travel sustainably when practical.
- *Infrastructure* - ensure all new capital works programs and office relocations incorporate comprehensive environmental sustainability principles.
- *Compliance* - comply with all relevant environmental legislation, regulations and policies.
- *Monitoring* - monitor and review our environmental performance against annually reviewed targets. Improve the quality of data collected and reported.
- *Communication* - communicate our environmental performance to all staff and stakeholders whilst encouraging participation and feedback.

Procedures

Staff are expected to save energy, utilise smarter travel, utilise greener procurement, save water, utilise waste and recycling systems, and save paper.

Policy owner/branch: Environment Manager, People and Workplace Services.

Approved by: DEDJTR Executive Board (19 August 2015).

Next review: 3 years from effective date.

Version No. DOC/15/242170 (version 1).

Box 3.1. The DEDJTR Environment Policy

3.2.1. Victorian Approvals

Offshore Petroleum and Greenhouse Gas Storage Act 2010

The OPGGS Act 2010 (and associated OPGGS Regulations 2011) is the key legislation regulating GHG activities in Victorian state waters, and mandates that environmental considerations should be integrated into decision-making with regard to the administration of the Act. In this regard, an EP must be prepared and submitted to the Regulator (the Earth Resources Regulation [ERR] branch of the DEDJTR) for acceptance.

This Act and its Regulations (Chapter 2 – Environment) are similar to the Commonwealth Act and Regulations of the same name, however have not been modified to align with most recent revisions of the Commonwealth Act and regulations (streamlining amendments made in 2014) and hence variations between jurisdictions exist.

4. Stakeholder Consultation

The CarbonNet Project has a strategic and systematic approach to stakeholder engagement.

CarbonNet has opened the channels of communication with stakeholders (definition provided in Section 4.2.1) to provide an opportunity for open and honest communication that promotes integration of stakeholder values into its decision-making process. This provides the means for CarbonNet to identify interested individuals and groups as well as their needs, ideas, values, and issues of concern regarding the environmental and/or social impacts of the proposed Pelican 3DMSS.

In keeping with DEDJTR's Environment Policy (see Section 3.1), CarbonNet is also committed to open, on-going and effective engagement with the communities in which it operates and providing information that is clear, relevant and easily understandable.

This section of the EP defines the:

- Objectives of stakeholder consultation;
- Regulatory requirements for stakeholder consultation;
- Who needs to be considered in decision-making;
- When decisions must be completed;
- The on-going consultation schedule; and
- How commitments are documented and tracked to closure.

4.1. Stakeholder Consultation Objectives

CarbonNet's Stakeholder Engagement Plan (SEP) for the MSS provides a structured approach to engagement activities in line with current best practice. The implementation of the SEP will help stakeholders build an understanding of the MSS, facilitate an open dialogue between the Project and key stakeholders, and potentially minimise stakeholder concerns and impacts regarding the proposed MSS.

The key objectives of the SEP are to:

- Provide stakeholders with access to clear, up-to-date and timely information, and a point of contact for the project;
- Provide an opportunity for a two-way information exchange and meaningful stakeholder consultation;
- Build on the stakeholder engagement that CarbonNet has already undertaken in the Gippsland region;
- Demonstrate integrity and transparency in the Project's approach to stakeholder engagement; and
- Meet the stakeholder consultation requirements for EPs (see Section 4.2).

In developing the SEP, CarbonNet has incorporated key learnings from engagement programs of recent MSS (e.g., the MSS conducted by Geoscience Australia in 2015).

CarbonNet is also liaising with its lead research organisation, the CO2CRC, which oversees the GipNet assets. GipNet involves deploying a number of CCS research assets (such as atmospheric and marine monitoring equipment) to validate baseline data gathering technologies and assist in defining practical and relevant shallow-marine Measurement, Monitoring and Verification (MMV) programs.

4.2. Regulatory Requirements

Stakeholder consultation is required under both the OPGGS(E) and the OPGGS Regulations. This section summarises these regulatory requirements.

4.2.1. Commonwealth Requirements

Section 280 of the OPGGS Act states that a person carrying out activities in an offshore permit area should not interfere with other users of the offshore area to a greater extent than is necessary for the reasonable exercise of the rights and performance of the duties of the first person. In order to determine what activities are being carried out and whether petroleum activities may interfere with existing users, consultation is required.

In relation to the content of an EP, more specific requirements are defined in the OPGGS(E) Regulation 11A. This regulation requires that a Titleholder consult with 'relevant persons' in the preparation of an EP. A 'relevant person' is defined in Regulation 11A as:

1. Each Department or agency of the Commonwealth to which the activities to be carried out under the EP, or the revision of the EP, may be relevant;
2. Each Department or agency of a State or the Northern Territory to which the activities to be carried out under the EP, or the revision of the EP, may be relevant;
3. The Department of the responsible State Minister, or the responsible Northern Territory Minister;
4. A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP, or the revision of the EP; and
5. Any other person or organisation that the titleholder considers relevant.

Further guidance regarding the definition of functions, interests or activities is provided in NOPSEMA's Assessment of Environment Plans: Deciding on Consultation Requirements Guidelines (N-04750-GL1629, Rev 0, April 2016), as follows:

- Functions – a person or organisation's power, duty, authority or responsibilities;
- Activities – a thing or things that a person or group does or has done; and
- Interests – a person or organisation's rights, advantages, duties and liabilities; or a group or organisation having a common concern.

Regulation 14(9) of the OPGGS(E) also defines a requirement for consultation in relation to the Implementation Strategy defined in the EP. In addition, Regulation 16(b) of the OPGGS(E) requires that the EP contain a summary and full text of this consultation.

4.2.2. Victorian Requirements

Section 61(2)(j) of the OPGGS Act 2010 specifies that “decisions and actions should provide for community involvement in issues that affect them.”

The OPGGS Regulations 2011 also specify that certain activities in relation to stakeholder consultation must occur, as listed below:

- Regulation 13(1)(f) – a Minister can only accept an EP if it “demonstrates that there has been an appropriate level of consultation with authorities, interested persons and organisations” and
- Regulation 16(8) – “the implementation strategy must provide for appropriate ongoing consultation with relevant authorities of the Commonwealth or the State and other relevant interested persons or organisations.”
- Regulation 19(b) – “a report on all consultations between the operator and relevant authorities, interested persons and organisations in the course of developing the EP.”

4.3. Stakeholder Identification

The CarbonNet project team used a number of methods to determine the key stakeholders for the proposed Pelican 3DMSS. These stakeholders are grouped into five categories of relevant persons as outlined by the OPGGS(E) (as listed in Section 4.2.1).

Stakeholders identified for the proposed Pelican 3DMSS, divided into the categories defined under Regulation 11A of the OPGGS(E), are listed in Table 4.1.

Table 4.1. Stakeholders identified for the proposed Pelican 3DMSS

Department or agency of the Commonwealth to which the activities to be carried out under the EP may be relevant	
National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA)	Australian Maritime Safety Authority (AMSA) - Nautical and Regulation Section
Department of the Environment and Energy (DoEE)	Department of Defence (DoD) – Defence Support Group
Australian Fisheries Management Authority (AFMA)	Department of Agriculture and Water Resources (DAWR)
Australian Hydrographic Office (AHO)	Department of Communications and ACMA
Department of Immigration and Border Protection - Maritime Border Command	National Offshore Petroleum Titles Administrator (NOPTA)
Each Department or agency of a State to which the activities to be carried out under the EP may be relevant	
Environment Protection Authority (EPA)	Department of Environment, Land, Water and Planning (DELWP) - Oiled Wildlife Response team
Parks Victoria	
Maritime Safety Victoria	

The Department of the responsible State Minister	
DEDJTR - Earth Resources Regulation (ERR)	Victorian Fisheries Authority (VFA)
A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP	
<i>Fisheries</i>	
Commonwealth Fisheries Association (CFA)	Seafood Industry Victoria (SIV)
South-East Trawl Fishing Industry Association (SETFIA)	Eastern Zone Abalone Industry Association
Lakes Entrance Fisherman's Cooperative (LEFCOL)	Victorian Abalone Divers Association (VADA)
Victorian Scallop Fisherman's Association (VSFA)	Sustainable Shark Fishing Association (SSFAssn)
Southern Shark Industry Alliance (SSIA)	VRFish
Victorian Abalone Council	Small Pelagic Fishery
Eastern Rock Lobster Industry Association	Victorian Rock Lobster Association (VRLA)
Australian Southern Bluefin Tuna Industry Association (ASBTIA)	
<i>Individual fishing licence holders</i>	
Nine licence holders (communication via Victorian Fisheries Authority)	
<i>Adjacent/overlapping petroleum Titleholders</i>	
Cape Energy (Victoria) Pty Ltd – VIC/RL1(V)	3D Oil (VIC/P57)
ExxonMobil (Esso Australia Resources Pty Ltd) – VIC/RL1 and VIC/L1 in particular (Esso also hold many other petroleum tenements in the Basin)	Lakes Oil (Petrotech) - Petro Tech Pty Ltd – VIC/P44(V), VIC/P43(V) and Lakes Oil onshore PRL2 and PRL3
Carnarvon Hibiscus Pty Ltd – VIC/P57 and VIC/L31	
<i>Oil spill preparedness and response agencies</i>	
DEDJTR – Emergency Management Division (EMD)	AMSA
Any other person or organisation that the Titleholder considers relevant	
<i>Local Government Authorities</i>	
Wellington Shire Council	South Gippsland Shire Council
East Gippsland Shire	Latrobe City Council
<i>Other infrastructure</i>	
Basslink	Telstra
OSD Services (Tasmanian Gas Pipeline)	
<i>Community and other groups</i>	
Committee for Gippsland	Gippsland Ports

Gippsland Water	Gippsland Coastal Board
Gunaikurnai Land & Waters Aboriginal Corporation (GLaWAC)	East Gippsland Catchment Management Authority (EGCMA)
Golden Beach Surf Club	Lakes Entrance Coastguard
Golden Paradise Beach Ratepayers Association (GPBRA)	Gippsland Water Police
Victorian National Parks Association (VNPA)	National Native Title Tribunal (NNTT)

CarbonNet recognises that the relevance of stakeholders identified in this EP may change in the event of a non-routine event or emergency. Every effort has been made to identify stakeholders that may be impacted by a non-routine event or emergency, the largest of which is considered a Level 2 or 3 marine diesel spill from the survey vessel (see Section 7.16).

CarbonNet acknowledges that other stakeholders not identified in this EP may be affected, and that these may only become known to CarbonNet in such an event.

4.4. Engagement Method and Approach

This section outlines the approach and methodology in which CarbonNet has undertaken its stakeholder consultation.

4.4.1. Engagement Approach

Consultation has been broadly undertaken in line with the International Association for Public Participation (IAP2) spectrum, which is considered best practice for stakeholder engagement. In order of increasing level of public impact, the elements of the spectrum and their goals are:

- Inform – to provide the public with balanced and objective information to assist them in understanding the problems, alternatives and/or solutions.
- Consult – to obtain public feedback on analysis, alternatives and/or decisions.
- Involve – to work directly with stakeholders throughout the process to ensure that public concerns and aspirations are consistently understood and considered.
- Collaborate – to partner with the public in each aspect of the decisions, including the development of alternatives and the identification of the preferred solution.
- Empower – to place final decision-making in the hands of the stakeholders.

The manner in which CarbonNet has informed, consulted and involved stakeholders with the asset's ongoing operations are outlined through this section. Attempts to collaborate with stakeholders including the commercial fishing industry have been made, and discussions on several proposals are continuing.

Under the regulatory regime for the approval of EPs, the decision maker is the regulator (or regulators in the case of multiple jurisdictions, such as experienced for this project). This being the case, the final step in the IAP2 spectrum, 'Empower', has not been adopted.

The Project has a strategic and systematic approach to stakeholder engagement, which aims to foster an environment where two-way communication and ongoing,

open dialogue is encouraged to build positive relationships. Key principles that guide CarbonNet in its stakeholder engagement activities include:

- Timely engagement;
- Transparency;
- Providing accurate and objective information;
- Monitoring stakeholder interests;
- Ongoing active consideration of stakeholder feedback; and
- Tailoring appropriate communications to meet audience needs.

CarbonNet has applied these principles to its stakeholder engagement since its inception in 2009, and has methodically recorded its engagement activities in the project's consultation database (see Section 4.4.3).

The MSS will include four main phases of stakeholder engagement, these being:

1. Planning and conducting engagement activities until the EPs are approved by Victorian and Commonwealth regulators;
2. Pre-mobilisation communications;
3. Communications during the survey; and
4. Community survey results after the survey is completed.

Additional periods of engagement and communications activities may be required, depending on the needs of the project and feedback from consultation.

An initial overview of the proposed activities was provided to relevant stakeholders (including key fishing associations) in March 2017. Initial contact was via a letter and information sheet that was both emailed and sent in hard copy. This formed the basis for consultation. Stakeholders who had not responded within a month were contacted by phone and/or email. Further information was provided to stakeholders based upon identified issues and concerns.

As part of preparing the SEP, CarbonNet consulted with the Victorian fishery regulator (the Victorian Fisheries Authority, VFA) to assist with stakeholder identification and to understand the status of fisheries in the MSS area. This was followed by engagement with fishing industry associations from March 2017, including Seafood Industry Victoria (SIV), the South East Trawl Fishing Industry Association (SETFIA), the Lakes Entrance Fishermen's Cooperative (LEFCOL) and the Victorian Scallop Fishermen's Association (VSFA). The VFA was also used to distribute information on the survey directly to individual licence holders, which was appropriate as licence holder details are confidential.

In planning and delivering CarbonNet's current communications and stakeholder engagement activities, the CarbonNet project team is supported by the team's Stakeholder Engagement Coordinator.

4.4.2. Engagement Methodology

A range of stakeholder engagement and communications methods and tools have been used throughout the engagement process, including (but not limited to) the following:

- Face-to-face meetings;
- Letters;
- Fact sheet;

- Outgoing phone calls;
- Community Open Day;
- Emails; and
- Up-to-date information on the DEDJTR website (<http://earthresources.vic.gov.au/carbonnet>).

At the commencement of formal consultation, stakeholders were issued a project fact sheet and cover letter in March 2017 by email and post.

The letter invited feedback and offered face-to-face meetings with CarbonNet representatives to formally seek stakeholder views, discuss any issues and concerns and provide an opportunity to ask questions. Meetings also enabled CarbonNet to confirm stakeholders' functions, activities and interests' and to identify further opportunities for engagement.

Overall, CarbonNet has made contact with over 130 individual stakeholders from more than 70 organisations and conducted more than 40 face-to-face meetings with stakeholders to inform the EP (including 14 meetings with fishing industry stakeholders, four meetings with local community groups and a community open day held in Golden Beach). This is in addition to phone calls, emails, letters and briefings.

The Open Day, held in Golden Beach on 12 July 2017, was attended by more than 40 local residents and holiday-makers who were provided with copies of the MSS fact sheet and information about the activity and how it may affect them. Feedback on the day was positive and indicated that the community has significant interest in the project.

4.4.3. Record of Stakeholder Engagement

A log of all consultation is recorded in CarbonNet's consultation database, Consultation Manager™, including any objections and claims about possible adverse impacts of the activity raised by relevant persons. This includes meeting summaries, phone call summaries, logs of emails and letters.

4.4.4. Distribution of Survey Information to Individual Fishing Licence Holders

CarbonNet has consulted with all relevant fishing industry groups who may be present in the area during the survey, and has validated this stakeholder list with the VFA and fishing industry stakeholders. This has included notifying individual fishing licence holders (via VFA) who have catch and effort history within VFA fishing grid cells that overlap the proposed operational area. CarbonNet has not received any responses to the letters that were sent direct to fishing licence holders via VFA.

CarbonNet understands that SIV also distributed a letter to potentially affected fishing licence holders via VFA. The VFA confirmed that this letter went to the same list of nine fishers, two of whom no longer hold a licence.

CarbonNet held meetings with affected fishing licence holders in Lakes Entrance, Traralgon and Melbourne, who were invited via SIV, VSFA and SETFIA. Scallop fishers made up the majority of attendees at these meetings.

CarbonNet will liaise closely with all fishing industry organisations to notify their members of when the MSS will take place, and has offered to meet any reasonable costs for those organisations to do so. To date, this offer has been taken up by SETFIA, with whom CarbonNet has a contract to notify the trawl fishing fleet.

4.4.5. Dedicated Project Email and Customer Service Centre

The CarbonNet team has a dedicated email inbox and Departmental Customer Service Centre for all enquiries relating to the project (these details are included on all collateral).

In addition, all identified stakeholders have been provided with a direct line to the Stakeholder Engagement Coordinator, which is available 24 hours a day, 7 days a week during the activity period.

All correspondence and feedback is recorded in Consultation Manager™.

4.4.6. CarbonNet Website

Information on the Pelican 3DMSS, including the fact sheet, has been made available on the CarbonNet website (<http://earthresources.vic.gov.au/carbonnet>) for all interested members of the public to access. Contact information for the team is also available. Flyers prepared for future project milestones (see Section 4.7) will also be made available on the website.

4.5. Summary of Stakeholder Consultation

Stakeholder consultation has involved extensive consultation with a broad range of stakeholders, as listed in Table 4.1. The key theme emerging from this consultation was the potential impacts on marine fauna, and in particular, scallops. Table 4.2 outlines the key themes and outcomes from this.

A summary of key stakeholder consultation undertaken to date, together with CarbonNet's responses and assessment of feedback merits is included in Table 4.3. This table focuses on stakeholders who have been identified as 'relevant persons' whose functions, interests or activities may be affected by the activity. It also includes key stakeholders with whom engagement has taken place to enable CarbonNet to determine whether they are 'relevant persons' for the survey.

Table 4.2. Key themes and outcomes from stakeholder consultation

Theme	Key stakeholders	Outcomes
Potential impacts on commercial scallops in the vicinity of the MSS and potential risks to the scallop fishery.	SIV, VSFA, LEFCOL, VFA	<ul style="list-style-type: none"> SIV and the VSFA have expressed ongoing concerns about the proposed MSS on the basis that it will affect the viability of scallop beds in and around the proposed acquisition area that are (anecdotally) in a rebuilding phase after a period of low abundance. To inform the EIA with up-to-date data and scientifically-sound data on the potential presence of species such as scallops, CarbonNet commissioned a marine habitat assessment of the proposed acquisition area that was undertaken in April 2017. The assessment did not detect beds of commercial scallops. CarbonNet has carefully considered and applied all relevant studies, including Day et al (2016a;b), and commissioned underwater sound modelling. The potential impacts to scallop fisheries have been assessed by CarbonNet as minor. In addition to the marine environmental habitat assessment conducted in April 2017, CarbonNet will

Theme	Key stakeholders	Outcomes
		<p>undertake a further pre- and post-MSS marine habitat assessment, which CarbonNet is designing in partnership with fishing industry representatives and the VFA. This aims to provide additional certainty regarding the presence or absence of commercial scallops in the proposed acquisition area and surrounds.</p> <ul style="list-style-type: none"> • CarbonNet provided extracts from the draft EP and from the submitted EP to the fishing industry (SIV) regarding impacts of underwater sound on scallops and their associated fisheries to enable them to review CarbonNet's impact and risk assessments and provide considered comments. • CarbonNet has contributed to a whole of Victorian Eastern Scallop Fishery Stock Assessment to be undertaken by the VFA and industry in early 2018.
Avoidance of fishing competitions at Golden Beach.	GPBRA, Parks Victoria, GLaWAC	<ul style="list-style-type: none"> • The GPBRA has expressed concern that undertaking the MSS immediately prior to or during fishing competitions (around the Australia Day and Easter long weekends) will mean fish will avoid the area and impact on the fishing competitions (with resultant economic losses to coastal towns). • CarbonNet has committed to not conducting the MSS between Christmas and Australia Day long weekend (fishing competition) and avoiding the Easter long weekend (fishing competition). CarbonNet has advised it will aim to undertake the MSS in February, subject to vessel availability and weather, in order to minimise impacts on recreational fishing. • CarbonNet has offered to collaborate with the organisers of the fishing competitions to support their promotion and attendance rates.
Potential impacts on other commercial fisheries in the vicinity of the MSS.	SETFIA, SIV, LEFCOL, SSFAssn, SSIA, VRLA, individual fishing businesses	<ul style="list-style-type: none"> • CarbonNet has carefully considered and applied all relevant studies and commissioned sound modelling. The potential impacts to fisheries have been assessed by CarbonNet as minor.

4.6. Ongoing Consultation

From March 2017 to the time of original EP submission (18 August 2017), CarbonNet invested six months engaging with its stakeholders. Consultation has continued up to the time of EP re-submission. CarbonNet is committed to continuing stakeholder consultation in the lead-up to, during, and after the MSS.

Key milestones that will trigger further consultation include:

- Phase 2:
 - Confirmation of the timing of the survey.

- Future optimisation activities (e.g., changes to the operational area); EP acceptance and the availability of the EP Summary on the NOPSEMA and DEDJTR websites.
 - Operational planning aspects.
- Phase 3:
 - Any significant incidents (e.g., large hydrocarbon spill).
- Phase 4:
 - Completion of the MSS and sharing of relevant outcomes from environmental habitat assessment and the underwater sound validation study (see Section 2.7).

Consultation Manager remains a live database and is updated on an as-required basis.

Table 4.3. Summary of stakeholder consultation undertaken

Stakeholder	Functions, interests and/or activities	Date	Concerns, impacts or claims raised by stakeholder	CarbonNet's assessment of merit to stakeholder
Department or agency of the Commonwealth to which the activities to be carried out under the EP may be relevant				
Australian Fisheries Management Authority (AFMA)	Manager of Commonwealth fisheries	21/3/17	CarbonNet emailed AFMA with a letter that invited comment, fact sheet and contact details.	N/A
		5/5/17	CarbonNet sent follow up email to check if initial email was received and if catch data is available for fisheries that overlap the MSS area.	N/A
		11/5/17	CarbonNet phoned and spoke to AFMA. They advised: <ul style="list-style-type: none"> • There is a fair bit of activity in the MSS area - primarily south east trawl and gillnets in the Southern and Eastern Scalefish and Shark Fishery (SESSF). • Data is available through the ABARES Annual Fishery Status Reports - last version released Sept 2016. AFMA does not have any additional data to these reports that it can provide. • AFMA has list of industry groups on its website and SETFIA is the main player in the area, as well as the Southern Shark Industry Alliance (SSIA) and the Sustainable Shark Fishing Association (SSFAssn). • AFMA's biggest concern is that the actual industry representatives are consulted rather than AFMA Happy for CarbonNet to continue to consult with SETFIA and other relevant groups and no need to come back to AFMA. 	CarbonNet advised we will have already contacted all relevant fishing groups and will continue to consult with them. Also advised we have accessed the ABARES reports to inform the EP. Thanked AFMA for the information.
		7/8/17	CarbonNet emailed AFMA with an update on the duration and expanded operational area for the MSS.	N/A
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
Australian Maritime	AMSA is a	21/3/17	CarbonNet sent email to AMSA re MSS, including fact sheet and	N/A

Safety Authority (AMSA)	statutory authority established		contact details.	
under the <i>Australian Maritime Safety Authority Act 1990</i> , with one its principal functions being to promote maritime safety and protection of the marine environment.		27/3/17	<p>Email from AMSA in response to CarbonNet MSS email providing historic traffic plot for survey area and directions for survey vessel.</p> <p>AMSA requests:</p> <ul style="list-style-type: none"> • The survey vessel to contact AMSA’s Joint Rescue Coordination Centre (JRCC) through rccaus@amsa.gov.au for AUSCOAST warning broadcasts before operations commence and during the survey period. AMSA’s JRCC will require the vessels details (including name, callsign and Maritime Mobile Service Identity (MMSI)), satellite communications details (including INMARSAT-C and satellite telephone) and area of operation and need to be advised when the survey starts and ends. • Australian Hydrographic Service must also be contacted four working weeks out for Notice to Mariners (see separate contact). 	AMSA comments noted in the preparation of the EP and survey. The vessel traffic plot map is incorporated into Section 5.6.7 of the EP.
		28/3/17	Email from AMSA with requested traffic map with 1 year of data.	AMSA information noted in the preparation of the EP and survey.
		21/4/17	<p>CarbonNet had a telephone discussion with AMSA’s Manager of Marine Environmental Pollution Response to request the latest list of oil spill response equipment. AMSA referred CarbonNet to its website where the latest equipment listing can be downloaded. CarbonNet provided a briefing on the oil spill modelling results and enquired about the division of responsibilities between the Commonwealth and the State, given that a spill in Commonwealth waters is predicted to quickly travel into state waters. AMSA stated that in this case, it is likely that given the volume of the spill and the availability of resources nearby, AMSA would delegate overall spill response to DEDJTR (EMD).</p>	<p>CarbonNet thanked AMSA and progressed the OPEP based on the information provided.</p> <p>CarbonNet downloaded the equipment lists available for Victoria.</p>
		14/6/17	<p>Meeting with AMSA regarding possible methods to ensure the safety of mariners while the survey is being undertaken.</p> <p>Advice received from AMSA:</p> <p>There are no mechanisms under Commonwealth legislation (Navigation Act) for establishing exclusion zones around survey</p>	AMSA comments noted in the preparation of the EP and survey.

	<p>vessels (as there are under Victorian waters). Best ways to ensure this is to request clearance through AMSA & Austn Hydrographic Office. AMSA advised that a requested clearance and the use of survey support vessels are the main controls regarding collision risk. Advised that near misses/accidents are reportable under Navigation Act. For recreational boats the responsible authority is Victoria & for commercial it is transitioning from Victoria to the Commonwealth (AMSA).</p> <p>Need to be aware of the area to be avoided in Bass Strait and need to get a permit from NOPSEMA for seismic vessel to enter into this area: https://www.border.gov.au/AustralianBorderForce/Documents/Bass%20Strait%20Area%20to%20be%20Avoided%20Industry%20information%20sheet.pdf</p> <p>There may also be provisions under the OPGGS Act that provide that it is an offence to interfere with a seismic vessel.</p>	
21/6/17	Email from AMSA confirming advice provided in meeting on 14/6/17.	AMSA comments noted in the preparation of the EP and survey.
7/8/17	Email to AMSA with an update on the duration and expanded operational area for the MSS.	N/A
9/8/17	AMSA emailed CarbonNet with a historical AIS traffic plot based on data collected from July 2016 until June 2017. AMSA noted that as there has only been a slight change to the operational area to accommodate the survey vessel's manoeuvring requirements, previous advice provided by AMSA on 27/3/17 remains extant.	N/A
9/8/17	CarbonNet had a telephone discussion with AMSA's Manager of Marine Environmental Pollution Response to confirm the response arrangements between AMSA and EMD in the event of a hydrocarbon spill from the MSS and to confirm the operational monitoring resources that could be accessed from AMSA and the delegation of spill response from AMSA to EMD.	CarbonNet progressed the OPEP based on the information provided.
9/8/17	CarbonNet followed up the phone call with an email to confirm its understanding of the delegation of spill response from AMSA to	N/A

			EMD, and to confirm the resources available at the Commonwealth level for scientific monitoring. No response to this email has been forthcoming to date.	
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
		6/10/17	CarbonNet sent a copy of a letter to CSIRO to AMSA on 6/10/17. The letter seeks confirmation from CSIRO regarding its readiness to assist with scientific monitoring activities under existing AMSA arrangements in the unlikely event of an oil spill from the Pelican 3DMSS. There has been no response to date.	N/A
Department of Environment and Energy (DoEE)	Commonwealth department responsible for administration of the EPBC Act, marine parks and various other matters of national environmental significance.	22/2/17	CarbonNet spoke with DoEE confirming that it would be sending a letter to confirm the EPBC application process for the MSS in Victorian waters.	N/A
		22/2/17	Letter sent to DoEE seeking confirmation of the EPBC application process for the MSS in Victorian waters.	N/A
		21/3/17	CarbonNet sent email to DoEE re MSS, including fact sheet and contact details.	N/A
		24/3/17	Letter from DoEE confirming that it is the appropriate agency to assess Environment Protection and Biodiversity Conservation Act 1999 Matters of National Environmental Significance (MNES) for the MSS in Victorian waters.	DoEE comments noted in the preparation of the EP and survey.
		6/4/17	Email from DoEE confirming receipt of the MSS fact sheet, and that it currently doesn't have any questions in relation to the MSS proposal. (Sandra - COR/17/131125)	N/A

		4/5/17	Meeting with DoEE to provide an update on CarbonNet's MSS and to discuss a possible EPBC referral for the Victorian waters part of the survey.	DoEE comments noted in the preparation of the EP and survey.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
National Offshore Petroleum Titles Administrator (NOPTA)	National greenhouse gas titles administrator	3/5/17	CarbonNet meeting with NOPTA to provide a general overview on CarbonNet stage 3 activities including an update on its proposed MSS.	NOPTA comments noted in preparation of survey and EP.
		2/8/17	CarbonNet meeting with NOPTA re the MSS and the extent of the key GHG operation approval to conduct the survey; and whether a dredge based scallop stock assessment is consistent with the approval.	NOPTA comments noted in preparation of survey and EP.
		7/8/17	Email to NOPTA seeking responses to questions on the MSS and the extent of the key GHG operation approval to conduct the survey; and whether a dredge based scallop stock assessment is consistent with the approval.	N/A
		8/8/17	Email to NOPTA with an update on the duration and expanded operational area for the MSS.	N/A
		10/8/17	Email to NOPTA seeking confirmation that no further approvals required for an expanded MSS operational area outside of the VIC-GIP-002 GHG assessment permit area in Commonwealth waters.	N/A
		11/8/17	Email from NOPTA confirmation that no further approvals required for an expanded MSS operational area outside of the VIC-GIP-002 GHG assessment permit area in Commonwealth waters.	NOPTA comments noted in preparation of survey and EP.
		7/9/17	CarbonNet received an email from NOPTA that provided some preliminary views regarding the scope of the MSS approval and whether a dredge-based scallop assessment was consistent with the approval.	N/A
		15/9/17	CarbonNet emailed NOPTA regarding the scope of the MSS approval and dredge based scallop assessment.	N/A

		20/9/17	Email from NOPTA confirming that the scope of the MSS approval is inconsistent with a dredge-based scallop assessment.	NOPTA comments considered during consultation with the VFA and SIV regarding the proposed scallop fishery stock assessment.
Department of Communication and Australian Communications and Media Authority (ACMA)	Administrator of submarine cable protection zones	12/4/17	CarbonNet sent Department of Communication an email with invitation to comment and a fact sheet.	N/A
		26/4/17	CarbonNet received email response on behalf of the Department of Communication and ACMA noting that the MSS is not within the vicinity of existing submarine cable Protection Zones, nor does there appear to be any submarine cables within the vicinity of the proposed seismic survey area. The department advised that the protection regime does not cover all submarine cables so CarbonNet should check with other operators.	CarbonNet thanked the department for their response. CarbonNet has consulted other infrastructure operators in the area, including Telstra and Basslink.
Australian Hydrographic Office (AHO)	Issuer of Notice to Mariners	21/3/17	CarbonNet emailed the AHO a letter with a fact sheet and contact details.	N/A
		28/3/17	AHO emailed CarbonNet to advise information had been noted, and requested CarbonNet advise AHO within four weeks of activity to publish notice to mariners.	CarbonNet will contact AHO again four weeks out from the MSS to publish notice to mariners.
		7/8/17	CarbonNet emailed AHO to advise area and duration of survey have now been refined, and advising we will submit EP in mid-August.	N/A
		8/8/17	AHO emailed CarbonNet to request they be kept informed once reasonably firm dates are available closer to the event.	AHO is included in the list of stakeholders to be notified prior to the survey commencing (Section 8.7.1).
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
Department of Defence (DoD) - Defence Support	Manage all Australian defence activities. DoD has operations	21/3/17	CarbonNet emailed Department of Defence (DoD) - Defence Support Group with a letter, fact sheet and contact details.	N/A
		29/5/17	CarbonNet sent a follow up email to the department.	N/A
		30/5/17	CarbonNet received an email response to advise they are still	N/A

Group	in Sale, Gippsland.		consulting with internal stakeholders.	
		8/6/17	Department of Defence emailed CarbonNet to say they have no objections or comments to raise.	CarbonNet thanked the DoD for their advice. Defence activities are addressed in Section 5.6.8 of the EP.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
Department of Agriculture and Water Resources (DAWR) - Biosecurity	Biosecurity requirements for vessels entering Australian waters and ports	21/3/17	CarbonNet emailed Department of Agriculture with a letter, fact sheet and contact details inviting comment.	N/A
		6/4/17	CarbonNet called to follow up and resent email as it was not received.	N/A
		11/5/17	CarbonNet called to follow up and resent email once again.	N/A
		12/5/17	CarbonNet received a response from the department with information regarding with requirements for all international vessels arriving into Australian seas, including requirements for vessels coming from overseas ports.	CarbonNet thanked DAWR for the information and forwarded to CarbonNet's seismic advisor for implementation.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
Department of Infrastructure and Regional Development (DIRD)	Potential for overlapping projects and/or activities	21/3/17	CarbonNet emailed Department of Infrastructure with a letter, fact sheet and contact details inviting comment.	N/A
		7/4/17	CarbonNet called to follow up, not sure if email was received and left message for relevant person to call back.	N/A
		12/4/17	CarbonNet called again and briefly discussed project to determine who in the department needs to review the information.	N/A
		12/4/17	CarbonNet received an email response advising the department has no feedback on the MSS and requesting we liaise with AMSA regarding maritime safety and other issues. They would like to be kept updated on the project as it progresses.	CarbonNet thanked DIRD for their response and advised that AMSA is being consulted. CarbonNet will keep the department

				updated on the project as it progresses.
		17/8/17	CarbonNet emailed DIRD to advise area and duration of survey have now been refined, and advising we will submit EP in mid-August.	N/A
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
Geoscience Australia (GA)	Author of recent report on impacts of seismic surveys on marine fauna in the Gippsland region	14/2/17	CarbonNet met with Geoscience Australia to discuss their previous marine seismic survey, associated research, and stakeholder engagement.	CarbonNet will continue to discuss project with GA as we progress.
		26/5/17	CarbonNet called GA to discuss their Gippsland Marine Environmental Monitoring Study (2015). GA provided shapefiles for their study. GA discovered low to moderate numbers of commercial scallops to the south of the proposed MSS area in 2015. GA advised they cannot make any claims about the presence or absence of scallops as the scallop beds move.	CarbonNet thanked GA for the information and mapped the scallop bed information against the MSS area for internal planning purposes.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
Department of Immigration and Border Protection - Maritime Border Command	Coordination of offshore maritime security	21/3/17	CarbonNet emailed Maritime Border Command with a letter, fact sheet and contact details inviting comment.	N/A
		7/4/17	CarbonNet called and left a voicemail for a call back. Resent the original email. Also sent the email to an address listed on the Maritime Border Command website.	No response received. CarbonNet understands Maritime Border Command will receive Notice to Mariners.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A

Each Department or agency of a State to which the activities to be carried out under the EP may be relevant				
Environment Protection Authority (EPA)	Victorian environmental regulator	21/3/17	CarbonNet sent email to EPA re MSS, including fact sheet and contact details.	N/A
		26/4/17	CarbonNet meeting with EPA to provide a general overview on CarbonNet stage 3 activities including an update on its proposed MSS.	EPA comments noted in preparation of survey and EP.
		9/5/17	Email from EPA seeking feedback on how the EP will address/mitigate the potential impacts of the survey on the Burranan dolphin.	CarbonNet provided an email to EPA on 10/8/17 with the information and assessment incorporated in EP relating to the Burranan dolphin. Based on the available research, underwater sound modelling and using DEDJTR's risk assessment framework, the consequence rating to dolphins has been determined to be 'insignificant.'
		8/8/17	Email to EPA with an update on the duration and expanded operational area for the MSS; and information on the Burranan dolphins.	N/A
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
		23/8/17 & 1/9/17	CarbonNet received an email from the EPA seeking further clarification on MSS and potential impacts to Burranan dolphins.	CarbonNet provided a detailed email to EPA on 4/10/17 with information and extracts from the EP on the predicted negligible impacts of the MSS on the Burranan dolphin population.
		Parks Victoria	Manager of Gippsland Lakes Coastal Park (including Golden Beach)	21/3/17
6/4/17	CarbonNet spoke to Parks Victoria who advised the letter had been forwarded internally for feedback and no response had been received.			N/A

foreshore)	24/5/17	<p>Following contact provided by Maritime Safety Victoria, CarbonNet met with Parks Victoria in Sale, who manage the foreshore campground area in Golden Beach. CarbonNet discussed the project and MSS. Parks Victoria advised:</p> <ul style="list-style-type: none"> • CarbonNet can leverage existing Parks Victoria signage • Busy times in Golden Beach are between Christmas – New Year’s, and the Australia Day long weekend. • Many visitors come from Latrobe Valley • The campground at Golden Beach has no booking system, so best way to reach campers is via park rangers and notices in the town • Parks Victoria may be able to provide boat-based support • The foreshore area is jointly managed with GLaWAC, so advised to have joint meetings where possible. 	<p>CarbonNet will continue talking to Parks Victoria and GLaWAC in the lead up to the MSS.</p> <p>CarbonNet committed to avoid the period between Christmas – Australia Day long weekend to avoid peak tourist time.</p> <p>CarbonNet will consider avenues to advertise the MSS in the Latrobe Valley to target holiday-makers. CarbonNet will also consider using Parks Victoria boat support.</p>
	7/8/17	<p>CarbonNet emailed Parks Victoria advising that area and duration of survey have now been refined, and advising we will submit EP in mid-August.</p>	N/A
	9/8/17	<p>CarbonNet met with Parks Victoria in Sale to discuss planning for the MSS and EP submission.</p> <p>CarbonNet discussed impacts on swimmers and divers, and CarbonNet’s plans to use beach patrols to advise people not to swim at certain times when the vessel is near to shore. Parks Victoria was comfortable with this approach.</p> <p>CarbonNet discussed timing and commitments to avoid Christmas – Australia Day and the Easter long weekend.</p> <p>Parks Victoria asked if CarbonNet could avoid the Labour Day long weekend (10-12 March) as the beach could be busy. CarbonNet advised the MSS acquisition window is narrow so avoiding this time could be difficult.</p> <p>Parks Victoria advised that it could provide signage at Golden Beach advising the public that the beach is not suitable for swimming and direct people to the patrolled beach at Seaspray. Parks Victoria could update the noticeboard at Golden Beach to make notices more effective and likely to be seen. GLaWAC could project manage this.</p>	<p>CarbonNet will schedule an operational planning meeting with Parks Victoria, GLaWAC and any other relevant stakeholders after a vessel has been selected later in 2017.</p> <p>CarbonNet will look at options to minimise impacts on the beach if the survey has to run over the Labour Day long weekend.</p>

			Parks Victoria is also happy to put up signs on CarbonNet's behalf.	
Department of Environment, Land, Water and Planning (DELWP) - Oiled Wildlife Response team	DELWP brings together Victoria's planning, local government, environment, energy, suburban development, forests, emergency management, climate change and water functions. Through ParksVictoria, they jointly manage the foreshore adjacent to the proposed MSS with the GLaWAC, and are responsible for oiled wildlife response in the event of a hydrocarbon spill in state waters.	21/3/17	CarbonNet emailed DELWP's Oiled Wildlife Response team with a fact sheet and contact details.	N/A
		6/17	CarbonNet had a telephone discussion with the DELWP's Principal Officer for Wildlife Emergencies regarding the proposed oiled wildlife response strategy for the MSS OPEP.	N/A
		21/6/17	CarbonNet emailed DELWP a summary of the oil spill modelling results, seeking confirmation that the proposed oiled wildlife response is suitable based on the nature of marine diesel, the volume potentially spilled and the sensitivities that may be contacted.	N/A
		3/8/17	CarbonNet sent a reminder email to DELWP seeking feedback on the proposed oiled wildlife strategy.	N/A
		4/8/17	DELWP's Principal Officer for Wildlife Emergencies replied via email with no objection to the proposed oiled wildlife response strategy and confirming that DELWP will need to be contacted in the event of a Level 1 hydrocarbon spill and that DELWP is the lead agency with regards to oiled wildlife response.	CarbonNet progressed the OPEP based on the information provided.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A

Maritime Safety Victoria (MSV)	Victorian government agency responsible for maritime safety	21/3/17	CarbonNet contacted MSV (an agency within Transport Safety Victoria) via email with a letter inviting comment, fact sheet and contact details.	N/A
		13/4/17	Telephone call from MSV confirming that it is happy to assist with: <ul style="list-style-type: none"> • Notice to Mariners (recommended doing this in addition to Australian Hydrographic Service) • Creating a legal exclusion zone in state waters • Contacts at Parks Victoria for signage along beach • Contacts at local boat/yacht clubs (mentioned Gippsland Water Police also good for this) 	The controls suggested by MSV are contained within Section 7.13.7 of the EP.
		13/4/17	CarbonNet email sent to MSV with a copy of the fact sheet for the MSS. MSV also added to the stakeholder list for the survey.	N/A
		24/4/17	Meeting with MSV to discuss MSS. MSV confirmed that it can help with notifications (notice to mariners) for both state and Commonwealth waters. This would include local stakeholders including Gippsland Water Policy, Yachting Victoria, Gippsland Ports etc. MSV can also establish a temporary exclusion zone that would disallow vessels and people from coming within a certain distance of the vessel. A works permit including a risk assessment is required to establish the zone.	MSV comments noted in preparation of survey and EP.
		30/5/17	CarbonNet received phone call from MSV advising who we should speak to at AMSA to clarify exclusion zone arrangements.	CarbonNet will follow up with AMSA to discuss.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
The Department of the responsible State Minister				
Victorian Fisheries Authority (VFA)	Regulator / manager of Victorian fisheries	20/12/16	CarbonNet met with VFA to discuss plans for the proposed MSS, including stakeholder engagement with the fishing industry. VFA committed to provide fishing data for the proposed MSS area.	N/A

	23/12/16	VFA emailed CarbonNet to provide fishing data for 2006 to 2016.	N/A
	10/1/17	CarbonNet met with VFA to provide an update on plans for the proposed seismic survey and requested further catch data.	N/A
	11/1/17	CarbonNet emailed VFA seeking clarification on the fishing data provided.	N/A
	16/1/17	CarbonNet met with VFA to discuss catch data in the proposed seismic survey area.	N/A
	7/2/17	CarbonNet met with and emailed VFA to discuss available fishing data relating to the proposed seismic survey area, and requested VFA review a fishing summary prepared by CarbonNet.	N/A
	14/2/17	VFA emailed CarbonNet to provide a copy of the VFA commercial fish production information bulletin dated 2015.	N/A
	27/2/17	VFA emailed CarbonNet to provide a review of CarbonNet's fishing summary.	CarbonNet incorporated this information into the EP.
	1/3/17	CarbonNet wrote to VFA to formally request assistance with validating claims about catch history and in attending meetings as an observer. VFA responded to confirm their assistance with the MSS.	N/A
	21/3/17	CarbonNet sent VFA a letter including fact sheet and contact details. CarbonNet provided 9 copies of a stakeholder letter with a fact sheet to VFA to send to individual licence holders with catch and effort history in the MSS area. The letter invited feedback and provided contact details. (See entry under 'Individual fishing licence holders').	N/A
	8/5/17	VFA emailed CarbonNet to provide data on catch and effort, and total value in CarbonNet's proposed MSS area.	CarbonNet incorporated this information into the EP.
	23/6/17	CarbonNet confirmed with VFA that the fishing licence holders that had been contacted by SIV were the same 9 licence holders who were sent a letter by VFA on behalf of CarbonNet in March. VFA phoned 7 of the 9 to follow up and 2 are no longer licenced.	N/A
	21/7/17	CarbonNet attended a meeting in Melbourne called by and chaired	CarbonNet scheduled a follow up

	<p>by VSFA. SIV and VFA also attended. (See summary of meeting listed under VSFA.)</p> <p>Of particular note to VFA, they clarified that their role is not to advocate for any parties or to play a regulatory role in this process. VFA will seek to ensure all parties have adequate, appropriate and validated information.</p> <p>VFA will look at the information provided by SIV re scallops that are claimed to have been dredged from the survey area recently and validate this information, taking into account VMS/GPS logs and other data available to them.</p> <p>VFA is happy to attend future meetings.</p>	<p>meeting in Gippsland.</p> <p>CarbonNet provided further information to meeting attendees on why the use of a dredging method for a scallop stock assessment is inconsistent with CarbonNet's approval for the MSS, on 24/7/17.</p>
26/7/17	<p>VFA emailed CarbonNet regarding the scallop fishing information provided via SIV. VFA has requested VMS data from AFMA and has requested permission from the fisherman to release the data. VFA confirmed that the photo of scallops supplied does not have any location data attached to it and the location where the photo was taken cannot be verified.</p>	<p>CarbonNet has acknowledged the information provided by SIV in the EP but the details of scallop bed locations can not be confirmed or verified by VFA</p>
27/7/17	<p>CarbonNet emailed VSFA, SIV and VFA with the following:</p> <ul style="list-style-type: none"> • Draft agenda for meeting in Traralgon on 28/7 • Draft scope for pre- and post-Environmental Assessment and Monitoring for discussion • Extracts from draft EP (at 27/7) with information on scallops. 	N/A
27/7/17	<p>VFA emailed CarbonNet with VMS info for scallop fisherman who has reported catch in MSS area. AFMA has confirmed the plots provided by the fisherman match up with the VMS data.</p>	N/A
28/7/17	<p>VFA attended a meeting with VSFA in Traralgon. See notes under VSFA.</p>	N/A
2/8/17	<p>CarbonNet spoke to VFA on the phone regarding the verification of scallop data provided via SIV and stock assessment methodologies.</p> <p>VFA's fishing data doesn't show any catch recorded at the time when the scallops were claimed to be dredged, but the fisherman said he</p>	<p>CarbonNet requested VFA send a statement outlining the facts about the scallop data provided via SIV and what has and hasn't been verified.</p>

	<p>returned the scallops so it would not have been recorded anyhow.</p> <p>VFA advised it would be difficult for them to validate CarbonNet's environmental habitat assessment. VFA could assist with a ground-truthing study but suggested using a marine biologist or someone suitably qualified to do the work.</p> <p>VFA does not accept the point made by VSFA that scallops can be buried 2 meters beneath the seabed. VFA confirmed when they do an abundance survey they dredge.</p>	CarbonNet invited VFA to meetings in Lakes Entrance with scallop fishermen.
7/8/17	<p>VFA emailed CarbonNet with some further information on the scallop data provided and using video as a stock assessment methodology. VFA said the GPS coordinates from the fisherman's vessel indicated he was fishing outside of the MSS area. One of the two fishing areas was close to the MSS area boundary.</p> <p>AFMA verified that the Vessel Monitoring System data was consistent with the GPS data.</p> <p>The photograph of scallops provided does not have location data, so VFA cannot verify where it was taken. The fisherman also did not keep any of his catch, so this information would not be returned to VFA. Although VFA cannot validate when/ where the picture was taken, it does not discount the fisherman's account that he caught scallops in the area.</p> <p>VFA spoke to TasPorts, who confirmed they use towed cameras to assess environmental impacts on all of its 'ecological receptors' (e.g., scallops, kelp, seagrass). They also focus on non-invasive methods and consider this to be best practice.</p>	CarbonNet thanked VFA for the information and will invite them to attend meeting in Lakes Entrance with fishermen on 9/8/17.
7/8/17	<p>CarbonNet emailed VFA advising that the operational area and duration of survey have now been refined, and advising we will submit EP in mid-August.</p> <p>The email explained that the survey area is now larger due to vessel turns, and provided map with amended operational area, and acquisition area (which is unchanged).</p> <p>The survey duration is likely to be 13-16 days but could be up to 27</p>	N/A

	days depending on final vessel selection.	
9/8/17	<p>CarbonNet met with SIV, LEFCOL, VFA and 5 scallop fishermen in Lakes Entrance to discuss the MSS.</p> <p>Of particular note for VFA, they provided some historical data for the fishery and said catch rates have been very low since the early 90s. VFA and SIV will discuss the collaboration proposals CarbonNet has tabled with the fishing industry.</p>	N/A
11/8/17	<p>CarbonNet spoke to VFA on the phone regarding the MSS, including the expanded operational area. VFA confirmed that there is one additional fisherman who has reported very low catch and effort in the expanded operational area, and that he is not a scallop or lobster fisherman.</p>	Now that CarbonNet has been made aware of this additional stakeholder, CarbonNet will write to the impacted fisherman via VFA.
22/8/17	<p>CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.</p>	
24/8/17	<p>VFA emailed CarbonNet regarding a request they have received from VRLA for maps of sound exposure and the full STLM report.</p>	
25/8/17	<p>CarbonNet spoke to VFA on the phone regarding the MSS and requests from VRLA for maps of sound exposure, and request from SIV for the full STLM report.</p> <p>VFA is now looking to undertake an Eastern Victoria Scallop Fishery Stock Assessment, which may occur in the next couple of months, including within the MSS area. CarbonNet will make a funding contribution to this activity.</p> <p>CarbonNet provided a summary of the STLM outcomes presented to stakeholders. VFA said it looked comprehensive and acknowledged the difficulties in providing the full report without context, or producing the maps requested.</p> <p>VFA will encourage the fishing industry to take up CarbonNet's offer of a briefing from the STLM report author.</p> <p>VFA asked whether CarbonNet will release the full EP. While CarbonNet has gone above and beyond in providing draft extracts to</p>	N/A

			stakeholders, will consider this further.	
		28/8/17	CarbonNet received email confirmation from VFA that the letter to the additional impacted fisherman will be sent tomorrow.	N/A
		18/9/17	CarbonNet met with SIV and VFA in Melbourne to discuss progress on the EP, scallop stock assessment, pre- and post-MSS environmental habitat assessment and other issues.	CarbonNet re-issued the draft scope for the pre- and post-MSS environmental assessment to SIV and VFA on 20/9/17. CarbonNet also proposed a follow up meeting on 3/10/17 in Werribee.
		3/10/17	CarbonNet met with representatives from SIV and VFA in Werribee with its environmental and acoustic consultants to discuss sound modelling, pre- and post-MSS environmental habitat assessment, VFA's proposed scallop stock survey and the MSS EP. See also notes under SIV.	Additional information provided by SIV in this meeting is included in Section 5.6.3.
		2/10/17	CarbonNet emailed VFA regarding the application process for the temporary removal of lobster pots during the MSS.	N/A
		4/10/17	CarbonNet sent a letter to the CFO of the VFA confirming the project's offer to contribute towards the VFA's reasonable costs associated with the 2017/18 Eastern Victorian Scallop Stock Assessment, up to \$200,000 (including GST). The VFA is currently considering this offer.	N/A
		5/10/17	VFA emailed CarbonNet with advice regarding the lobster pot removal process.	N/A
Emergency Management Division (EMD) - DEDJTR	Plays a key role in implementing the Victorian Government's emergency management reform agenda. EMD is responsible for	18/1/17	CarbonNet met with the Manager of EMD's Marine Pollution Branch to provide a briefing about the MSS and request clarification on DEDJTR's capabilities to respond to hydrocarbon spills in state waters. CarbonNet requested that it works closely with the EMD in reviewing the OPEP, which EMD was happy to do.	CarbonNet committed to providing drafts of the OPEP to EMD for review.
		21/3/17	CarbonNet sent email to EMD re MSS, including fact sheet and contact details.	N/A

coordinating an oil spill response in Victorian waters.	29/3/17	CarbonNet met with the EMD's Environmental Science Coordinator to discuss the proposed oil spill response strategies outlined in the EP and OPEP and whether these were suitable given the nature of marine diesel, the shoreline sensitivities and the volume of oil modelled. The Environmental Science Coordinator stated that the strategies appeared sound.	CarbonNet progressed the OPEP spill response strategies discussed during this meeting.
	11/4/17	CarbonNet emailed the EMD requesting a meeting to discuss the impact assessment prepared for the oil spill response strategies to ensure that the resources available and response strategy are able to demonstrate ALARP and acceptability.	A meeting was subsequently arranged for 3/5.
	3/5/17	CarbonNet met with two members of the Marine Pollution Branch to discuss oil spill response strategies and resourcing arrangements available to the EMD. The Marine Pollution Branch subsequently provided information on State Resource Team membership and a list of spill response equipment available.	N/A
	8/6/17	CarbonNet met with members of EMD to broadly discuss resourcing in the event of a hydrocarbon spill from the MSS.	CarbonNet progressed the OPEP spill response strategies based on the information provided.
	26/6/17	CarbonNet provided a draft of the OPEP to the Marine Pollution Branch for review.	N/A
	12/7/17	The Marine Pollution Branch provided comments on the OPEP via email.	CarbonNet reviewed the comments and requested a meeting to discuss the comments.
	14/7/17	CarbonNet met with the Manager of the Marine Pollution Branch to discuss the comments on the OPEP and clarify terminology, response resourcing and other operational matters.	CarbonNet progressed the OPEP based on the clarifications provided.
	28/7/17	CarbonNet met with the Manager of the Marine Pollution Branch to go through the latest version of the OPEP to ensure that all feedback had been incorporated adequately.	CarbonNet and EMD agreed that the OPEP is at a point that is ready for submission to regulators.
	4/8/17	CarbonNet emailed the final version of the OPEP to the EMD for	N/A

			their records.	
		8/8/17	CarbonNet sent EMD an email advising that the operational area and duration of survey have now been refined, and that the EP will be submitted in mid-August.	N/A
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
		06/10/17	CarbonNet sent a letter to the DEDJTR Executive Director of Strategy Governance & Coordination to confirm the availability of Victorian emergency response capabilities and resources for the MSS survey.	N/A
A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP				
Commonwealth Fisheries Association (CFA)	Industry association for commercial fishing industry in Commonwealth regulated fisheries	21/3/17	CarbonNet contacted CFA via post and email with a letter that requested a meeting, invited feedback and provided a fact sheet.	N/A
		19/4/17	CarbonNet left voicemail requesting a call back to discuss the project.	N/A
		16/5/17	CarbonNet spoke to CFA who confirmed the letter was received. CFA explained that they are the representative body for associations, and general only comment on activities that affect a majority of members. As the project only impacts Bass Strait, CFA advised CarbonNet to consult with the relevant associations, specifically SETFIA, SIV and LEFCOL. CFA stated that they would like to be kept up-to-date on the project but will likely not provide any comments.	CarbonNet is engaging with SETFIA, SIV and LEFCOL. CarbonNet will communicate with CFA on major milestones and developments.
		7/8/17	CarbonNet sent CFA an email advising that the operational area and duration of survey have now been refined, and that the EP will be submitted in mid-August.	N/A

		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
South-East Trawl Fishing Industry Association (SETFIA)	Industry association representing quota owners, fishermen and sellers in the Commonwealth south east trawl fishery	21/3/17	CarbonNet contacted SETFIA via post and email with a letter that requested a meeting, invited feedback and provided a fact sheet.	N/A
		21/3/17	CarbonNet received an email response from SETFIA stating that trawl-based fisheries are likely to be the most affected fishing sector. SETFIA requested notifications at regular intervals in the lead-up to, and during, the MSS. SETFIA advised they can provide a notification service to the trawl fishing fleet on a fee-for-service basis.	CarbonNet established a fee-for-service contract with SETFIA to deliver notifications to the trawl fishing fleet.
		19/4/17	CarbonNet spoke to SETFIA to arrange meeting in Lakes Entrance.	N/A
		26/4/17	CarbonNet met with two representatives from SETFIA including a fisherman in Lakes Entrance. SETFIA described the MSS area including species they know to be present in the area. SETFIA is concerned that CarbonNet doesn't have enough data on fishing activity in the MSS area. SETFIA stressed the importance of notifications and ensuring they are provided to SETFIA to ensure the fleet can move out of the MSS area and not waste valuable fishing time. November would be better timing for the MSS for SETFIA as they run a stock survey in winter. (Further to this discussion, SETFIA later advised that the November timing is not preferable for most of their members.) SETFIA discussed what data is captured by VFA and explained that they don't have catch data for Commonwealth-licensed fishing operators. SETFIA could assist CarbonNet in gathering data from both VFA and AFMA.	CarbonNet stated that it was confident it has all publicly available information regarding fishing effort in the proposed acquisition area, which is presented in the EP. However, to be sure that this is the case, CarbonNet committed to engaging SETFIA to deliver a report on fishing activity in the MSS area. These results are included in Section 5.X of the EP. The exact timing of the survey is dependent on multiple factors, but CarbonNet notes SETFIA's position. A discussion on survey timing is presented in Section 2.2.

		CarbonNet has committed to providing advanced notifications of the MSS to stakeholders, as stated in Section 8.7 of the EP. CarbonNet has also agreed to engage SETFIA to provide notifications to the fleet in the lead-up to, and during, the MSS.
2/5/17	<p>CarbonNet emailed SETFIA in follow up to the meeting, providing the following information:</p> <ul style="list-style-type: none"> • CarbonNet's presentation. • Geoscience Australia report: 'Marine Seismic Survey Impacts on Fish and Invertebrates: Final Report for Gippsland Marine Environmental Monitoring Study.' • Commitment to review the list of species (Jackass Moorwong, Blue Warehou, Whiting, Flathead) provided at meeting and incorporate into EP. <p>CarbonNet requested from SETFIA:</p> <ul style="list-style-type: none"> • Details on any additional information that is not publicly available that SETFIA can provide. • Formal proposal to send notifications to the trawl fishing fleet. 	The fish species provided by SETFIA have been described in Section 5.4 of the EP.
11/5/17	<p>CarbonNet emailed SETFIA with:</p> <ul style="list-style-type: none"> • Summary of field observations and map. • Request to confirm which groups represent which stakeholders. • Request for any information SETFIA can provide to inform the assessment process. 	N/A
17/5/17	<p>CarbonNet spoke to SETFIA to follow up emails and offer another meeting. SETFIA is concerned that CarbonNet doesn't have enough fishing catch data for the Commonwealth-managed fisheries, and that CarbonNet is aiming to submit an EP 30 days after commencing consultation.</p> <p>Discussed SETFIA offer to put in data request to AFMA. If there is no/low catch effort in the MSS area, SETFIA will step back and won't</p>	<p>CarbonNet commenced formal stakeholder consultation for the MSS in March 2017 and indicated an intention to submit the EP imminently.</p> <p>However CarbonNet advised that it is committed to engaging with stakeholders and is continuing to do so.</p>

	<p>need to be involved in further consultation.</p> <p>CarbonNet:</p> <ul style="list-style-type: none"> • Requested a formal proposal for data report. • Requested a formal proposal to send notifications to the fleet. • Confirmed that SETFIA does not object to holding joint meetings with SIV and LEFCOL (as proposed by SIV). • Will schedule a meeting to discuss proposals if required. 	
22/5/17	<p>CarbonNet sent an email to SETFIA to check on progress with the formal proposals.</p> <p>CarbonNet received a proposal from SETFIA covering:</p> <ul style="list-style-type: none"> • The preparation of a fishing data report for MSS area. • Notifications to be sent to trawl fleet during MSS. 	N/A
26/5/17	<p>CarbonNet spoke to SETFIA to confirm that any data they may access under terms of proposal provided to CarbonNet would be legal and accessed in an appropriate manner.</p>	N/A
1/6/17	<p>CarbonNet received an amended proposal from SETFIA for preparing a reporting detailing fishing effort in the proposed survey area.</p>	CarbonNet accepted this proposal and issued paperwork to commence work.
27/6/17	<p>CarbonNet sent SETFIA a summary of the underwater sound modelling results, including offering to make the consultant available to discuss the findings. CarbonNet requested SETFIA get in touch with any questions about the results. No such requests were forthcoming.</p>	N/A
6/7/17	<p>CarbonNet received first draft of report from SETFIA titled 'Report to CarbonNet describing commercial fishing in the area of the proposed CarbonNet 3D Marine Seismic Survey'.</p>	SETFIA's report validated information CarbonNet had already gathered to inform the assessment of the existing environment. This is presented in Section 5.6.3 of the EP.
14/7/17	<p>CarbonNet sent through feedback to SETFIA to finalise report.</p>	N/A
15/7/17	<p>SETFIA emailed CarbonNet to confirm receipt of feedback and will</p>	N/A

	consider and revert as quickly as possible.	
25/7/17	CarbonNet emailed SETFIA to check on data report and ask if they had anything to discuss with regards to the EP.	N/A
27/7/17	<p>SETFIA emailed CarbonNet with the final data report.</p> <p>SETFIA said that we should discuss how to proceed, as now that we know who the key affected groups are we should limit discussions to affected fishers.</p> <p>Data report also included a list of key contacts for representative bodies. CarbonNet has spoken to all the groups and individuals listed, and confirmed the SETFIA contact is also the contact for the South Shark Industry Alliance.</p> <p>Scheduled a phone meeting to discuss how to proceed, and an in person meeting in Lakes Entrance to discuss issues and concerns.</p>	N/A
2/8/17	<p>CarbonNet held a teleconference with SETFIA to discuss next steps for consultation. They said:</p> <p>There are three 'critical sectors':</p> <ol style="list-style-type: none"> 1. Commonwealth Trawl Sector (CTS), especially seiners. 2. Commonwealth Gillnet shark fishery. 3. Victoria purse seine fishery (1 operator - Mitchelson Fisheries) . <p>SETFIA represents the two Commonwealth groups. They would prefer the MSS is undertaken between April – September and would like CarbonNet to avoid November. CarbonNet said the survey window is November – March, but that it would note the request for not conducting the survey in November.</p> <p>SETFIA said the important thing is providing adequate notice to operators, and SETFIA now knows who they are.</p> <p>SETFIA mentioned the plankton study that was published in Nature journal – CarbonNet said we would send the CSIRO study that modelled how long it would take plankton numbers to replenish.</p> <p>CarbonNet and SETFIA arranged to meet in Lakes Entrance next week to progress discussions.</p>	N/A

2/8/17	CarbonNet emailed SETFIA with link to the CSIRO paper that looked at the potential impacts on zooplankton of seismic surveys. SETFIA responded to say it looks like plankton numbers replenish in three days through breeding or currents (a basic summary of report findings).	N/A
4/8/17	CarbonNet emailed SETFIA with the following draft excerpts from the EP: <ol style="list-style-type: none"> 1. Impact assessment summary - marine fauna. 2. Impact to plankton. 3. Impact on fish. 4. Risks to fin fisheries. 5. Risk assessment summary for fisheries. CarbonNet requested that SETFIA advise any other specific concerns that still need to be addressed.	N/A
4/8/17	SETFIA emailed CarbonNet to say the impact (significance) on zooplankton is not insignificant. While the CSIRO paper shows that zooplankton is again mixed after three days, SETFIA pointed out that commercial fish larvae form part of the zooplankton layer but do not have the same life history characteristics as zooplankton proper. Rather, after an annual spawn these commercial fish larvae turn into commercial fish species and live for 5-40 years. SETFIA commented that the McCauley paper made specific mention of commercial fish larvae that they did not see in CarbonNet's EP.	CarbonNet discussed these issues with SETFIA at a face-to-face meeting in Lakes Entrance on 9/8/17. Plankton is described in Section 5.4.3 of the EP.
7/8/17	CarbonNet sent SETFIA an email advising that the operational area and duration of survey have now been refined, and that the EP will be submitted in mid-August. The email explained that the operational area is now larger due to vessel turns, and provided map with amended operational area, and acquisition area (which is unchanged). The survey duration is likely to be 13-16 days but could be up to 27 days depending on final vessel selection.	N/A

	9/8/17	<p>CarbonNet met with SETFIA in Lakes Entrance to discuss the finalisation of the EP and issues raised.</p> <p>SETFIA said they will be happy if CarbonNet can demonstrate that it has taken stakeholder concerns into consideration in our EP, namely:</p> <ol style="list-style-type: none"> 1. Timing - SETFIA's preference is for the MSS to avoid November. 2. Conducting a scallop survey in collaboration with industry in some form, to which SETFIA would be an interested party only. <p>SETFIA is particularly concerned about Blue Warehou juveniles and Jackass Moorwong in the MSS area and the impacts on them.</p>	<p>Information about blue warehou and jackass moorwong spawning periods have been detailed in Section 5.4.4 of the EP.</p> <p>CarbonNet will continue to talk to SETFIA about timing for the MSS, and will seek to avoid November if possible.</p> <p>CarbonNet will involve SETFIA as an interested party in planning for its pre- and post-MSS environmental habitat assessment.</p>
	22/8/17	<p>CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.</p>	N/A
	22/8/17	<p>SETFIA emailed CarbonNet to ask if it has proposed a date for the MSS yet.</p>	<p>CarbonNet responded on 24/8/17 explaining that the MSS window had not changed, but a key consideration for CarbonNet in selecting a vessel will be availability in February/March in order to avoid November (being the least preferred month by three key fishing groups).</p> <p>SETFIA replied on 24/8/17 to thank CarbonNet for the information.</p>
	26/9/17	<p>CarbonNet was made aware of an email sent by SETFIA to oil and gas companies about the Fishery Independent Survey (FIS), which requested no seismic or other activity between February and mid-September 2018.</p> <p>CarbonNet phoned SETFIA to discuss this, as the previous view was that February/March was the preferred window for the MSS to take</p>	<p>CarbonNet thanked SETFIA for the feedback and requested that CarbonNet be added to their mailing list for future notifications.</p>

			<p>place.</p> <p>SETFIA said CarbonNet's proposed MSS is not near the FIS fish shots, so they are not too concerned.</p> <p>Also, the FIS is not a trawl survey, which is the fishery most likely to be impacted by the proposed MSS.</p>	
Lakes Entrance Fisherman's Cooperative (LEFCOL)	Co-operative of commercial fishers in Lakes Entrance with activities in or near the proposed acquisition area	21/3/17	CarbonNet contacted LEFCOL via post and email with a letter that requested a meeting, invited feedback and provided a fact sheet.	N/A
		28/3/17	CarbonNet called LEFCOL to confirm whether letter was received – reception recommended reissuing the letter to a different email address.	The letter was subsequently re-issued and invited LEFCOL to a meeting on the 6 th or 7 th of April.
		18/4/17	CarbonNet called LEFCOL and left a message requesting a meeting.	N/A
		20/4/17	<p>CarbonNet spoke to LEFCOL, who raised concerns that the MSS is planned for prime crayfish ground. LEFCOL has heard from one fisherman in the area who is very concerned that the MSS will destroy rock lobsters in the area. LEFCOL has spoken to the Victorian Rock Lobster Association who said a recent MSS in the Otways "decimated the rock lobster population" and pointed to the Day et al (2016) study on rock lobsters and scallops. LEFCOL also indicated that rock lobster fishermen would look for compensation.</p> <p>LEFCOL indicated that any issues they may have (mostly concerning lobsters and scallops) will be covered by SIV. LEFCOL's preference is for engagement on the MSS to be coordinated through SIV, and they will maintain their own dialogue with SIV. LEFCOL is happy to meet with CarbonNet next week.</p> <p>LEFCOL also commented that sound from the MSS can have impacts outside of the survey area.</p> <p>CarbonNet stated that any local feedback or knowledge LEFCOL can provide would be helpful in refining the risk assessment for the EP.</p>	<p>CarbonNet has received fishing catch data from VFA indicating low rock lobster catch from the area.</p> <p>CarbonNet has not been contacted by any individual fishermen or received any specific information about the potential impacts on fishing activities. Based on all the available evidence, including catch effort from VFA, CarbonNet has assessed the risk to lobster fishing as low.</p> <p>CarbonNet acknowledged that LEFCOL prefers to defer discussions on the MSS to SIV.</p> <p>CarbonNet will continue to give LEFCOL the opportunity to meet and discuss issues.</p>

26/4/17	<p>CarbonNet met with LEFCOL in Lakes Entrance to provide an overview of the CarbonNet project, the MSS, the marine habitat assessment, and discuss any potential impacts.</p> <p>LEFCOL raised the following comments and issues:</p> <ul style="list-style-type: none"> • The potential impacts on scallops and lobsters, particularly in light of the Day et al (2016) study. • The Victorian scallop fishery has been dormant for a long time. • The lobster fishery is nearshore at Golden Beach. There are two lobster fishermen in the area – one in particular has raised concerns with LEFCOL. He doesn't take many lobsters because there's not many left, but it's enough to keep him going for the next 2-3 years. • Lobster fishermen will be happy to share information on location and catch. • Seine fishers are unlikely to have objections to the MSS as they can move out of the way. • The commercial fishing industry is sceptical of Victorian Government involvement as there is a perception government is trying to ban commercial fishing in the Gippsland Lakes. This is despite scientific studies that have found positive impacts on the Lakes from commercial fishing. 	<p>CarbonNet advised LEFCOL during the meeting that the preliminary results from the marine environmental assessment indicated a limited number of scallops were observed in two of over sixty sampling locations in the survey area, and limited habitat for lobsters was observed.</p> <p>As per advice from LEFCOL, CarbonNet issued response to matters raised to SIV on 27/7 and 4/8. CarbonNet is unaware of whether this correspondence has been shared with LEFCOL by SIV.</p>
2/5/17	<p>CarbonNet emailed LEFCOL with:</p> <ul style="list-style-type: none"> • Information about CarbonNet. • A link to Geoscience Australia's Final Report on the Gippsland Marine Environmental Monitoring Study. • Request to meet with the lobster fisherman referred to at the meeting on 26/4/17. 	N/A
3/5/17	<p>LEFCOL responded to CarbonNet's email stating they will work closely with SIV and SETFIA on this issue to ensure issues are raised as a collective.</p>	<p>CarbonNet respects LEFCOL's previously stated wishes regarding communications to be channelled through SIV and will communicate with all groups on issues that are relevant to them.</p>

11/5/17	<p>CarbonNet emailed LEFCOL with the following:</p> <ul style="list-style-type: none"> • Summary of field observations and a map showing where observations were taken. • Request to clarify which groups represent which stakeholders. • Request for further information to inform the environmental impact assessment process. 	N/A
19/5/17	<p>CarbonNet spoke to LEFCOL to advise that that it would be in Lakes Entrance the following week if they would like to meet. LEFCOL stated they had spoken to SIV about doing a separate stock assessment focusing on scallops and lobsters to ascertain whether those species are present in the proposed MSS area.</p> <p>CarbonNet requested a formal proposal to progress this initiative. LEFCOL replied that it would come from SIV.</p>	N/A
19/5/17	<p>CarbonNet emailed LEFCOL and SIV to enquire about the status of the aforementioned proposal .</p>	N/A
27/6/17	<p>CarbonNet sent an email to LEFCOL with the summary of sound transmission modelling results, and requested LEFCOL get in touch if they would like to discuss. The summary included an offer to make CarbonNet's acoustic consultant available to discuss the results. CarbonNet also told LEFCOL that the results had been sent to SIV.</p> <p>There has been no response since this time.</p>	N/A
7/8/17	<p>CarbonNet sent LEFCOL an email advising that the operational area and duration of survey have now been refined, and that the EP will be submitted in mid-August.</p> <p>The email explained that the operational area is now larger due to vessel turns, and provided map with amended operational area, and acquisition area (which is unchanged).</p> <p>The survey duration is likely to be 13-16 days but could be up to 27 days depending on final vessel selection.</p>	N/A
8/8/17	<p>LEFCOL attended a meeting in Lakes Entrance with SIV, VFA and five scallop fishermen. See comments recorded under SIV.</p>	CarbonNet offered to send draft extracts from the EP regarding scallops, which were sent to SIV in July, to all

				stakeholders present on request.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
Victorian Abalone Council	Represent Victorian Abalone fishermen who may have activities near the proposed acquisition area	21/3/17	CarbonNet contacted the Victorian Abalone Council via post with a letter that invited feedback and provided a fact sheet.	N/A
		18/5/17	CarbonNet phoned Victorian Abalone Council and was advised it no longer exists. CarbonNet was advised to speak to the Victorian Abalone Divers Association.	CarbonNet consulted the Victorian Abalone Divers Association as directed.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
Eastern Rock Lobster Industry Association	Represent Eastern Victorian rock lobster fishermen who may have activities near proposed acquisition area	21/3/17	CarbonNet contacted Eastern Rock Lobster Industry Association via post with a letter that invited feedback and provided a fact sheet.	N/A
		18/5/17	CarbonNet tried to call but the telephone number is disconnected. A website and email listing was found. An email address was sent email but it bounced. The website no longer exists.	No response received – organisation appears to no longer exist.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A

Australian Southern Bluefin Tuna Industry Association (ASBTIA)	Represent fishermen who may have activities near proposed acquisition area	21/3/17	CarbonNet contacted the ASBTIA via email with a letter that invited feedback and provided a fact sheet.	N/A
		22/3/17	CarbonNet received a response via email to advise the proposed survey is outside key areas for bluefin tuna fishing, so they have no objections to the timing or location of the survey. They asked that CarbonNet also contact the Eastern Tuna and Billfish Fishery.	CarbonNet responded with thanks. Fishing activity for this fishery is reflected in Section 5.6.3 of the EP. CarbonNet has consulted with the Eastern Tuna and Billfish Fishery as requested.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
Tuna Australia (Eastern Tuna and Billfish Fishery Industry Association)	Represent fishermen who may have activities near proposed acquisition area	24/3/17	CarbonNet contacted Tuna Australia via email with a letter that invited feedback and provided a fact sheet.	N/A
		30/3/17	CarbonNet received a response via email to advise that the proposed survey location does not impact on fishing activity in the Eastern Tuna and Billfish Fishery.	CarbonNet responded with thanks. Fishing activity for this fishery is reflected in Section 5.6.3 of the EP.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
Southern Shark Industry	Represent fishermen who may have	21/3/17	CarbonNet contacted SSIA via post with a letter that invited feedback and provided a fact sheet.	N/A

Alliance (SSIA)	activities near proposed acquisition area	18/5/17	CarbonNet tried to phone the number listed on the AFMA website, but it is disconnected. Found the website for SSIA online and sent an email using the 'contact us' form. CarbonNet spoke to the former contact for the Small Pelagic Fishery Industry Association, who advised that the SSIA contact now looks after that group. They provided two contact email addresses and a mobile phone number for SSIA. CarbonNet left a voicemail for SSIA requesting a call back.	N/A
		6/6/17	CarbonNet sent an email to the two email addresses provided earlier to advise that the EP is nearly finished and to see if SSIA had any questions. There has been no response since this time.	Section 5.6.3 of the EP contains sufficient information regarding the shark fishery and is confident enough in this data that no follow up of this stakeholder is required.
		27/7/17	CarbonNet received the final data report from SETFIA, which listed the SETFIA contact as the contact for SSIA.	As consultation with the SETFIA contact has been extensive and has covered sharks, this is sufficient for the SSIA.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
Small Pelagic Fishery Industry Association	Represent fishermen who may have activities near proposed acquisition area	21/3/17	CarbonNet contacted the Small Pelagic Fishery Industry Association via post and email with a letter that invited feedback and provided a fact sheet.	N/A
		18/5/17	CarbonNet spoke to a listed contact who advised they no longer work for the association. This person provided two email addresses and a mobile phone number for the person who is now looking after the association, which is the same contact as the SSIA. CarbonNet left a voicemail for SSIA requesting a call back.	N/A
		6/6/17	CarbonNet sent an email to the two email addresses provided earlier to advise that the EP is nearly finished and to see if the contact person had any questions. No response has been received to date.	Section 5.6.3 of the EP contains sufficient information regarding the pelagic fisheries and is confident enough in this data that no follow up of this stakeholder is required.

		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
Seafood Industry Victoria (SIV)	Represent all Victorian fishing licence holders, including fishermen with catch and effort history within and around proposed acquisition area	21/3/17	CarbonNet contacted SIV via post and email with a letter that invited feedback, requested a meeting and provided a fact sheet.	N/A
		27/3/17	SIV emailed CarbonNet to confirm receipt of email and requested a time to meet.	N/A
		30/3/17	CarbonNet met with SIV at their office in West Melbourne to provide overview of the project and the MSS. SIV raised some initial concerns and issues, including recent studies on the impacts of seismic surveys, compensation to fishers, fishers getting forced out of their fishing grounds, avoiding spawning seasons and sound modelling. CarbonNet offered to meet again in late April/early May to continue discussions, possibly in Lakes Entrance.	CarbonNet responded to all issues raised by SIV in discussions over several meetings and via email on 4/8. (see later in this table).
		18/4/17	CarbonNet emailed SIV to schedule next meeting.	N/A
		19/4/17	CarbonNet received a phone call from SIV saying they are unavailable for a meeting until mid-May. SIV would like to convene a meeting in Lakes Entrance with all stakeholder groups (including CFA, SETFIA and LEFCOL) to maintain an 'open and transparent' consultation process. CarbonNet said it is consulting all relevant stakeholders and want to ensure everyone has the chance to have their say on issues relevant to them, so would not adopt this approach but willing to have SIV attend meetings with their members. SIV also mentioned it would need to run a consultation process with its members (including those registered to fish for lobster/scallop in Victoria) on a fee-for-service basis from CarbonNet. SIV commented that they were unaware that CarbonNet was calling for formal responses to the MSS. CarbonNet said it is and is keen to obtain input from SIV.	CarbonNet stated it is consulting all fishing industry stakeholders and is willing to have SIV attend meetings with their members. CarbonNet declined to respond to the request from SIV to be paid to consult its members.

21/4/17	<p>CarbonNet phoned SIV to confirm the next meeting in May. SIV commented that without receiving funding to consult its members, the level of feedback will be 'high level', including:</p> <ul style="list-style-type: none"> • Ensuring compensation is on the table as an option. • Rebuilding strategies for impacted fisheries. <p>CarbonNet also confirmed it is meeting LEFCOL and SETFIA in Lakes Entrance and will assess the need for further meetings (joint or one-on-one) after that time.</p>	N/A
3/5/17	SIV requested a map of the MSS area with the VFA catch and effort grid overlaid on it.	CarbonNet issued this map on 3/5/17.
11/5/17	<p>CarbonNet sent SIV an email including:</p> <ul style="list-style-type: none"> • Summary of environmental habitat assessment study and map of where observations were made. • Request to clarify which groups represent which stakeholders. • Request for further information to inform assessment process. 	N/A
11/5/17	<p>CarbonNet received an email from SIV requesting any work that has been done to map the sound distribution of the survey, noting the sound does not go straight down. SIV also requested a map of the total impacted area.</p> <p>CarbonNet responded to say it has contracted a specialist consultant in acoustic modelling to do this work and the results from this work will be sent to SIV when available.</p>	CarbonNet sent an email to SIV on 27/6/17 with the summary of the STLM results, and requested SIV get in touch if they would like to discuss. The summary included an offer to make CarbonNet's acoustic consultant available to discuss the results.
12/5/17	<p>CarbonNet met with SIV at their office in West Melbourne to progress discussions. The meeting focused on:</p> <ul style="list-style-type: none"> • Which groups represent which fishers/stakeholders, especially where multiple groups are representing the same individual/s. • The findings of CarbonNet's environmental habitat assessment. • How SIV will consult its members, which has not yet commenced. <p>SIV clarified that it represents all Victorian licence holders.</p>	<p>Following the meeting, CarbonNet sent SIV:</p> <ul style="list-style-type: none"> • The letter that was sent to individual fishing licence holders by VFA. • Information on the company contracted to complete the STLM.

	<p>CarbonNet asked SIV to confirm which fishers it is specifically representing for this MSS.</p> <p>SIV said it will contact the same fishers initially contacted by VFA (see 'individual fishing licence holders') and obtain their feedback.</p> <p>SIV said there has been one fisherman active in the Victorian scallop fishery for the last 3-4 years.</p> <p>It was decided that the next meeting will be in either late May or mid-June, depending on how the consultation progresses.</p>	
17/5/17	<p>CarbonNet called SIV to organise the next meeting.</p> <p>SIV called CarbonNet back. It will take around another week for SIV to run its consultation process with fishers. They stated that they could meet in late May, depending on how feedback is going.</p>	CarbonNet replied that it will contact SIV next week to schedule a meeting to discuss.
19/5/17	<p>CarbonNet emailed LEFCOL and SIV to advise it is waiting on any questions or proposals from either organisation with relation to the MSS.</p>	N/A
23/5/17	<p>CarbonNet spoke to SIV who advised that VFA has just issued a letter to potentially affected licence holders. SIV advised that it cannot meet this week as it will not have spoken to their members and therefore has no feedback. It was agreed that the next meeting will be late June.</p>	N/A
23/6/17	<p>CarbonNet met with SIV at their office in West Melbourne to discuss feedback from their members on the MSS. It was confirmed that nine letters were sent to licence holders by VFA on behalf of SIV, and five responses were received.</p> <p>SIV raised the recent study on plankton published in the <i>Nature</i> journal and their concerns about long-term impacts on fisheries.</p> <p>SIV also mentioned a recent media article that questioned the viability of CCS.</p> <p>SIV would like to meet with CarbonNet and the individual fishers to progress discussions.</p> <p>In response to the plankton study, CarbonNet discussed a CSIRO study that is yet to be published which looked at the real-world impacts on plankton. CarbonNet will provide more information on</p>	<p>On the same day, CarbonNet emailed SIV with:</p> <ul style="list-style-type: none"> • Proposals for opportunities to collaborate, as sent to VSFA. • Information on the status of CCS, including the CarbonNet presentation previously provided to SIV. • Request to meet with fishers on 4/5 July in Gippsland. • Confirmation that nine fishermen were sent a letter from VFA and seven were followed up by phone

	<p>that study.</p> <p>CarbonNet stated that it is keen to talk to fishermen about the potential for disruption to their operations. SIV said it is keen to go beyond that. CarbonNet advised that it is not discussing compensation, but that it would send SIV the collaboration proposals that were previously sent to VSFA and are also offered to SIV.</p> <p>CarbonNet is awaiting information from SIV to schedule meetings with fishermen.</p> <p>CarbonNet will send information on the opportunity CCS represents for Gippsland.</p>	<p>(two no longer hold a licence).</p> <ul style="list-style-type: none"> Request for any further information SIV would like to formally provide to CarbonNet.
27/6/17	<p>CarbonNet sent SIV a summary of the STLM results, including an offer to make the acoustic consultant available to discuss the results. CarbonNet requested SIV get in touch with any questions about the results.</p>	N/A
27/6/17	<p>CarbonNet emailed SIV with a link to a media release about the CSIRO modelling work on plankton.</p>	N/A
30/6/17	<p>CarbonNet emailed and phoned SIV to clarify if meetings with fishers scheduled for 4/5 July was still progressing. SIV stated it is still trying to confirm the availability of fishers.</p>	CarbonNet offered to meet on 13 July in Sale as another option.
3/7/17	<p>CarbonNet emailed and left voicemail for SIV cancelling meetings on 4/5 July in Gippsland as no response had been received. CarbonNet requested confirmation of whether 13 July worked for meetings.</p>	N/A
11/7/17	<p>CarbonNet left a phone message for SIV to ask if they would like to meet on 13 July in Sale.</p> <p>CarbonNet emailed SIV to confirm the meeting planned for 13 July will not proceed. CarbonNet explained that as it had not received a response to opportunities to meet, it will continue with EP preparation with the information available.</p> <p>SIV emailed CarbonNet to say they can't meet on 13 July as it has not received the information they want to be able to progress discussions. SIV would like to discuss some information on scallops with CarbonNet.</p>	N/A

12/7/17	<p>CarbonNet received an email from SIV including the following:</p> <ul style="list-style-type: none"> • Photos SIV claimed were taken within the proposed acquisition area of significant quantities of scallops (80 mm in size). According to SIV, an operator dragged a dredge through a number of locations in the proposed acquisition area, all of which were abundant with scallops that were below the legal size limit (so they were returned to the water alive). SIV said it has more photos and GPS points, which were not attached. • Noted a previous conversation on the viability of CCS and said the MSS could cause scallop deaths for something 'that will probably not work'. • Raised the <i>Nature</i> journal article on plankton - one operator who fishes for pilchards, Australian salmon and other species is significantly concerned about the impact on these species in light of the plankton research. • Asked if CarbonNet has a bond in place to compensate on any future impacts to these fisheries. • Asked if CarbonNet has a future monitoring strategy in mind for potentially impacted species. • Commented on CarbonNet's habitat assessment - said scallops live within the seabed and require a dredge to see/catch them, and that rock lobster lives in 'cryptic habitat', which is why the video did not detect them. • Asked when the regulated 'precautionary principle' applies and how is it reported and considered in the EP. • Asked if the EP will be available to view publicly, so SIV can ensure it considers their concerns prior to being submitted. 	<p>In response to this email, CarbonNet undertook the following:</p> <ul style="list-style-type: none"> • Followed up the scallop dredging locations with SIV and VFA, subsequently finding that all the dredge locations were outside the proposed acquisition area. • Responses to other issues are detailed below (see over page). .
13/7/17	<p>CarbonNet sent SIV an email requesting they send through all the information they have regarding the presence of scallops in the proposed survey area, and asked if SIV can verify the information. CarbonNet also said we may asked the VFA (VFA) to assist in the verification process.</p>	N/A
14/7/17	<p>CarbonNet sent SIV an email responding to the claim that CCS will</p>	N/A

	<p>probably not work.</p> <p>CarbonNet provided information on the need for CCS, its viability and the commitment from state and federal governments to pursue CCS.</p> <p>CarbonNet requested that discussions focus on the potential impacts of the MSS and not the merits of CCS and/or CarbonNet.</p>	
19/7/17	<p>SIV emailed CarbonNet with some further information on the scallops that were allegedly dredged by an operator in MSS area. SIV provided coordinates for two 'boxes' the operator dredged within. SIV has photos of the plotter to confirm this information that they can show us, but cannot send via email as the information was provided in confidence.</p> <p>Shell size was 70 to 80 mm and the meat count was 90 to 100 with developing roe.</p>	N/A
20/7/17	<p>CarbonNet emailed SIV in response to the additional information on scallops to request they work with the VFA to obtain detailed information that can be verified and validated.</p> <p>CarbonNet wrote that our initial assessment is that the majority of the 10 coordinate points provided are outside of the MSS area with only two close to (parallel with) the survey area.</p> <p>It is not clear where the scallops were collected, with one of the 'boxes' extending well beyond the MSS area.</p> <p>CarbonNet requested verified and validated data from SIV on a confidential basis.</p>	N/A
21/7/17	<p>CarbonNet attended a meeting in Melbourne called by and chaired by VSFA. SIV and VFA also attended. (See summary of meeting listed under VSFA.)</p> <p>Of particular note to SIV, they requested further information from CarbonNet on why the project cannot support an invasive stock assessment method. CarbonNet noted that it is related to the legislation under which CarbonNet operates and committed to provide further clarification on this by Monday 24 July.</p>	<p>CarbonNet schedule a follow up meeting in Gippsland.</p> <p>CarbonNet provided further information to meeting attendees on why the use a dredging method for scallop stock assessment is inconsistent with CarbonNet's approval for the MSS on 24/7/17.</p>

24/7/17	<p>CarbonNet emailed SIV, VSFA and VFA with further clarification on CarbonNet's inability to fund a dredge-based survey. CarbonNet said a dredge-based scallop stocktake assessment within the MSS area is inconsistent with the purpose and scope of the approvals under the OPGGS Act, and as such CarbonNet can not fund such an activity.</p> <p>Separately, CarbonNet also emailed SIV to invite them to the next meeting with VSFA in Gippsland. SIV responded to say they don't have time to attend but would like to speak this week to discuss how to proceed.</p>	
25/7/17	<p>CarbonNet spoke to SIV about the information that was provided by them about scallops claimed to be dredged in the MSS area.</p> <p>SIV said the fisherman was fishing when the scallops were observed, not undertaking a stock assessment. SIV understands that VSFA also received the information via SIV.</p> <p>SIV tried to invite some fishermen to attend the meeting on 21/7 but VSFA refused to allow this.</p> <p>Three other fishermen want to meet with us, including scallop fishermen and a fishery company who fish for pilchard and small pelagic fish. LEFCOL is also keen to attend a meeting..</p> <p>SIV does not think we need to rush in reaching out to these fishermen for the first time and it can be after we have submitted our EP</p> <p>SIV suggested the second week in August for a meeting in Lakes Entrance.</p> <p>CarbonNet responded to request confirmation of meetings in Lakes Entrance on 8 and 9 August, and confirmed that we may submit our EP in the interim but that consultation will be ongoing.</p>	CarbonNet scheduled meetings in Lakes Entrance with invites to be coordinated by SIV.
27/7/17	<p>CarbonNet emailed VSFA, SIV and VFA with the following:</p> <ul style="list-style-type: none"> • Draft agenda for meeting in Traralgon on 28/7 • Draft scope for pre- and post-Environmental Assessment and Monitoring for discussion • Extracts from draft EP (at 27/7) with information on scallops. 	N/A

	<p>SIV responded to send apologies for meeting. SIV will aim to provide insight on the draft risk and impact assessment information provided once he has sought broader industry comment.</p> <p>To date, SIV has not provided any feedback on the extracts from the draft EP.</p>	
31/7/17	<p>SIV emailed CarbonNet with proposal to hold meetings in Lakes Entrance with the following:</p> <ul style="list-style-type: none"> • The pilchard /small pelagic fishery • Scallop fishermen who have not previously engaged via VSFA • LEFCOL • Any other interested fishers <p>CarbonNet confirmed availability and requested confirmation of meeting times.</p>	N/A
2/8/17	<p>CarbonNet received email confirmation from SIV confirming there will be 2 or 3 meetings on the afternoon fo 8 August at LEFCOL's office in Lakes Entrance.</p>	
4/8/17	<p>CarbonNet emailed SIV with the following remaining draft EP extracts:</p> <ul style="list-style-type: none"> • Impacts to plankton • Impacts on fish • Risks to fin fisheries • Risks to rock lobster fishery <p>CarbonNet also sent SIV responses to concerns and questions raised in their email on 12/7:</p> <ol style="list-style-type: none"> 1. Significant quantities of scallops were dredged by a fisherman within the survey area (two sets of GPS coordinates and a photo provided to CarbonNet). 2. The Victorian seafood industry fears that the fishing industry will be forced to suffer the death of scallops for something that will probably not work. 3. As you are aware, there is extremely credible science produced in September last year that identified the stress caused to 	<ol style="list-style-type: none"> 1. Based on the information available, CarbonNet understands that the area where scallops are claimed to have been found is outside the proposed MSS area, and in the case of the larger area many kilometres away. Therefore CarbonNet disagrees with the claim that there are 'significant quantities' of scallop 'within the survey area'. 2. Refer to CarbonNet's draft risk and impact assessments for scallops, which assessed the risk to the sustainability of the Victorian scallop fishery has been assessed as 'low'. The merits and viability of CCS fall outside the scope of the EP for CarbonNet's proposed MSS, however CarbonNet responded to



	<p>Scallops from seismic exposure results in mortality</p> <ol style="list-style-type: none">4. Australian research on seismic damage to zooplankton has found that the impact range is 100 times greater than previously assumed (from 10m to 1,200+m). And, there is a two to three fold increase in mortality5. Significant concerns about the implications of the Macauley study as they relate to species that spawn year round – what happens if the survey knocks out future recruitment to these fisheries?6. Do you have a Bond in place to compensate on future impacts to these fisheries? Do you have an idea in mind of a future monitoring strategy for potentially impacted species (which there are a few).7. I note that CarbonNet had your own assessment of the area undertaken (using the underwater camera vehicle) that states there is ‘no/minimal evidence’ of populations of Scallops and Rock Lobsters in the area. A few comments on this: A - Scallops live within the seabed (hence the use of dredges to catch them)- we wouldn’t expect you would see them, hence why stock surveys are undertaken they involve ‘catching’ the fish. B - Rock Lobster live hidden in cryptic habitat... So to industry, it is no wonder a video underwater assessment at a number of sites showed no signs of these species.8. When does the regulated ‘precautionary principle’ apply and how is it reported and considered in your EP? Will your EP be available to view publicly, so we can ensure it considers our concerns prior to being submitted?	<p>SIV on 14/7 on this point.</p> <ol style="list-style-type: none">3. Refer to CarbonNet’s draft risk and impact assessments for scallops, which examined all available science including the Day et al (2016) study, which CarbonNet co-funded, in great detail.4. Refer to CarbonNet’s draft impact assessment for plankton provided5. Refer to CarbonNet’s draft impact assessment for plankton and fish provided.6. CarbonNet has assessed the potential for both impacts and risks, as presented in the draft EP for the approval of regulators. Under the regulatory regime CarbonNet is not required to provide a bond. <p>CarbonNet is open to discussing monitoring strategies associated with the implementation of the MSS EP, and has put forward a proposal to industry, including SIV and VFA, to complete a pre- and post-habitat assessment survey. It is not the role of CarbonNet to provide monitoring strategies for the sustainability of fisheries.</p> <ol style="list-style-type: none">7. CarbonNet engaged highly qualified experts including leading marine biologists to design and undertake the environmental habitat assessment, details of which have been provided to SIV. <p>CarbonNet is confident that the</p>
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		<p>survey methodology used (towed ROV) was appropriate for confirming the presence or absence of scallops, and habitats suitable for rock lobsters. For more detail, see Section 5.6.3 of the EP.</p> <p>8. CarbonNet has provided draft extracts of its EP that details how risks and impacts have been considered and applied, including ALARP which incorporates the precautionary principle.</p> <p>Further to this, the OPGGS(E) does not stipulate that EPs are publicly released, but a summary of the EP will be.</p>
7/8/17	<p>CarbonNet sent SIV an email advising that the operational area and duration of survey have now been refined, and that the EP will be submitted in mid-August.</p> <p>The email explained that the operational area is now larger due to vessel turns, and provided map with amended operational area, and acquisition area (which is unchanged).</p> <p>The survey duration is likely to be 13-16 days but could be up to 27 days depending on final vessel selection.</p>	
8/8/17	<p>CarbonNet attended two meetings with SIV in Lakes Entrance.</p> <p>The first meeting was with SIV and the sole operator in the Victorian Ocean Purse Seine fishery. They stated November and December are bad timing for the MSS as fish are spawning at those times.</p> <p>The operator asked if how we will measure impact on fisheries, and what will happen if we kill all the fish. They suggested putting a \$10 million bond in place, to which CarbonNet said there was no basis for a bond. The operator said they are specifically concerned about Australian salmon, pilchards and mackerel. At this meeting SIV requested to see the full STLM report.</p>	<p>CarbonNet noted that draft EP extracts on fisheries have been provided to SIV. CarbonNet offered to send those to the operator as well, if they can provide their contact details. (To date this information has not been provided.)</p> <p>CarbonNet has described the fish species of concern in Section 5.4.4 of the EP.</p>

	<p>The second meeting was with SIV, LEFCOL, VFA and five individual scallop fishermen. Discussion was focused on potential impacts of seismic surveys to scallops and concerns that the MSS will wipe out local populations.</p> <p>The fishermen asked whether there would be a need to do future seismic surveys, and CarbonNet explained that there are a range of monitoring techniques, including seismic.</p> <p>The issue of dredge vs towed ROV as a methodology for stock assessments was also discussed at length, with the fishermen claiming scallops bury themselves and are not visible with a camera. All fishermen stated a dredge is needed to find them.</p> <p>One fisherman said he can guarantee there are scallops inside CarbonNet's proposed MSS area. The scallop fishermen indicated they will do their own stock assessment and give us the information.</p> <p>SIV reiterated its request for the full STLM report and map of the area impacted by sound. SIV also requested the risk assessment for scallops, which was sent on 27/7. CarbonNet provided hard copies in the meeting.</p> <p>SIV discussed the plankton study published in Nature journal and concerns about impacts on fisheries. CarbonNet said it has provided the draft extracts from the EP on plankton to SIV.</p> <p>SIV said spawning season for scallops is December to March.</p> <p>SIV committed to talk to VFA and industry regarding the proposals CarbonNet has put forward to collaborate.</p> <p>VFA provided some historical data for the fishery, said catch rates have been very low since the early 90s.</p>	<p>CarbonNet notes the preference for the MSS occurring outside of November and December. A discussion of MSS timing is provided at Section 2.2 of the EP.</p> <p>CarbonNet will consider whether and how to include fish species in its pre- and post-survey environmental habitat assessment.</p> <p>Details regarding the spawning period for scallops is outlined in Section 5.4.1.</p> <p>CarbonNet expressed to the meeting attendees that it is committed to ongoing consultation and will continue discussions and consider any new information as it comes to light.</p> <p>CarbonNet will resend the draft EP extracts that were already provided to SIV, and will provide them to any other stakeholders direct upon request.</p>
10/8/17	<p>SIV emailed CarbonNet to express thanks for the meetings in Lakes Entrance and the good discussions that were held around unsuitable dates and opportunities.</p> <p>SIV requested a copy of the full STLM report including the methodology and results.</p>	
11/8/17	<p>CarbonNet emailed SIV to acknowledge discussions around MSS timing.</p>	N/A

	<p>CarbonNet said the concerns raised by the individual fishers are addressed in the draft EP extracts provided to SIV (27/7 and 4/8) and it was unfortunate that the information had not been passed on or read.</p> <p>With regards to the request for the full STLM report, CarbonNet noted:</p> <ul style="list-style-type: none"> • CarbonNet agreed to provide the outcomes of the STLM report. • CarbonNet provided the outcomes of the STLM report on 26/7, which was a summary prepared with the consultant JASCO • At that time CarbonNet offered to make JACO available to discuss the results. This offer stands. <p>It is CarbonNet's belief that the modelling would be best understood if explained directly to SIV by JASCO.</p> <p>CarbonNet expressed hope that the collaboration opportunities it has tabled can be progressed.</p>	
11/8/17	<p>SIV responded to CarbonNet to question why it would not provide the STLM results and requested a comprehensive copy of same and a map that identifies the spread of noise beyond the MSS acquisition and operational areas. SIV noted that sound does not travel straight up and down.</p> <p>SIV commented that they did not appreciate the tone of CarbonNet's email and that a previous request for compensation to SIV to arrange meetings and distribute information was met with a blank face.</p> <p>SIV said there will continue to be an ongoing discussion around the impacts of seismic.</p>	N/A
22/8/17	<p>CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.</p>	N/A
18/9/17	<p>CarbonNet met with SIV and VFA in Melbourne to discuss progress on the EP, scallop stock assessment, pre- and post-MSS environmental habitat assessment and other issues.</p> <p>SIV said CarbonNet's commitment to provide funding support to VFA</p>	N/A

	<p>for a Victorian scallop stock assessment is 'big win for industry'. SIV would like to review and provide feedback on pre and post environmental assessment scope.</p>	
24/9/17	<p>SIV emailed CarbonNet with an attachment 'Reproductive and Larval Dispersal periods for key fishery species off eastern Victoria', which was prepared by VFA.</p> <p>SIV requested that the following be included in the EP: "Of the thirteen species reviewed, the literature indicated that the spring-summer period, particularly November-January, is the most important period of the year for spawning and larval dispersal of most species." SIV also requested to review documentation relating to fisheries resources prior to resubmitting EP.</p>	<p>The information provided by SIV has been considered with regard to refining the timing of the MSS to minimise potential impacts on commercial fishreis (see Chapter 2 and Section 7.2.7).</p> <p>The impact and risk assessments from the submitted EP were provided to SIV at a meeting on 3/10/17 (see entry for this date).</p>
26/9/17	<p>CarbonNet spoke to SIV on the phone to confirm meeting in Werribee on 3/10/17. SIV said they are meeting with VFA today to go through the request for quote for VFA's scallop stock assessment. SIV would like to have that meeting first before deciding who should attend the meeting on 3/10/17.</p> <p>CarbonNet explained that it will go ahead and arrange the meeting, including flying its acoustic consultant from Queensland to Melbourne for the meeting to discuss the STLM results.</p>	N/A
3/10/17	<p>CarbonNet met with representatives from SIV and VFA in Werribee with its environmental and acoustic consultants to discuss sound modelling, pre- and post-MSS environmental habitat assessment, VFA's scallop stock survey and the MSS EP.</p> <p>CarbonNet's acoustic consultant provided a presentation of sound modelling thresholds and results for the project. In response, SIV requested a map of the 'sound reach'. CarbonNet discussed the difficulties and inaccuracies in doing this and the conservative distance of 1,220 metres to no impact for scallops and lobsters.</p> <p>CarbonNet provided an overview of how the EP is structured and gave SIV updated copies of sections 7.1 and 7.8 (impacts to biological receptions and fisheries), which were previously provided</p>	N/A

		<p>on the 27th of July.</p> <p>CarbonNet discussed its proposal to conduct a pre- and post-MSS environmental habitat assessment. SIV has not yet looked at the scope but will do so. SIV suggested using Danish Seine boats with cameras to view scallops.</p> <p>SIV said the area near CarbonNet's MSS area hasn't been fished in about 7-8 years, but recent information provided by a fisherman to CarbonNet and from Danish Seine fishermen indicates some stock rebuilding has occurred.</p> <p>VFA discussed the scallop stock assessment survey they are planning. They aim to go to market with a Request for Quote (developed with input from SIV and CarbonNet) soon with the survey to take place this summer.</p> <p>CarbonNet provided the extract from the EP regarding the impact assessment to biological receptors (crustaceans and molluscs) and risks to fisheries. While flicking through this material, SIV claimed CarbonNet is cherry picking data with regard to the impacts of MSS on scallops. CarbonNet explained that this is not that case and that all relevant studies have been taken into consideration and presented in the EP, including a detailed examination of Day et al (2016) and its implications for this MSS.</p> <p>SIV and VFA will work together to verify a video of scallops fished in the MSS area.</p> <p>SIV asked when the EP was going to be resubmitted. CarbonNet said it plans to resubmit the EP on 20 October. SIV said it would provide feedback on the EP material prior to 20 October.</p> <p>To date, SIV has not provided any feedback on the extracts from the submitted EP.</p>	
	5/10/17	<p>Following on from discussions with the VFA regarding the MSS, CarbonNet has been exploring opportunities for collaborative arrangements to promote a better scientific understanding of the marine environment in which the fishing industry and project operates. In particular, discussion have focussed on a well-designed, scientifically robust, best practice, whole of fishery stock assessment that would benefit all stakeholders and support the VFA in the</p>	

			sustainable management of the scallop fishery. Accordingly, CarbonNet has formally offered (via letter) to contribute towards the VFA's reasonable costs associated with the 2017/18 Eastern Victorian Scallop Stock Assessment, up to \$200,000 (including GST). The VFA is currently considering this offer.	
Eastern Zone Abalone Industry Association	Represent fishermen who may have activities near proposed acquisition area	21/3/17	CarbonNet contacted the Eastern Zone Abalone Industry Association via post with a letter that invited feedback and provided a fact sheet. No response was received.	N/A
		18/5/17	CarbonNet called a mobile phone number and requested a call back. Also called a landline number listed but there was no answer.	N/A
		18/5/17	CarbonNet found an email address for the Eastern Zone Abalone Industry Association online and re-issued the original letter and fact sheet and asked whether the association has any questions or objections to the proposed survey. CarbonNet explained that its understanding of the survey area is that abalone are unlikely to be present.	CarbonNet's understanding is that abalone are commercially fished only in aquaculture leases in the eastern-most nearshore areas of Victoria. As such, further follow up is not warranted as the fishery is located well outside the proposed acquisition area.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
Victorian Abalone Divers Association (VADA)	Represent fishermen who may have activities near proposed acquisition area	21/3/17	CarbonNet contacted VADA via post and email with a letter that invited feedback and provided a fact sheet.	N/A
		18/5/17	CarbonNet phoned VADA to follow up and was advised that there is no abalone fishing activity in the MSS area. VADA has no concerns and does not need to be consulted further.	CarbonNet will not make further contact with this stakeholder in accordance with their wishes.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A

Sustainable Shark Fishing Association (SSFAssn)	Represent fishermen who may have activities near proposed acquisition area	21/3/17	CarbonNet contacted SSFAssn via post and email with a letter that invited feedback and provided a fact sheet.	N/A
		18/5/17	CarbonNet called a mobile phone number and left a voicemail message requesting a call back. No response was received.	N/A
		6/6/17	CarbonNet re-issued the original letter and fact sheet via email, stating it is nearing the end of the EP preparation and have not received any response from SSFAssn.	Section 5.6.3 of the EP contains sufficient information regarding the shark fishery and is confident enough in this data that no follow up of this stakeholder is required.
		14/6/17	CarbonNet received a voicemail from SSFAssn indicating they had tried to email us previously but the email had bounced. On the same day, CarbonNet received an email from SSFAssn which objected to the MSS, on the following basis: <ul style="list-style-type: none"> • Information provided by CarbonNet did not include sound modelling. • The MSS area is a possible pupping ground for gummy and school shark. • The timing of the MSS falls into prime period for pupping and no science exists on impacts of seismic on breeding behaviour. • Information provided by CarbonNet does not state that the MSS will conform to best practice. • CarbonNet has not included the subsequent acoustic modelling based on ISO standards that occurred. subsequent to the FRDC studies that permitted further seismic surveys to continue in Bass Strait. • CarbonNet did not mention any 'TEP species' such as sea horses. 	N/A
		23/6/17	CarbonNet emailed SSFAssn addressing the issues raised and requesting clarification on who the SSFAssn is representing. CarbonNet's response including the following points: <ul style="list-style-type: none"> • CarbonNet has provided SIV, SETFIA and LEFCOL with the following, and offered to provide the same to the SSFAssn: <ul style="list-style-type: none"> • Summary of environmental habitat assessment 	N/A

	<ul style="list-style-type: none"> • Commitment to provide info on the sound transmission modelling • Commitment to provide the relevant draft risk assessment • CarbonNet provided catch data for the MSS area including shark, and requested any further detailed info on fishing activity from SSFAssn. • A discussion on impacts of seismic on sharks and breeding. CarbonNet said it is not expected that shark breeding behaviour will be compromised. • CarbonNet detailed how the MSS will comply with best practice, including relevant industry codes of practice and guidelines. • CarbonNet interprets 'TEP species as 'Threatened Ecological Communities (TEC)'. No TEC occur in the MSS area, and suitable habitat for seahorses is scarce. • Carbonnet sought clarification from SSFAssn on its point regarding acoustic modelling and seismic surveys in Bass Strait – CarbonNet is not aware of what this refers to. • CarbonNet asked if SSFAssn's views were being represented via SIV, SETFIA and LEFCOL and if not sought clarification on who SSFAssn is representing. 	
29/6/17	<p>CarbonNet received letter via email from SSFAssn which confirmed they are representing the Gillnet and Hook Shark Fishers.</p> <p>The letter raised the following issues:</p> <ol style="list-style-type: none"> 1. The SSFAssn is concerned that an area identified collaboratively for stock recovery of sharks by fisheries management and the fishing sector is being considered for a seismic survey. 2. The SSFAssn understands that sharks, crustaceans and bivalves are all sensitive to particle motion. 3. The SSFAssn believes that CarbonNet and the Victorian Government should display leading practice. 4. The SSFAssn recommended CarbonNet adopt methodology from the IUCN document 'Effective planning strategies for managing environmental risk associated with geophysical and other imaging surveys' by Nowacek and Southall (2016). 5. The SSFAssn recommended CarbonNet conduct 'validation' or 	<p>CarbonNet responded to concerns on 3/8/17:</p> <ol style="list-style-type: none"> 1. CarbonNet has not been advised by fishing regulators or associations of any areas within the proposed MSS area is nominated as an area of stock recovery for sharks. 2. Provided information from draft EP on the sensitivity of sharks to particle motion. 3. CarbonNet agrees that we should follow best practice and believes its environmental impact assessment is best practice. 4. The IUCN document referenced



	<p>'ground truthing' of sound from the survey, an analysis of catch rates and species abundance, including sharks tagged with acoustic tags. They also said while particle motion and acceleration may be modelled, it must be measured directly.</p> <ol style="list-style-type: none">6. The SSFAssn requested CarbonNet consider the recent work on seismic surveys completed by the NZ Department of Conservation Technical Working Group (link to this work was provided).7. The SSFAssn notes seismic surveys are yet to be eliminated as a potential cause of spinal damage in sharks.8. The SSFAssn would like to know whether regional and temporal cumulative noise impacts will be considered and included in the modelling?9. The SSFAssn asked whether CarbonNet will need to conduct future seismic surveys and how often they will occur. The SSFAssn stated this is a cumulative impact, which places responsibility on CarbonNet to display leading practice, detailing monitoring during the survey and evaluation post-survey.	<p>focuses on marine mammals. CarbonNet said we are adopting mitigation and monitoring measures and is committed to evaluating and improving environmental risk management.</p> <ol style="list-style-type: none">5. Given CarbonNet has a detailed understanding of the areas of ecological sensitivity and substrate types from our marine environmental assessment conducted in April 2017, and seafloor topography (Vic Gov LiDar) the need for such validation is yet to be established. CarbonNet will continue to consider this as part of preparations for the MSS.6. Due to the proposal to work outside the key migration periods for pygmy blue, southern right and humpback whales, CarbonNet has determined that additional controls, such as PAM, is not required for this survey.7. CarbonNet's literature review has not found reports of such damage occurring.8. CarbonNet is not aware of any other surveys due to occur at the same time as the proposed Pelican 3DMSS. Should one arise, CarbonNet has committed that at least a 40 km separation will be maintained.9. The use of seismic surveys, along with many other monitoring techniques, are used by CCS projects internationally.
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	1/8/17	CarbonNet sent SSFAssn an email with the habitat assessment summary and STLM results, both of which were provided to other commercial fishing industry bodies.	N/A
	3/8/17	CarbonNet emailed SSFAssn with relevant extracts from draft EP risk and impact assessment and responses to questions raised (see notes against previous entry). Draft excerpts provided: 1. Summary of Impacts on Marine Fauna 2. Impacts on Fin Fish 3. Summary of Risks to Commercial Fisheries 4. Risks to Fin Fisheries CarbonNet offered to meet with SSFAssn in Lakes Entrance on 9 August. No response was received.	N/A
	7/8/17	CarbonNet sent SSFAssn an email advising that the operational area and duration of survey have now been refined, and that the EP will be submitted in mid-August. The email explained that the operational area is now larger due to vessel turns, and provided map with amended operational area, and acquisition area (which is unchanged). The survey duration is likely to be 13-16 days but could be up to 27 days depending on final vessel selection.	N/A
	10/8/17	CarbonNet received an email from SETFIA passing on some feedback from SSFAssn regarding shark fishing season. SSFAssn commented that November-December would be the worst period for the MSS and agreed that March would be ok. SSFAssn also made the point that they believe that seismic surveys have negative environmental consequences and their preferred timing would be never.	CarbonNet thanked SETFIA for the feedback and advised we will feed the timing preference information in our EP and decision-making processes. CarbonNet offered for SSFAssn to call us to discuss.
	22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A

Victorian Scallop Fisherman's Association (VSFA)	Represent scallop fishermen who may have activities near proposed acquisition area	21/3/17	CarbonNet contacted VSFA via post and with letter that requested a meeting, invited feedback and provided a fact sheet.	N/A
		3/4/17	CarbonNet tried to call number listed on AFMA website, phone rang out.	N/A
		4/4/17	CarbonNet found email address for VSFA and sent letter and fact sheet via email.	N/A
		19/4/17	CarbonNet attempted to call, phone number rang out and there was no message facility. Issued a follow up email requesting a meeting in Lakes Entrance.	N/A
		19/4/17	CarbonNet received a phone call from VSFA to arrange meeting in Lakes Entrance. VSFA would like to discuss: <ul style="list-style-type: none"> • CarbonNet's EP submission timeframes. • Details on the seismic source – how many decibels. • Juvenile scallop beds in MSS area. 	N/A
		26/4/17	CarbonNet met with four members and representatives of VSFA in Lakes Entrance and provided an outline of the project and MSS. VSFA expressed a clear view that seismic surveys impact scallops and the scallop industry. VSFA stated that it has developed and adopted a Scallop Management Plan (commercial-in-confidence), which operates outside of the regulatory framework. VSFA indicated that a significant scallop bed was in the area of the survey, which fishers are intending to harvest from next season (2018). VSFA expressed a willingness to work with CarbonNet to conduct a scallop stock assessment to determine where scallop beds are. CarbonNet advised VSFA that the preliminary results from a marine environmental assessment in the proposed acquisition area commissioned by CarbonNet indicated a limited number of scallops were observed in two of over sixty locations in the habitat assessment area.	CarbonNet has requested information from VSFA on the location of scallop beds within MSS area and no detailed information has been provided. CarbonNet's habitat assessment of the MSS area did not find any evidence of a commercially significant number of scallops present. Based on the evidence available to CarbonNet, CarbonNet cannot validate this claim. Nonetheless, reference to this scallop bed is made in Section 5.6.3 of the EP.

	<p>CarbonNet undertook to consider options to work collaboratively with VSFA and present these for consideration.</p> <p>CarbonNet undertook to provide further information about the proposed MSS and to meet again with the VSFA in May.</p>	
2/5/17	<p>CarbonNet emailed VSFA with the presentation distributed at the meeting on 26/4/17. CarbonNet committed to provide:</p> <ul style="list-style-type: none"> • The results of the marine environmental assessment (reporting in progress). • The results of sound modelling (currently underway). • Further concepts on how to work collaboratively with VSFA. <p>CarbonNet requested the following from VSFA:</p> <ul style="list-style-type: none"> • Information about the Scallop Management Plan adopted by VSFA. • Information on the location of the scallop beds in the area of the proposed MSS. • A proposal to conduct a stock assessment, including a brief outline of the proposed survey methodology and any co-contribution being sought. 	<p>CarbonNet emailed VSFA on 11/5/17 with a summary of the environmental habitat assessment and a map showing where observations were taken.</p>
11/5/17	<p>VSFA emailed CarbonNet confirming receipt of email. The VSFA Board has agreed to provide:</p> <ul style="list-style-type: none"> • A summary document of VSFA's stock management plan (commercial-in-confidence). • A stock assessment proposal, including any co-contribution sought. <p>VSFA requested to schedule a meeting in May.</p>	N/A
12/5/17	<p>VSFA phoned CarbonNet seeking more information on the habitat assessment, including:</p> <ul style="list-style-type: none"> • Whether the survey used towed ROV. • The survey method – were samples taken and was it non-intrusive. • Was the survey conducted in transects, towed in a circle, straight line, etc. • What was the area covered at each site. 	<p>CarbonNet sent VSFA an email on 18/5/17 containing further information on habitat assessment methodology.</p>

	<ul style="list-style-type: none"> Any other parameters for how the data was collected. <p>CarbonNet committed to send relevant excerpts on habitat assessment methodology to VSFA.</p>	
18/5/17	<p>VSFA sent CarbonNet email with a letter that outlined VSFA's views on MSS, a copy of VSFA's stock management plan and stock assessment proposal for CarbonNet. The stock management plan was provided to CarbonNet on a commercial-in-confidence basis and is not for further distribution, beyond submission of CarbonNet's EP to MSS regulators (NOPSEMA and ERR).</p> <p>VSFA's letter stated that the activity proposed will have a long lasting negative impact on the VSFA's functions, interests and activities within Bass Strait.</p> <p>VSFA provided a map indicating that the area from Marlo to Port Albert is a significant area for commercial scallop fishing operations.</p> <p>VSFA stated the location of the proposed MSS overlaps identified scallop beds earmarked as important to the long-term success of scalloping in southeast Australian waters. They claimed that the MSS will disrupt the healthy adult scallops that contribute to the spawning biomass in these waters and surrounds in both the short- and long-term. Stock losses and undue stress applied to rehabilitating stocks could significantly impact operators in the Victorian Zone, Bass Strait Central Zone and Tasmanian Zone as fishing effort is displaced to other areas.</p> <p>VSFA stated the methods of CarbonNet's habitat assessment were not designed to discover scallops, and that the survey was not conducted in an open or transparent manner as it did not take into account industry information.</p> <p>VSFA provided a proposal for a joint stock assessment, with</p>	<p>As noted below (see following pages) CarbonNet has met with VSFA on a number of occasions to work through these issues and sent VSFA relevant draft EP extracts regarding impacts and risks to scallops and scallop fisheries.</p>

	CarbonNet to provide a 65-70% co-contribution.	
23/5/17	<p>CarbonNet met with VSFA in Lakes Entrance to discuss collaboration opportunities raised by VSFA, new collaboration opportunities proposed by CarbonNet, and scallop stock management.</p> <p>VSFA made the following points:</p> <ul style="list-style-type: none"> • Requested CarbonNet send through details of any new collaboration proposals via email for consideration. • Not interested in working with VFA on a joint stock assessment. • Already knows where scallops are; does not need to complete a stock assessment for themselves. • Their view is that non-intrusive survey methods are not industry standard, whereas a dredging method is standard. • They are proceeding with its own stock assessment regardless of CarbonNet's contribution or participation. • Raised questions about maritime safety and right of way laws should the survey vessel encounter another vessel. • Refused to provide any information on the location of scallop beds in MSS area as that is commercial-in-confidence. <p>CarbonNet committed to:</p> <ul style="list-style-type: none"> • Send VSFA a proposal that outlines possible collaboration opportunities. • Send VSFA information on the STLM when complete. • Send VSFA the assessment of impacts to the scallop fishery from the EP. • Hold another meeting with VSFA to discuss before submitting EP. 	<p>CarbonNet emailed VSFA on 31/5/17 with collaboration proposals for joint studies/stock assessments:</p> <ul style="list-style-type: none"> • Conduct field observations pre- and post-MSS via non intrusive methods (e.g., video and diver inspection), within and adjacent to CarbonNet's proposed acquisition area, solely at CarbonNet's cost. The field observations are to be undertaken by qualified marine biologists. VSFA could participate in the design of the field observation methodology, along with other representatives, and be present during the observations. It may be possible to engage a VSFA vessel from which to take the field observations. • CarbonNet could provide a financial contribution to a scientifically-sound Victorian Eastern Zone Scallop Fishery stock assessment undertaken by VSFA in conjunction with other industry groups (e.g., SIV) and regulators (e.g., VFA). Pending confirmation of the expected scope and total costs, CarbonNet could consider a contribution up to 10% or \$200,000, whichever is the greater. • A financial contribution could be made towards equipment that the



			<p>VSFA considers would benefit the industry in terms of sustainability of the scallop fishery or the safe operations of scallop fishers at sea. Scope and value are subject to further discussion.</p> <ul style="list-style-type: none">• CarbonNet offers to meet the reasonable costs of the VSFA in notifying its members as part of the operational phase of the MSS, should it be approved by regulators. Scope and value subject to further discussion. <p>CarbonNet noted that VSFA expressed an unwillingness to work with VFA, so requested feedback on these options. CarbonNet also said it is not in a position to fund an activity that is contrary to the scope of its proposed MSS under the relevant legislation.</p> <p>CarbonNet reiterated its commitment to provide the STLM results, when complete, and CarbonNet's draft risk assessment addressing the concerns raised by VSFA.</p> <p>CarbonNet again requested information on the location of any known scallop beds within and around the proposed MSS operational area. CarbonNet confirmed it is considering a legal exclusion zone. CarbonNet also said it would provide further information on the law of the sea as part of operational</p>
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		planning
27/6/17	CarbonNet sent the VSFA a summary of the STLM results, including an offer to make the acoustic consultant available to discuss the results. CarbonNet requested VSFA get in touch with any questions about the results. No response to this provision of data has been received to date.	N/A
5/7/17	CarbonNet received an email from the VSFA requesting that CarbonNet consider the original proposal put forward by VSFA for a joint stock assessment. VSFA disputed CarbonNet's email regarding the outcomes from the previous meeting, in particular where VSFA stated they would not be willing to work with the VFA. VSFA stated they are willing to negotiate on their proposal and would like to meet to discuss.	While CarbonNet's consultation record stands, it will progress discussions regarding proposals to collaborate with both VSFA and VFA.
10-11/7/17	CarbonNet called and emailed the VSFA to offer to meet in Sale on 13/14 July. VSFA responded to set up meeting on 21 July in Melbourne.	N/A
13/7/17	CarbonNet received an email from the VSFA confirming the meeting date of 21 July, requesting CarbonNet find a suitable venue in Melbourne and advising they would send through attendees shortly.	CarbonNet sent the VSFA an email on 17/7/17 confirming location of meeting, requesting any items to add to the agenda and requesting they confirm attendees.
17/7/17	CarbonNet sent VSFA an email confirming location of meeting, offering to discuss proposals put forward for collaboration, requesting any items to add to the agenda and requesting VSFA confirm attendees.	N/A

20/7/17	<p>CarbonNet received a text message with an agenda for meeting. The agenda purpose was stated as: 'Meeting called by VSFA – Failure to give due consideration to VSFA scallop assessment proposal'.</p> <p>CarbonNet responded via text to note CarbonNet has a difference of views on a number of topics and regarding previous discussions.</p> <p>CarbonNet requested any specific clarifications on the STLM results.</p>	N/A
21/7/17	<p>CarbonNet attended a meeting in Melbourne called by and chaired by VSFA. SIV and VFA also attended.</p> <p>At the meeting, VSFA presented their version of consultation to date, including their perception that CarbonNet had failed to adequately address the VSFA's stock assessment proposal.</p> <p>CarbonNet attempted to ask the meeting to note that CarbonNet has its own records on the previous discussions which in some areas differ to that described by VSFA. VSFA noted that the current agenda item was for VSFA to summarise the previous consultation, not CarbonNet.</p> <p>VSFA stated non-invasive habitat assessment methods (e.g. towed ROV camera, divers) of observing scallop presence were not industry standard and therefore CarbonNet's environmental habitat assessment, which found very few scallops, is flawed and inaccurate.</p> <p>CarbonNet attempted to ask the meeting to note that non invasive techniques have been used to assess the presence of scallops in other situations. The meeting chair (VSFA) refused to allow this to be discussed. CarbonNet also attempted to table other proposals that CarbonNet had previously put forward (via email to VSFA 31/5), including funding pre- and post-survey non-invasive habitat assessments, and/or supporting industry (including SIV and VFA) to conduct a region-wide scallop stock assessment. VSFA stated this meeting was to discuss their proposal and why CarbonNet was not willing to work or negotiate with VSFA. VSFA did not allow a discussion of other proposals.</p> <p>At the meeting, the issue of dredging or invasive survey methods vs non-invasive methods dominated discussion. VSFA expressed the view that CarbonNet's inability to conduct an invasive stock</p>	<p>CarbonNet scheduled a follow up meeting in Gippsland.</p> <p>CarbonNet provided further information on why a dredging method for scallop stock assessment is inconsistent with CarbonNet's approvals on 24/7/17.</p>

	<p>assessment means that CarbonNet is not willing to work with VSFA. CarbonNet stated that it is seeking to find a way to work collaboratively with VSFA, SIV and VFA in this matter, and that there were non-invasive collaboration opportunities that had been tabled by CarbonNet.</p> <p>SIV requested further information from CarbonNet on why the project cannot support an invasive stock assessment method. CarbonNet noted that it is related to the legislation under which CarbonNet operates and committed to provide further clarification on this by Monday 24 July. (Note: see summary consultation records between CarbonNet and NOPTA).</p> <p>VFA clarified that its role is not to advocate for any parties or to play a regulatory role in this process. VFA will seek to ensure all parties have adequate, appropriate and validated information.</p> <p>VFA will look at the information provided by SIV re scallops that are claimed to have been dredged from the survey area recently and validate this information, taking into account VMS/GPS logs and other data available to them.</p>	
24/7/17	<p>CarbonNet emailed VSFA, SIV and VFA with further clarification on CarbonNet's inability to fund a dredge-based survey. CarbonNet said a dredge-based scallop stocktake assessment within the MSS area is inconsistent with the purpose and scope of the approvals under the OPGGS Act, and as such CarbonNet can not fund such an activity.</p> <p>CarbonNet also emailed VSFA to schedule next meeting, and received response to say they will confirm attendees soon.</p>	N/A
26/7/17	<p>VSFA emailed CarbonNet requesting more information on its inability to fund a dredge-based survey, asking if it was prohibited and where in the OPGGS Act the information is located.</p>	N/A
27/7/17	<p>CarbonNet emailed VSFA, SIV and VFA with the following:</p> <ul style="list-style-type: none"> • Draft agenda for meeting in Traralgon on 28/7 • Draft scope for pre- and post-MSS environmental assessment and monitoring for discussion 	N/A

	<ul style="list-style-type: none"> Extracts from draft EP (at 27/7) with information on scallops. VSFA responded via email to confirm attendance at meeting. To date, SIV and the VSFA have not provided any feedback on the extracts from the draft EP. 	
27/7/17	CarbonNet emailed VSFA to provide further information on its approval and disturbance of the sea bed. CarbonNet explained that under the OPGGS Act the marine seismic survey is a key greenhouse gas operation for which an approval has been granted. The scope the approval for the marine seismic survey does not permit CarbonNet to disturb the seabed.	N/A
28/7/17	<p>CarbonNet met with VSFA and VFA in Traralgon to discuss the collaboration proposals CarbonNet and VSFA had put forward. The fisherman who provided information on scallops claimed to be dredged near the MSS acquisition area also attended.</p> <p>CarbonNet provided an update on EP timing and said it plans to submit around Monday 14 August. Discussions with stakeholders will be ongoing between now and the MSS.</p> <p>VFA asked if stakeholders have an opportunity to make submissions to NOPSEMA or ERR after the EP has submitted, which CarbonNet said is a matter for stakeholders if they wish, but the EP submission is not the end of the dialogue. VSFA sought clarification on how any consultation post-EP submission is considered by NOPSEMA in their decision making, and CarbonNet said that is up to regulators.</p> <p>VSFA requested further detail on the legislation that prevents CarbonNet from dredging to assess presence of scallops. VSFA said they have spoken to NOPSEMA about the matter and their view is that it is not prohibited. VSFA restated their offer to collaborate with CarbonNet on a dredging stock assessment. CarbonNet said it has received expert advice from qualified marine scientists that video is a suitable method to determine the presence or absence of scallops, and it did not set out to conduct a stock assessment or abundance</p>	<p>CarbonNet offered to have further discussions with VSFA and would consult both NOPSEMA and NOPTA on dredging. CarbonNet explained that it has a permit to conduct the MSS from NOPTA and will provide further advice to VSFA on this matter.</p> <p>CarbonNet will continue to talk with VFA, VSFA, SIV and other interested parties regarding its proposal to co-design a pre- and post-MSS environmental habitat assessment study. CarbonNet's offer to make a contribution to a whole-of-fishery scallop stock assessment coordinated by VFA also stands.</p> <p>CarbonNet's risk assessment for the Victorian scallop fishery is provided in Section 7.8.7 of the EP which has considered the presence of scallops in the vicinity of the MSS operational area as indicated by the recent information</p>



	<p>survey.</p> <p>VSFA's view is that CarbonNet currently has inaccurate baseline data from its environmental habitat assessment as scallops bury in 2 metres below the surface. VFA said dredging only goes about 10 – 20 cms below the surface.</p> <p>VSFA asserted that CarbonNet doesn't want to dredge because it doesn't want to find scallops in the area.</p> <p>VSFA asked what CarbonNet needs to stop the MSS.</p> <p>The fisherman who provided location information about scallop dredges provided the following information:</p> <ul style="list-style-type: none">• He was fishing when he found juvenile scallops (50 mm)• He found many scallops from the Seahorse Buoy through the pipelines in an area about 6 miles long.• The photo that was provided was taken on the same day as the fishing logs (according to the time stamp).• There are two scallop beds in the area, which correlate to the two sets of GPS points provided to VFA/SIV and CarbonNet, with a break between the two beds.• There is a future there for scallop fishermen for five years.• Seine fishers are avoiding the area near the pipelines as their nets are getting stuck on scallops. <p>VFA confirmed that AFMA has stated the data is consistent with the fisherman's explanation of events.</p> <p>There was a discussion about doing some ground truthing to verify whether or not there are scallops inside the MSS operational area. Evidence provided to date shows very few scallops inside area. VFA suggested it could work with CarbonNet and VSFA to design a study to go back and do further field observations.</p>	<p>provided by a fisherman.</p>
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7/8/17	<p>CarbonNet sent VSFA an email advising that the operational area and duration of survey have now been refined, and that the EP will be submitted in mid-August.</p> <p>The email explained that the operational area is now larger due to vessel turns, and provided map with amended operational area, and acquisition area (which is unchanged).</p> <p>The survey duration is likely to be 13-16 days but could be up to 27 days depending on final vessel selection.</p>	N/A
8/8/17	<p>CarbonNet sent VSFA further clarification on CarbonNet's approval and dredging. CarbonNet said NOPSEMA has confirmed that the approval of CarbonNet's seismic survey as a key greenhouse gas operation is a matter for NOPTA under the OPGGS Act. CarbonNet is continuing to consult NOPTA to confirm that a dredge-based activity that would disturb the seabed and be in proximity to oil and gas assets is inconsistent with its approval.</p>	N/A
22/8/17	<p>CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.</p>	N/A
27/9/17	<p>VSFA emailed CarbonNet to raise a number of issues. They:</p> <ul style="list-style-type: none"> • Requested CarbonNet work with them on a dredge-based scallop survey. • Requested information on CarbonNet's "regulated prohibition to be associated with, or contribute financially to, work of this nature". • Disputed CarbonNet's claim that there are a low number of scallops in the area. • Disagree that camera technology can assess the abundance of scallops. • Claimed CarbonNet has said that the habitat is not suitable for scallops when it is prime scallop territory. • Claimed CarbonNet is misrepresenting fisher's knowledge to NOPSEMA. • Presented a link to a video of a scallop boat with scallops on 	<p>CarbonNet responded to this email on 3/10/17 and provided information on advice received from NOPTA regarding dredging and requested that VSFA work with VFA to verify the information on scallop presence.</p> <p>See also note.</p>

			<p>board, as well as footage of the boat's GPS tracker that showed it is within the MSS area.</p> <ul style="list-style-type: none"> • Stated that "the scallops surveyed in the areas adjoining E38°14.873', S147° 30.683' (video) range in size from small spat to commercial size". • Requested CarbonNet cease plans for the MSS until a dredge-based survey is completed with the VSFA. • Stated they are happy to discuss the establishment of an advisory body for this work. • Requested a copy of the full EP be forwarded for their reference including all research papers attached. 	
		2/10/17	<p>CarbonNet emailed VSFA in response to the queries raised on 27/9/17. CarbonNet:</p> <ul style="list-style-type: none"> • Noted that it has been requesting data on the location of scallops since March. • Asked VSFA to work with VFA to verify the video information provided. • Said NOPTA recently advised that conducting a dredge-based survey is inconsistent with CarbonNet's approval to undertake the Pelican MSS. • Encouraged VSFA to consult with VFA regarding the Victorian Ocean Scallop Stock Assessment that VFA is planning. • Encouraged VSFA to participate in the pre- and post-MSS habitat assessment along with SIV and VFA. • Asked for any feedback on the draft EP extracts provided and any specific aspects VSFA would like to discuss. • Noted that the EP acknowledged all available science, research and industry data. 	N/A
Victorian Rock Lobster Association (VRLA)	Represent lobster fishermen who may have activities near	21/3/17	CarbonNet contacted the VRLA via post with a letter that invited feedback and provided a fact sheet.	N/A
		18/5/17	CarbonNet found an email address online for VRLA and re-issued the original letter and fact sheet.	N/A

proposed acquisition area	18/5/17	CarbonNet received an email response from that VRLA stating that it has been providing advice and feedback to LEFCOL on this project and keeping across SIV's engagement, so that will be sufficient from VRLA's perspective.	CarbonNet thanked VRLA for the advice and said they are welcome to ask questions.
	15/6/17	CarbonNet received an email from VRLA claiming that the MSS may impact on the eastern zone rock lobster fishing grounds. VRLA said the Day et. al. study states that seismic air-guns cause significant and permanent damage to rock lobster and scallops. VRLA said precedent has been set for compensation for impacted rock lobster fishers, and that compensation for long term damage (5-7 years) is being discussed at a round table with regulators (NOPSeMA and ERR), Origin Energy, VFA, SIV and VRLA. VRLA requested that CarbonNet assess risk using the ISO 31000 risk management standards with the impact measured as significant/permanent and likelihood as certain.	See response dated 23/6.
	23/6/17	CarbonNet responded to VRLA's email on 15/6 outlining the consultation that has been completed to date and requesting confirmation of VRLA's role in this process given previous advice. CarbonNet explained that we wrote to VRLA on 21/3/17 and received email response on 18/5/17 advising VRLA was speaking to LEFCOL and SIV and that would be sufficient. CarbonNet has provided outcomes of environmental assessment, committed to share the STLM results and committed to share relevant parts of the draft risk assessment to LEFCOL, SIV and others. CarbonNet is willing to provide this info to VRLA also, but requested that VRLA clarify how it intends to engage with CarbonNet given previous advice and status of consultations. CarbonNet also said that the catch data indicates a very low level of lobster fishing in area, and that we are considering all available science including Day et. al. CarbonNet said our risk assessment is based on the Department of Economic Development, Jobs, Transport and Resources' system which is consistent with ISO AS/NZS 31000:2009.	N/A

		3/7/17	CarbonNet received an email response from VRLA requesting an update on both the risk appetite and the risk assessment on the impact to the marine ecosystem, including plankton. VRLA confirmed that there is not expected to be displacement of rock lobster fishing effort during the MSS.	See responses dated 1/8 and 4/8.
		14/7/17	VRLA sent CarbonNet an email requesting: <ul style="list-style-type: none"> • Catch data on rock lobster and who provided it • What habitat assessment has been made (eg LIDAR) • The risk assessment for both lobster and plankton VRLA has assessed impact to plankton as significant mortality, certain.	See response on dated 4/8.
		1/8/17	CarbonNet sent VRLA an email with the habitat assessment summary and STLM results, both of which were provided to other commercial fishing industry bodies.	N/A
		2/8/17	VRLA sent CarbonNet an email confirming receipt of habitat assessment summary and STLM results. VRLA said the sound modelling did not include impact to zooplankton, and asked if CarbonNet would be doing further modelling. VRLA also requested the draft risk assessments for both rock lobster (which VRLA has assessed as significant, permanent damage) and plankton.	See response dated 4/8.
		4/8/17	CarbonNet sent VRLA an email with the following excerpts from the draft EP that are relevant to their concerns: <ol style="list-style-type: none"> 1. Summary of Impacts on Marine Fauna 2. Impacts on Invertebrates 3. Impacts on Plankton 4. Summary of Risks to Commercial Fisheries 5. Risks to Rock Lobsters CarbonNet also addressed the issues and concerns raised by VRLA	CarbonNet provided the following responses to issues and concerns raised: <ol style="list-style-type: none"> 1. Refer extract from draft EP impact and risk chapter, specifically impacts to rock lobster and risks to rock lobster fishery 2. Refer extract from draft EP impact and risk chapter, specifically impacts to plankton and risks to



	<p>on 3/7, 14/7 and 2/8, as follows:</p> <ol style="list-style-type: none">1. Risks to rock lobsters from the MSS2. Concerns about impacts on zooplankton from the MSS3. Application of the ISO 31000:2009 risk management framework and risk appetite4. Fishery data supplied to CarbonNet by VFA5. Information on habitat assessment6. Risk assessment on the impacts to zooplankton and early life stages of rock lobster7. Scallop beds found in survey area8. Sound modelling does not include impacts to zooplankton9. CSIRO zooplankton modelling cannot be transferred to the southern ocean with any relevance10. Consideration of krill, tropical vs cool water plankton species, need for further modelling11. Request for the risk assessment framework, risk appetite, not just selective elements like the risk matrix	<p>fisheries</p> <ol style="list-style-type: none">3. CarbonNet responded on 23/6/17 detailing DEDJTR's risk management framework and preparation of the EP consistent with regulatory requirements. Extracts from the draft risk assessment have been provided.4. CarbonNet has received catch data consistent with VFA policies including confidentiality, therefore CarbonNet is not in a position to provide this information to VRLA. CarbonNet also engaged Fishwell Consulting via SETFIA to provide an analysis of all available fishery catch data relevant to the MSS area.5. CarbonNet has utilised all available information including the most recent Vic Gov LiDar. CarbonNet has engaged qualified marine biologists to undertake a comprehensive habitat assessment, the outcomes of which have been provided to VRLA.6. Refer extract from draft EP impact and risk chapter, specifically impacts to plankton and risks to fisheries.7. CarbonNet has not been provided any information indicating the presence of scallops inside our proposed survey area. We are working with SIV and VFA to verify some new information, the coordinates for which is outside our survey area. The draft risk
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		<p>assessment for impacts and risks to scallops have been provided to the relevant stakeholders.</p> <p>8. Yes it does, refer to extracts from draft EP impact and risk assessment provided</p> <p>9. CarbonNet and its environmental scientists have prepared a draft EP impact and risk assessment based on all available science, refer extracts from draft EP impact and risk assessment provided</p> <p>10. CarbonNet committed to investigating this matter and will provide information in due course.</p> <p>11. CarbonNet responded on 23/6/17 detailing DEDJTR's risk management framework and preparation of the EP consistent with regulatory requirements. Extracts from the draft risk assessment have been provided, including demonstration of ALARP</p>
4/8/17	<p>VRLA emailed CarbonNet to ask when is the deadline for stakeholder input to EP.</p> <p>Also requested a map showing the acquisition area, 'activation zone' (where seismic guns still running eg line turns) and 'affected area' where sound exposure reaches.</p>	See response dated 11/8.
7/8/17	<p>CarbonNet emailed VRLA advising that the operational area and duration of survey have now been refined, and that the EP will be submitted in mid-August.</p> <p>The email explained that the operational area is now larger due to vessel turns, and provided map with amended operational area, and acquisition area (which is unchanged).</p>	

	The survey duration is likely to be 13-16 days but could be up to 27 days depending on final vessel selection.	
10/8/17	<p>VRLA sent CarbonNet an email requested a map that defines the 'outermost sound affected area' of the MSS with the VFA fishing grids.</p> <p>VRLA also requested the deadline for input to EP again.</p>	<p>CarbonNet explained via email on 11/8 that as per the STLM results sent on 1/8 and the draft risk and impact assessment information for lobsters, it has conservatively used the 202 peak-peak pressure level threshold modelling in Payne et al (2007) and found that this level is reached at between 540 and 1220 metres from the sound source, depending on the location specific characteristics (depth, seabed). It is not straightforward to map this information as the distances vary depending on where the sound source is within the survey area.</p> <p>CarbonNet sent VRLA a map showing the expanded operational area with VFA fishing grid cells overlaid. CarbonNet said it has consulted VFA and no additional rock lobster fishers are impacted by this area.</p> <p>CarbonNet advised that it will submit the EP in the week commencing 14/8, but is committed to ongoing discussions. The draft extracts were provided as information and VRLA is welcome to make comment at any time.</p>
22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for	N/A

			stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	
		24/8/17	VRLA emailed CarbonNet to request follow up information on krill and cool water plankton species from the EP.	CarbonNet responded that it is chasing up the authors of the CSIRO paper regarding the impacts of MSS on plankton, and would provide a response when this information is available.
VRFish	Represent recreational fishermen who may have activities near proposed acquisition area	21/3/17	CarbonNet contacted VRFish via post and email with a letter that invited feedback and provided a fact sheet.	N/A
		19/4/17	CarbonNet called and left voicemail requesting a call back, and sent a follow up email.	N/A
		16/5/17	CarbonNet called and spoke to a VRFish representative, who confirmed the letter had been received and they had some questions and areas of interest to discuss, including: <ul style="list-style-type: none"> Proximity of the survey to the shore, especially during summer (key recreational fishing time). CarbonNet explained that the survey's closest point to the shore is 1 km. How the survey will be communicated to recreational fishers. Exclusion zones that may apply. Impacts to fish, and in particular sessile marine invertebrates. STLM. 	CarbonNet suggested a face-to-face meeting would be the best way to progress the discussion, and scheduled a meeting for the end of May. These issues were then discussed at meeting on 30/5 (see following row).
		30/5/17	CarbonNet met with VRFish in Melbourne, provided an overview of the CarbonNet project and discussed potential impacts to recreational fishers from the MSS. CarbonNet stated that all boats will need to avoid an area around the survey vessel for safety reasons, and explained that it will be requesting that the AHO issue a Notice to Mariners prior to the survey and that it will consult the local community to ensure people are aware the survey is happening. VRFish stated that it can act as a conduit to local fishing associations and groups, and has an e-newsletter (next edition slated for November 2017) that could be used as a channel to reach recreational fishers. VRFish also recommended speaking to the local	Information about the presence of boats in the proposed acquisition area and busy times along Gippsland Coast have been included in Section 5.6.4 of the EP. Noted preference to start near the shore and work outwards. CarbonNet will contact the local bait shop to disseminate information when operational dates are known.

	<p>bait shop to help get the message out closer to the time.</p> <p>VRFish will contact some of the local fishing groups to see if there are any specific issues to discuss further. (No information has been forthcoming to date.)</p> <p>VRFish provided some information on the proposed acquisition area:</p> <ul style="list-style-type: none"> • Small boats are likely to be present close to shore near the known reef area, while larger game fishing boats are likely to be farther out and will launch from nearby ports/boat ramps. • Busy times along the Gippsland Coast are between Christmas and the Australia Day weekend, but if the weather is good boats could be out anytime. <p>For ease of logistics, VRFish's preference is for the survey to work from the near shore – outwards.</p> <p>CarbonNet and VRFish discussed the potential impacts to marine invertebrates.</p> <p>CarbonNet committed to send a summary of environmental assessment and STLM results (when available). CarbonNet will continue to liaise with VRFish closer to the time from an operational and safety perspective.</p>	<p>CarbonNet will continue to liaise with VRFish to ensure communications are sent to recreational fishers.</p> <p>CarbonNet sent an email to VRFish on 31/5/17 with the summary of environmental habitat assessment.</p> <p>CarbonNet sent an email to VRFish on 27/6/17 with the summary of the STLM results, and requested VRFish get in touch if they would like to discuss. The summary included an offer to make CarbonNet's acoustic consultant available to discuss the results.</p>
27/6/17	CarbonNet sent VRFish summary of STLM results and requested they get in touch with any questions.	N/A
7/8/17	<p>CarbonNet emailed VRFish advising that operational area and duration of survey have now been refined, and advising we will submit EP in mid-August.</p> <p>The email explained that the survey area is now larger due to vessel turns, and provided map with amended operational area, and</p>	N/A

			<p>acquisition area (which is unchanged).</p> <p>The survey duration is likely to be 13-16 days but could be up to 27 days depending on final vessel selection.</p>	
		22/8/17	<p>CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.</p>	N/A
Victorian Bays and Inlets Fisheries Association	Represent fishermen who may have activities near proposed acquisition area	21/3/17	<p>CarbonNet contacted Victorian Bays and Inlets Fisheries Association via post and email with a letter that invited feedback and provided a fact sheet.</p> <p>No response has been received to date.</p>	Further attempts to engage this stakeholder are not required as the MSS is proposed for Bass Strait and won't impact on any bays or inlets.
Individual fishing licence holders	Fishers who have catch and effort history within state waters in CarbonNet's proposed operational area	21/3/17	<p>CarbonNet sent a letter (via VFA) to nine fishing licence holders who were identified by VFA as having catch and effort history in the MSS area. Due to privacy reasons, CarbonNet is not privy to the identity or contact information for the individuals.</p> <p>The letter included a fact sheet and CarbonNet contact details for individuals to get in touch.</p>	N/A
		4/4/17	<p>CarbonNet received an email from VFA, who confirmed they contacted all the individual fishers except for one and confirmed that the letters were received.</p> <p>VFA will email the letter and fact sheet to the one fisher who could not be reached.</p> <p>All fishers have been provided with CarbonNet contact information.</p>	N/A
		12/4/17	<p>CarbonNet spoke to VFA to ask if any further feedback or follow up was received from any of the individual licence holders.</p> <p>VFA said all fishers confirmed they had received the letter (except one, who was sent the letter via email). One fisher commented he was not happy and would contact LEFCOL to discuss. The others did not express any specific concerns.</p>	CarbonNet will continue to engage with LEFCOL and other fishing industry groups who represent individual fishers.
		28/7/17	<p>A scallop fisherman (who does not hold a licence but fishes under</p>	N/A

			another licence) attended a meeting with VSFA in Traralgon. See notes under VSFA.	
		8/7/17	SIV arranged two meetings in Lakes Entrance, once with the sole operator in the Victorian Ocean Purse Seine fishery and the second with five scallop fishers. See notes under SIV.	N/A
		28/8/17	After discovering that CarbonNet's expanded operational area could impact on an additional fisherman (see notes under VFA), a letter was sent to that licence holder (via the VFA) including a fact sheet and CarbonNet's contact details. No response has been received to date.	N/A
Petroleum tenement holders	Overlapping or adjacent tenement holders to the MSS area	2016 to 2017	CarbonNet commenced consultation with a number of petroleum tenement holders in 2016 regarding its proposed 3D marine seismic survey. Over 2016 and 2017 a number of meetings were held to discuss the survey.	N/A
		24/2/17	CarbonNet met with Esso Resources Australia to discuss the MSS and stakeholder engagement at a high level. Esso indicated they would be happy to provide advice and assist.	N/A
		21/3/17	CarbonNet emailed the following tenement holders to confirm that consultation with stakeholders for the MSS has commenced and to provide a copy of the MSS fact sheet: <ul style="list-style-type: none"> • Esso Resources Australia • Cape Energy • Carnarvon Hibiscus and 3D Oil • Lakes Oil (Petrotech) 	N/A
		21/3/17	Esso Resources Australia emailed CarbonNet to acknowledge the notification.	N/A
		31/3/17	CarbonNet emailed the following tenement holders to advise that field observations would be taking place in the week commencing 3/4/17: <ul style="list-style-type: none"> • Esso Resources Australia 	N/A

	<ul style="list-style-type: none"> • Cape Energy • Carnarvon Hibiscus and 3D Oil • Lakes Oil (Petrotech) 	
3/4/17	Carnarvon Hibiscus emailed CarbonNet to acknowledge the notification.	N/A
3/4/17	Esso Resources Australia emailed CarbonNet to acknowledge the notification and requested the emergency contact details for the vessel conducting the observations.	N/A
3/4/17	CarbonNet emailed Esso Resources Australia the contact details for the vessel.	N/A
7/4/17	CarbonNet met with Esso Resources Australia to discuss simultaneous operations (SIMOPS) planning for oil and gas activities and the marine seismic survey in the Gippsland Basin.	N/A
5/5/17	CarbonNet held its second SIMOPS meeting with Esso Resources Australia to discuss planning for oil and gas activities and the marine seismic survey in the Gippsland Basin.	N/A
5/5/17	CarbonNet met with Esso Resources Australia to discuss its Stage 3 appraisal activities, including providing an update on its proposed 3D marine seismic survey.	N/A
8/5/17	CarbonNet met with Cape Energy to discuss its Stage 3 appraisal activities, including providing an update on its proposed 3D marine seismic survey.	N/A
9/5/17	CarbonNet emailed Cape Energy with further information on its proposed 3D marine seismic survey following its meeting.	N/A
18/5/17	CarbonNet met with Carnarvon Hibiscus and 3D Oil to discuss its Stage 3 appraisal activities, including providing an update on its proposed 3D marine seismic survey.	N/A
25/5/17	CarbonNet met with Lakes Oil to discuss its Stage 3 appraisal activities, including providing an update on its proposed 3D marine seismic survey.	N/A
7/8/2017	CarbonNet emailed the following tenement holders advising that	N/A

	<p>area and duration of survey have now been refined, and advising the EP will be submitted in mid-August:</p> <ul style="list-style-type: none"> • Esso Resources Australia • Cape Energy • Carnarvon Hibiscus and 3D Oil • Lakes Oil (Petrotech) <p>The email explained that the survey area is now larger due to vessel turns, and provided map with amended operational area, and acquisition area (which is unchanged).</p> <p>The survey duration is likely to be 13-16 days but could be up to 27 days depending on final vessel selection.</p>	
22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
31/08/17	CarbonNet held its third SIMOPS meeting with Esso Resources Australia to discuss planning for oil and gas activities and the MSS.	N/A
19/9/17	CarbonNet emailed a request on 7/8/17 to Lakes Oil (Petro Tech) for permission to apply for a GHG special authority to allow seismic boat turns for the survey within the Petro Tech permit VIC/P43(V) and outside of the GGAP006386(V) assessment permit managed by CarbonNet.	
22/9/17	CarbonNet received a letter dated 22/9/17 via email from Lakes Oil (Petro Tech) consenting to a GHG special authority being granted to allow seismic vessel turns for the MSS within the Petro Tech permit VIC/P43(V) and outside of the GGAP006386(V) assessment permit.	N/A
26/9/17	CarbonNet met with Cape Energy to update them on CarbonNet Stage 3 activities and to get an update on their current areas of focus.	N/A
13/10/17	CarbonNet emailed Lakes Oil (Petro Tech) advising that Earth Resources Regulation has confirmed that no additional approvals are required in Victorian waters for seismic vessel movements outside of the GGAP006386(V) GHG permit area as long as data	N/A

			acquisition and sampling occurs within the permit area.	
Telstra	Manager of telecommunications cables	21/3/17	CarbonNet sent email notification to Telstra's environment contact email address, including fact sheet and contact details.	N/A
		6/4/17	CarbonNet attempted to call the environment team but couldn't get through via the automated phone system. The original email was reissued and asked if Telstra has any questions.	N/A
		18/5/17	CarbonNet sent another email to ask whether original email was received.	Section 5.6.9 of the EP describes the location of submarine telecommunications cables, which are located well west of the proposed acquisition area. As such, no follow up with this stakeholder is required.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
Basslink	Manager of subsea electricity interconnector	21/3/17	CarbonNet emailed Basslink with fact sheet and invitation to comment.	N/A
		22/3/17	CarbonNet received a phone call from Basslink to say they have no issue and nothing to add regarding CarbonNet's proposed MSS as it is not in the vicinity of the Basslink cable.	N/A
OSD Asset Services	Pipeline asset manager	21/3/17	CarbonNet sent email notification to OSD Asset Services, including fact sheet and contact details.	N/A
		7/4/17	CarbonNet called to follow up. The original email was re-issued, which was forwarded to the relevant person.	N/A
		18/5/17	CarbonNet called again to follow up, left a message requesting a call back.	Section 5.6.6 of the EP describes the location of submarine petroleum pipelines. No OSD assets are located in or near the proposed acquisition area. As such, no follow up of this stakeholder is required.

		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
Ion Geophysical	Has an approved EP to conduct a MSS in Bass Strait	11/7/17	CarbonNet spoke to Ion Geophysical regarding the Otway Span MSS, which has an approved EP to operate in Bass Strait and was scheduled to commence in Q4 2015, according to the NOPSEMA website. Ion Geophysical advised that the survey is not likely to proceed this summer. They will keep us advised if funding becomes available and the survey proceeds.	The potential for SIMOPS is discussed in Section 2.6.7, Section 7.14 and Section 8.5.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
		22/8/17	Ion Geophysical responded to CarbonNet to advise the OtwaySPAN survey will not proceed.	This information was included in Section 2.6.
Gippsland Emergency Management Planning Committee	First responders and emergency coordination agencies	28/3/17	CarbonNet received an email from the Earth Resources Regulation office in Gippsland, which helps coordinate the Gippsland Regional Emergency Management Planning Committee. A briefing from CarbonNet was requested to this committee in June.	CarbonNet met the relevant person in Gippsland and arranged the briefing for 1 June.
		1/6/17	CarbonNet provided a briefing to the Gippsland Emergency Management Planning Committee on the project and MSS.	N/A
		1/6/17	CarbonNet received an email from the Committee confirming the information provided in the briefing was sufficient, and they will contact us if any questions or issues arise.	CarbonNet will not provide further information unless requested.
		7/8/17	CarbonNet sent the Gippsland Emergency Management Planning Committee an email advising that the operational area and duration of survey have now been refined, and that the EP will be submitted in mid-August.	N/A
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for	N/A

			stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	
Any other person or organisation that the Titleholder considers relevant				
Gippsland Ports	Gippsland Ports is the local Authority responsible for the application of the Marine Act and other related legislation for the five local ports and two waterways. It is the Control Agency for level 1 hydrocarbon spills in State waters along the Gippsland Coast.	21/3/17	CarbonNet contacted Gippsland Ports via post and email with a letter that invited feedback and provided a fact sheet .	N/A
		6/4/17	CarbonNet called to follow up letter and left contact details for Acting CEO to call back to discuss.	N/A
		19/4/17	CarbonNet called and spoke to the Acting CEO. The information was received, but they are unsure how it impacts on Gippsland Ports. They said that they will consult internally and get back to CarbonNet. CarbonNet offered a meeting in Lakes Entrance on 26/27 April, but those dates don't work. Gippsland Ports may set up a teleconference if required.	N/A
		3/5/17	CarbonNet received email from Gippsland Ports that stated as the survey is being conducted outside of port waters under Gippsland Ports management, there are no foreseeable risks to waterway management and general vessel operation within those waterways. Gippsland Ports provided contact details for vessels to gain access to ports.	CarbonNet responded to Gippsland Ports thanking them for their reply. CarbonNet noted the contact information for access to the ports.
		21/6/17	CarbonNet had a telephone discussion with the Marine Officer at Gippsland Ports to discuss oil spill response planning, which was followed up with an email to Gippsland Ports providing additional information about the oil spill modelling results and proposed response strategies.	N/A
		23/6/17	The Marine Officer of Gippsland Ports responded to CarbonNet via email outlining the resources and capacities it has to respond to hydrocarbon spills in its jurisdiction.	CarbonNet progressed the OPEP based on the information provided.
		7/8/17	CarbonNet sent Gippsland Ports an email advising that the operational area and duration of survey have now been refined, and that the EP will be submitted in mid-August.	N/A
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for	N/A

			stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	
Lakes Entrance Coast Guard	Could be called upon in an emergency	21/3/17	CarbonNet contacted Lakes Entrance Coast Guard via post with a letter that invited feedback and provided a fact sheet .	N/A
		6/4/17	CarbonNet attempted to call to follow up but no answer. Sent an email via the Coast Guard website to check whether letter was received.	N/A
		11/5/17	CarbonNet spoke to Lakes Entrance Coast Guard to confirm information was received and how to communicate with them going forward. They have received information and have no questions The Lakes Entrance Coast Guard area goes down to Seaspray and overlaps the Port Albert Coast Guard. The Coast Guard gets tasked through Gippsland Water Police, so moving forward they are the primary contact. However keep Lakes Entrance Coast Guard on email list for notifications.	CarbonNet thanked Lakes Entrance Coast Guard for discussion and will communicate with Gippsland Water Police in the first instance and keep Coast Guard on email notification list for updates.
		7/8/17	CarbonNet emailed Lakes Entrance Coast Guard advising that the operational area and duration of survey have now been refined, and advising CarbonNet will submit EP in mid-August. The email explained that the survey area is now larger due to vessel turns, and provided map with amended operational area, and acquisition area (which is unchanged). The survey duration is likely to be 13-16 days but could be up to 27 days depending on final vessel selection.	No response received.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A

Golden Paradise Beach Ratepayers Association (GPBRA)	Representative group of local residents and holiday makers in Golden Beach community	21/3/17	CarbonNet contacted GPBRA via post with a letter that invited feedback and provided a fact sheet.	N/A
		18/5/17	CarbonNet spoke to local real estate agent who is a committee member for the GPBRA. The contact information we have for the GPBRA is out of date so was not received. CarbonNet offered a meeting in Golden Beach on 23/5. They requested information be emailed to them and will call back with the email address as they didn't have it on hand.	N/A
		22/5/17	CarbonNet spoke to real estate agent again to request the email address and schedule a meeting in Golden Beach on 23/5. GPBRA provided the email address and scheduled meeting at lunchtime when the GPBRA is holding a meeting at the Golden Beach Hall.	CarbonNet sent fact sheet via email and made arrangements for meeting on 23/5.
		23/5/17	CarbonNet met with representatives of the GPBRA and provided a CarbonNet project overview and discussed the MSS. The GPBRA advised the following: <ul style="list-style-type: none"> • There are two fishing competitions in Golden Beach on Australia Day weekend and Easter weekend. • Golden Beach is very busy with tourists from Boxing Day until Australia Day weekend. • The busy period extends until Easter. • Many holidaymakers come from the Latrobe Valley • There are no caravan parks in Golden Beach or Paradise Beach – just the foreshore campground. • Golden Beach has no active surf club – they are struggling to become affiliated with Lifesaving Victoria. • They recommended holding a community meeting with other interested groups/individuals, including the VMRR (reserve incorporating the golf club and bowls), art gallery, business owners, community. 	CarbonNet committed not to run the MSS over the Christmas – Australia Day long weekend to avoid peak tourist times. CarbonNet also committed to avoid the Easter long weekend. See Section 2.2 and Section 7.9.7 of the EP. CarbonNet will speak to Parks Victoria, which runs the foreshore campground. CarbonNet will hold an 'open day' where community members can visit and ask questions.
		29/5/17	CarbonNet spoke to GPBRA and advised we are working towards holding an open day for the community with research partners in July. Will be in touch when we have some dates.	CarbonNet subsequently set up open day for 12 July, which is during the school holiday period.

4/7/17	CarbonNet emailed GPBRA with a flyer inviting local residents to the open day on 12 July. GPBRA agreed to distribute the flyer to community members via the local post office, who will do a letterbox drop to all homes. The GPBRA will also post the flyer in the windows of the community hall and local businesses.	N/A
12/7/17	<p>CarbonNet held a community open day at the Golden Beach Community Hall, and addressed a meeting of the GPBRA in the evening.</p> <p>Community members were interested in CarbonNet and the MSS, and asked lots of questions about the science of CCS and the impact of the MSS on the township.</p> <p>Residents also informed CarbonNet:</p> <ul style="list-style-type: none"> • The main concern with the MSS are the town's two fishing competitions; Australia Day weekend and Easter 2018. • Entrants in the fishing competition primarily fish from the beach. • People are interested in impacts on swimmers, but it is a very treacherous beach and not many people swim. <p>The GPBRA said they were very pleased with how the day had gone and thanked CarbonNet for coming along.</p> <p>CarbonNet advised that it will be back to hold further session/s closer to the time of the MSS.</p>	<p>CarbonNet advised the GPBRA and attendees that we will not run the MSS over the Christmas – Australia Day long weekend to avoid peak tourist times. CarbonNet also committed to avoid the Easter long weekend.</p> <p>CarbonNet advised attendees that the MSS vessel will have an exclusion zone around it, and vessels, swimmers and divers will need to avoid an area near the vessel.</p>
7/8/17	<p>CarbonNet emailed GPBRA advising that area and duration of survey have now been refined, and advising we will submit EP in mid-August.</p> <p>The email explained that the survey operational area is now larger due to vessel turns, and provided map with amended operational area, and acquisition area (which is unchanged).</p> <p>The survey duration is likely to be 13-16 days but could be up to 27 days depending on final vessel selection.</p>	N/A
15/8/17	CarbonNet spoke to the GPBRA contact (same as the Surf Club) about planning for the MSS, including impacts to swimmers (see notes under 'Golden Beach Surf Club').	CarbonNet reiterated commitment to avoid the Christmas – Australia Day weekend, and the Easter long weekend. See Section 2.2 and Section 7.9.7 of the

	The GPBRA run the two annual fishing competitions, and the stakeholder expressed concern about the Easter fishing competition and requested we avoid the week prior. CarbonNet explained that we need a large window of time for the MSS to take place and that may not be possible, but that we will consider their feedback when planning for the MSS.	EP. CarbonNet will be back in Golden Beach to meet with community members in September/October.
22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
31/8/17	GPBRA sent CarbonNet a letter outlining some concerns about the impacts of the MSS on their Easter long weekend fishing competition, as well as the impact on tourism of closing the beach to swimmers and divers.	In parallel with the GPBRA sending this letter in the post, CarbonNet sent an email on 4/9/17 outlining the commitments made regarding timing for the MSS in response to concerns regarding the fishing competition and summer tourism, namely: <ul style="list-style-type: none"> • Not undertaking the survey between the Christmas holiday period (24th December 2017 through to the Australia Day long weekend, ending 28th January 2018). • Endeavouring to avoid survey acquisition during the Easter long weekend (30th March to 2nd April 2018).
5/9/17	CarbonNet spoke to GPBRA on the phone following CarbonNet's email of 4/9/17. GPBRA explained that they have written a letter to CarbonNet (dated 31/8/17) that outlines their concerns about the MSS, in particular the requirement for swimmers to stay out of the water and the impact on the Easter fishing competition. GPBRA's view is that any time in March is unacceptable for the MSS to occur, as they believe following seismic activity fish are slow to return to the area and they wish for the Easter fishing competition at the end of March to be a success. The fishing competition is	CarbonNet discussed the commitments made to avoid Christmas to Australia Day and the Easter long weekend. CarbonNet explained that it can't confirm exactly when the MSS will occur yet as several aspects are not within its control, including the weather, sea state and the availability of the services of a vessel.

	celebrating its 60 th anniversary in 2018 and businesses depend on the money they make at that time of year to see them through the winter months.	CarbonNet discussed its willingness to work with the community on positive initiatives to ensure the fishing competition is a success. CarbonNet will schedule a follow up meeting with the fishing competition organiser, as well as an operational planning meeting later in the year.
3/10/17	CarbonNet responded to GPBRA's letter via post and email. The letter reconfirmed the commitments made regarding timing (to not undertake the survey between Christmas and Australia Day, and to avoid the Easter long weekend) and confirmed a meeting with the fishing competition organiser in Golden Beach.	N/A
4/10/17	CarbonNet spoke to GPBRA on the phone to confirm the letter regarding timing commitments and future meetings was received via email, and to confirm a meeting in Golden Beach on 11/10/17 with the organiser of the fishing competition.	GPBRA thanked CarbonNet for the letter.
11/10/17	CarbonNet met with GPBRA and the fishing competition organisers in Golden Beach to discuss their concerns and how CarbonNet was seeking to address them. Key areas discussed included: <ul style="list-style-type: none"> • Potential impacts on fish, in particular the time it may take for fish to return to the area after the MSS; • Timing of the survey; and • Notifications to swimmers and impacts on holiday makers. CarbonNet explained the rationale for the timing of the survey to meet the needs of many different stakeholders and undertook to provide further information about the assessment of impacts on fish and work with the fishing competition organisers to support the local community. Carbonnet also advised that once a vessel is contracted, it will also consult key stakeholder groups on operational planning aspects to minimise impacts or disruption to holiday makers. CarbonNet also confirmed that its preference is for the MSS to be undertaken in February, subject to vessel availability and sea state conditions.	CarbonNet is seeking to address as many stakeholder preferences as possible regarding the timing of the MSS, and is focusing on February as the optimum outcome. CarbonNet made an offer to contribute to the fishing competition promotional aspects (advertising).

		13/10/17	CarbonNet sent emails/letter to GPBRA and fishing competition organisers following the meeting held on 11/10/17, providing a copy of extracts from the EP that assess the potential impacts on fish and plankton. CarbonNet advised that it is keen to work collaboratively with GPBRA, fishing competition organisers and the local community to minimise potential disruption and impact on the fishing competitions. CarbonNet also formally offered to contribute towards some local advertising in newspapers and signage to promote the upcoming fishing competitions.	N/A
Golden Beach Surf Club	Interest in beach activities at Golden Beach	21/3/17	CarbonNet sent Golden Beach Surf Club a letter via email that invited feedback and provided a fact sheet. Email bounced.	N/A
		18/5/17	CarbonNet tried to email but email bounced again. Tried a contact number listed but also a wrong number.	N/A
		23/5/17	CarbonNet met with GPBRA and learnt that one of the members is also the Surf Club contact. Provided information on the MSS. Surf Club advised that they are currently not active or affiliated with Lifesaving Victoria. They need funding to become affiliated. The closest active Surf Club is at Seaspray.	N/A
		12/7/17	Golden Beach Surf Club attended the community open day and GPBRA meeting in the evening.	No specific issues raised.
		15/8/17	CarbonNet spoke to Golden Beach Surf Club regarding impacts on swimmers during MSS and beach patrols. We explained we are preparing our EP for submission this week, which includes details about having beach patrols to advise swimmers to stay out of the water when the survey vessel is close to shore during survey acquisition. CarbonNet advised we are planning to have beach patrols and enquired as to whether the Surf Club may be able to assist. The Golden Beach Surf Club advised that it won't be up and running before Christmas as they have to do a coastal risk assessment before they can be accredited with Life Saving Victoria. They may be operating after Christmas, and life saving operations finish after	CarbonNet reiterated commitment to avoid the Christmas – Australia Day weekend, and the Easter long weekend. CarbonNet will meet with the Surf Club during the operational planning phase to discuss beach patrols and logistics. CarbonNet will continue to meet with Parks Victoria and GLaWAC, who jointly manage the campground areas, to

			<p>Easter. Irrespective of the Life Saving Victoria accreditation, the Surf Club could have people available to assist with beach patrols as they have public liability insurance. They cannot go in the water or conduct rescue operations.</p> <p>They provided some additional information on beach activity over summer:</p> <ul style="list-style-type: none"> • There could be 20-100 people at the main beach in Golden Beach on a busy day in summer, but foreshore campers are spread out along the coastline. • There are two shipwrecks on beaches near Golden Beach, but neither are submerged and no diving activities take place there or along the coast. 	<p>notify campers.</p> <p>Tourism and recreational activities are addressed in Section 5.6.4 and Section 5.6.5.</p>
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
Committee for Gippsland	Representative group of Gippsland businesses	21/3/17	CarbonNet contacted Committee for Gippsland via post with a letter that invited feedback and provided a fact sheet.	CarbonNet is in ongoing discussions with Committee for Gippsland regarding the project and MSS, but it is not a relevant stakeholder to this activity.
Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC)	Manager of the Gippsland Lakes Coastal Park (jointly managed with Parks Victoria)	21/3/17	CarbonNet contacted GLaWAC via post with a letter that invited feedback and provided a fact sheet.	N/A
		11/5/17	CarbonNet phoned and spoke to reception – not sure if letter was received. A new CEO has been appointed, CarbonNet forwarded the original email to the new CEO.	N/A
		16/5/17	<p>CarbonNet spoke to GLaWAC who confirmed the letter was received. GLaWAC are interested in whether there are any native title or cultural heritage impacts, and what partnership opportunities exist for longer-term benefits for the community.</p> <p>GLaWAC confirmed that native title does not apply if activity is occurring outside of 200 metres from the high water mark, but would like to discuss the project in more detail.</p>	<p>CarbonNet scheduled meeting to brief GLaWAC on the MSS and project.</p> <p>As no Native Title applies, no further actions are required. CarbonNet will continue to inform GLaWAC of activities and look for opportunities to collaborate.</p>

	23/5/17	<p>CarbonNet met with GLaWAC in Lakes Entrance. GLaWAC confirmed previous discussion that as the MSS is more than 200 metres offshore, it does not trigger Native Title processes.</p> <p>GLaWAC provided the following information:</p> <ul style="list-style-type: none"> • Gippsland Lakes Coastal and National Parks are jointly managed with Parks Victoria and if possible it's best to meet with both organisations at the same time. • GLaWAC can assist with communications: via website, quarterly newsletter and providing info to Gunaikurnai rangers. • GLaWAC recommended using Latrobe Valley media to target holidaymakers who visit Golden Beach • GLaWAC recommended contacting local MPs 	<p>CarbonNet will ensure Parks Victoria and GLaWAC are consulted jointly.</p> <p>CarbonNet will contact GLaWAC closer to the operational period to arrange notices on website, newsletters and via park rangers.</p> <p>CarbonNet will consider using Latrobe Valley media and contacting local MPs.</p>
	7/8/17	<p>CarbonNet sent GLaWAC an email advising that the operational area and duration of survey have now been refined, and that the EP will be submitted in mid-August.</p>	
	9/8/17	<p>CarbonNet spoke to GLaWAC to provide briefing on MSS following meeting with Parks Victoria that they were unable to attend. GLaWAC provided the following operational and timing information:</p> <ul style="list-style-type: none"> • Gunaikurnai rangers are generally at Golden Beach about 1 day per fortnight (estimate) but can factor in more staff if needed. • Gunaikurnai staff availability can be difficult over summer as there are lots of tourists around and if there are fires rangers could get called away. • As early as possible would be best timing for the MSS (November) due to ranger availability, but they have no issue with other timing aside from their rangers being available. • Asked if there were many opportunities for Gunaikurnai people to be involved in project - either big or small scale? 	<p>CarbonNet will stay in touch and continue to discuss project opportunities.</p> <p>CarbonNet will note preference for early timing, noting other stakeholders have requested for the MSS to avoid November.</p> <p>CarbonNet will schedule an operational planning meeting with Parks Victoria later in the year and invite GLaWAC to attend.</p>
	22/8/17	<p>CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.</p>	N/A
	23/8/17	<p>CarbonNet emailed a different staff member at GLaWAC who is</p>	N/A

			more operations-focused with some background information on CarbonNet and the MSS. CarbonNet will include GLaWAC in an operational planning meeting ahead of the MSS.	
Gippsland Water	Water infrastructure manager and employer of Golden Beach residents	21/3/17	CarbonNet contacted Gippsland Water via email with letter that invited feedback and provided a fact sheet.	N/A
		28/3/17	CarbonNet met with Gippsland Water to discuss the MSS stakeholder consultation. Gippsland Water advised they employ some staff members who live at Golden Beach at the Soil and Organic Recycling Facility (SORF), which is located nearby at Dutson Downs and staff could be affected. Gippsland Water would be happy to facilitate a presentation to staff there. Gippsland Water advised they will need to be consulted where CarbonNet needs to access physical infrastructure/assets, but otherwise they don't have any concerns..	CarbonNet will arrange a briefing to staff at the SORF.
		26/4/17	CarbonNet provided a briefing to staff at Gippsland Water's SORF near Golden Beach. Some staff are Golden Beach residents. Staff were interested in the project and MSS but did not raise any specific concerns.	CarbonNet offered to provide future briefings if staff are interested. As no concerns have been raised, no further consultation required.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
Wellington Shire Council	Local council in MSS area	7/3/17	CarbonNet briefed Wellington Shire Council Councillors and Executive Team on CarbonNet. Wellington Shire Council recommended a 'no surprises' approach and advised CarbonNet to get out and talk to the community.	CarbonNet ran a community open day in Golden Beach on 12/7/17 and will continue to work with community groups in the area. As demonstrated throughout this table, consultation with relevant stakeholders has been extensive.
		21/3/17	CarbonNet sent Wellington Shire Council a letter via post and email inviting feedback and providing a fact sheet.	N/A
		2/5/17	CarbonNet provided an update to Wellington Shire Council	No issues of concern were raised.

			councillors and relevant staff on the MSS.	
		7/8/17	CarbonNet emailed Wellington Shire Council advising that operational area and duration of survey have now been refined, and advising it will submit EP in mid-August.	N/A
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
		1/9/17	Wellington Shire Council contacted CarbonNet to discuss potential impacts of the MSS on the Golden Beach community. The GPBRA has contacted the council to express concerns about the impacts of the MSS on their two fishing competitions (Australia Day and Easter long weekends). Wellington Shire Council asked if the MSS could run in winter, and asked to be kept in the loop regarding impacts on the Golden Beach community.	CarbonNet explained that a firm commitment has been made to avoid Christmas to Australia Day, and will seek to avoid the Easter long weekend. CarbonNet explained that the MSS needs a calm sea state to operate, hence the summer operating window. CarbonNet will email the GPBRA to confirm the timing commitments that have been made in the EP. CarbonNet will invite Wellington Shire Council to attend a planning meeting with operational stakeholders in Golden Beach later in the year.
East Gippsland Catchment Management Authority	Manager of land and water resources in east Gippsland.	21/3/17	CarbonNet contacted East Gippsland Catchment Management Authority via email and post with a letter than invited feedback and provided a fact sheet.	N/A
		6/6/17	CarbonNet resent the original letter and fact sheet via email to follow up.	No response received.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
National	Commonwealth	21/3/17	CarbonNet sent letter to NNTT via email inviting feedback and	N/A

Native Title Tribunal (NNTT)	agency that makes determinations on whether native title exists		providing a fact sheet.	
		30/3/17	NNTT emailed CarbonNet to say that as of 28/3/17 a geospatial analysis indicates that there are no overlapping native title determination applications over the proposed survey area. However, that does not preclude any application being filed prior to survey commencing. It is not appropriate for the Tribunal to comment further on the proposed survey.	No further engagement required.
Gippsland Coastal Board	Provides advice to Victorian Government on coastal management	21/3/17	CarbonNet contacted Gippsland Coastal Board via email and post with a letter that invited feedback and provided a fact sheet.	
		25/5/17	Gippsland Coastal Board sent CarbonNet a written response acknowledging the MSS and advising no further consultation or correspondence is required.	No further engagement required.
East Gippsland Shire Council	Local council in neighbouring area to the north of MSS	21/3/17	CarbonNet contacted East Gippsland Shire Council via post and email with a letter that invited feedback and provided a fact sheet. CarbonNet received an automatic reply acknowledging receipt of the MSS email.	N/A
		29/5/17	CarbonNet sent a follow up email and offered a briefing to Councillors and staff.	No response received. MSS is outside council area so they are not a relevant stakeholder.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
South Gippsland Shire Council	Local council in neighbouring area to the south of MSS	21/3/17	CarbonNet contacted South Gippsland Shire Council via email and post with a letter that invited feedback and provided a fact sheet.	N/A
		7/4/17	CarbonNet spoke to South Gippsland Shire Council who advised they don't have any issues or feedback to the MSS.	MSS is outside council area and no issues raised, so no further engagement

				required.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
Gippsland Water Police	Branch of Victoria Police responsible for marine incidents	21/3/17	CarbonNet contacted Gippsland Water Police via post with a letter that invited feedback and provided a fact sheet	N/A
		28/3/17	Gippsland Water Police phoned CarbonNet to ask: <ul style="list-style-type: none"> Will the streamers have any visible markers between the vessel and tail buoys? Will it pose any danger to 13 foot fishing boats (tinnies)? Gippsland Water Police advised that in the Golden Beach area although there are no boat ramps, recreational fishers will often launch their boats off the beach and may not have sophisticated radio/GPS equipment to receive notifications.	CarbonNet will get back to Gippsland Water Police with answers to questions.
		29/3/17	CarbonNet phoned Gippsland Water Police and advised: <ul style="list-style-type: none"> The MSS vessel will have no visible markers along length of streamers, but will have support vessels in place, tail buoy and other safety measures including Notice to Mariners. As the equipment is submerged roughly 6 metres, a small tinny will not face a safety risk if they accidentally travel over a streamer. Gippsland Water Police advised they see no issue with the activity from a safety perspective. Would like to be kept in the loop closer to the time and Gippsland Water Police could be present if required to assist.	CarbonNet advised we will phone them again roughly 4 weeks out from the survey to discuss the operational plan.
		10/8/17	CarbonNet phoned Gippsland Water Police regarding the expanded operational area and amended duration estimate of up to 27 days. Gippsland Water Police requested we email the information so they can distribute internally for information.	CarbonNet emailed the expanded operational area map and duration information. Will follow up closer to the time with operational details.

		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
Latrobe City Council (LCC)	Local council in neighbouring area to the east of MSS	21/3/17	CarbonNet contacted Latrobe City Council via post and email with a letter that invited feedback and provided a fact sheet.	
		29/3/17	CarbonNet briefed LCC councillors and members of the executive team on CarbonNet and the MSS. LCC advised that community engagement will be very important, including making sure community members don't confuse CCS with coal seam gas (CSG). LCC advised that as the MSS is not in their council area it doesn't affect them, but are interested in the project.	CarbonNet will continue to brief LCC on the project, but they are not a relevant stakeholder for the MSS.
		7/8/17	CarbonNet emailed LCC advising that area and duration of survey have now been refined, and advising we will submit EP in mid-August.	No response received.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A
Committee for Wellington	Representative group of businesses in Wellington Shire Council area	24/3/17	CarbonNet contact Committee for Wellington via email with a letter that invited feedback and provided a fact sheet.	N/A
		3/4/17	Committee for Wellington emailed CarbonNet to say they will consider the information at a meeting on 6/4 and respond after that with any feedback.	N/A
		23/4/17	Committee for Wellington sent a letter to say they are happy with the information provided and would like to be kept informed as the project progresses.	CarbonNet thanked Committee for Wellington for their letter and advised we will keep them up to date on the project as we progress. No concerns raised regarding the MSS.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on	N/A

			18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	
Victorian National Parks Association	Interest in protection of national parks in Victoria	21/3/17	CarbonNet contacted Victorian National Parks Association via email and post with a letter that invited feedback and provided a fact sheet.	No response received. As CarbonNet's proposed MSS operational area is not likely to have an impact on any national parks and it has consulted extensively with Parks Victoria, no further consultation is required.
		22/8/17	CarbonNet emailed stakeholders to advise the EP was submitted on 18 August. CarbonNet provided links to the NOPSEMA website for stakeholders to subscribe to updates, and committed to provide a revised fact sheet once a survey vessel has been contracted.	N/A

5. Description of the Existing Environment

The 'environment that may be affected' (EMBA) by the activity is described in this chapter, together with its values and sensitivities. While each project hazard has its own unique EMBA, the largest one has been chosen for this chapter, which is that for the diesel spill hazard.

This diesel spill EMBA has been established through hydrocarbon spill modelling and is based upon the area that could be affected by the largest credible spill from the survey vessel (see Section 7.16 for spill scenario and modelling results). The EMBA (Figure 5.1) is therefore defined as:

The extent of low level hydrocarbon exposure to the sea surface (1 µm), entrained in the water column (11,760 ppb.hrs Total Petroleum Hydrocarbons (TPH)), dissolved in the water column (576 ppb.hrs), and contact to shorelines (>10-100g/m²) as a result of the loss of 306 m³ of marine diesel oil from a vessel within the proposed survey acquisition area during annualised metocean conditions.

Where appropriate, descriptions of the regional environment are provided for context. The 'environment' is defined in both sets of regulations as:

- Ecosystems and their constituent parts, including people and communities;
- Natural and physical resources;
- The qualities and characteristics of locations, places and areas;
- The heritage value of places; and
- The social, economic and cultural features of these matters.

The key sources of information utilised in developing this chapter include the:

- EPBC Act Protected Matters Search Tool (PMST) database (DoEE, 2016);
- Victorian Biodiversity Atlas, VBA (DELWP, 2017);
- South-east Marine Region Profile (DoE, 2015a);
- South-east Bioregional Plan (CoA, 2015);
- Marine Natural Areas Values Study Vol 2: Marine Protected Areas of the Flinders and Twofold Shelf Bioregions (Barton *et al.*, 2012);
- National Conservation Values Atlas (DoEE, 2017a);
- Victorian Oil Spill Response Atlas (OSRA) (DEDJTR, 2017a); and
- Pelican Marine Seismic Survey Habitat Survey (Advisian, 2017).

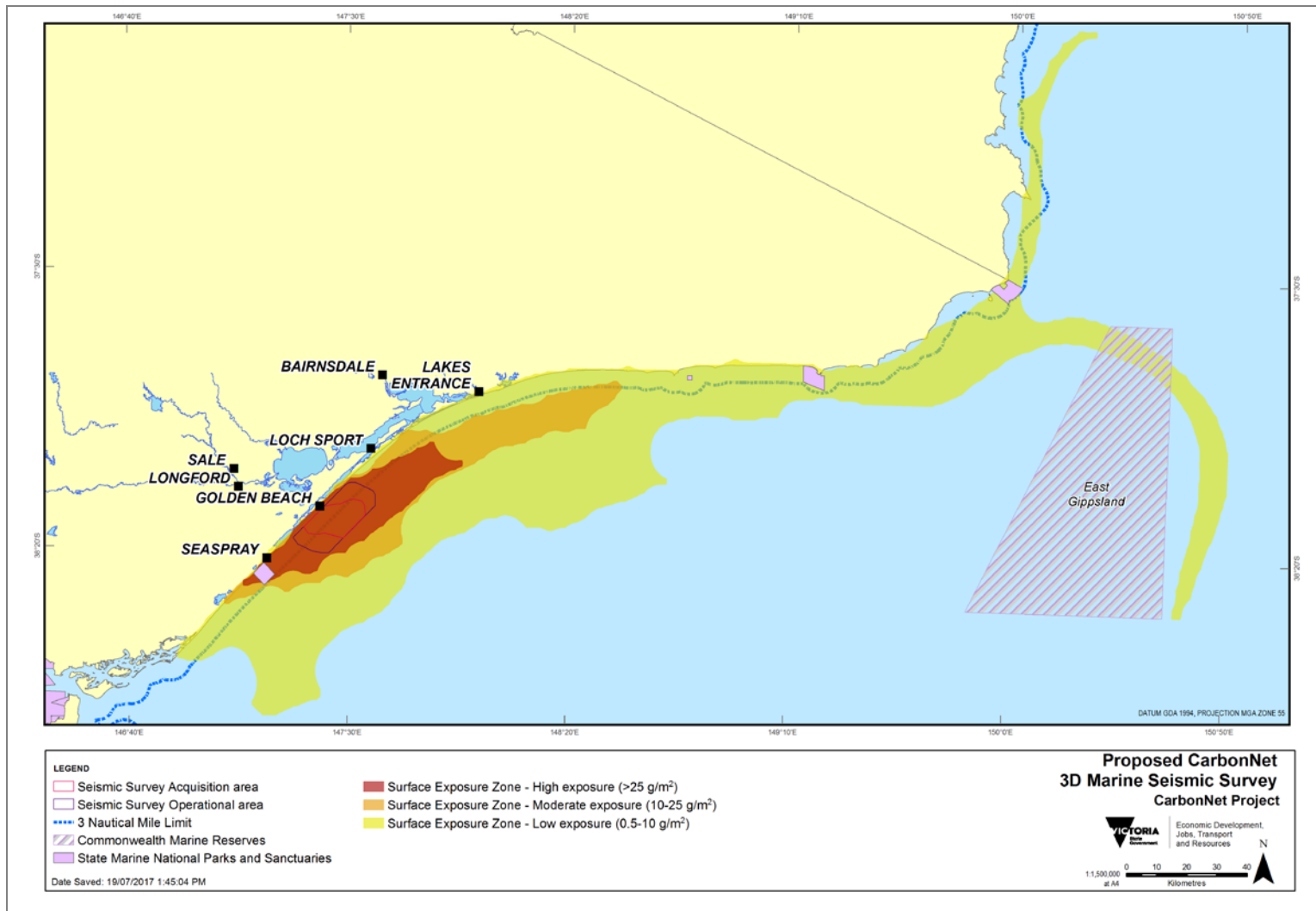


Figure 5.1 The EMBA for the proposed Pelican 3DMSS

Table 5.1 summarises the presence or absence of receptors and sensitivities within the proposed operational area (split between Commonwealth waters, Victorian State waters and the EMBA).

Table 5.1. Presence of receptors within Commonwealth and State waters of the proposed operational area and the EMBA

Receptor	Proposed operational area		EMBA
	Commonwealth waters	State waters	
Physical			
Low profile reef	Patchy	Patchy	Patchy
Sponge garden	Patchy		Likely
Conservation values			
CMRs			East Gippsland
World Heritage-listed properties			
National Heritage-listed properties			Gippsland Lakes & Corner Inlet
Threatened Ecological Communities (TECs)			Giant kelp forest
Key Ecological Features (KEFs)			Upwelling East of Eden
Nationally Important Wetlands			11 of them
Victorian marine protected areas			5 protected areas
Onshore protected areas			9 protected areas
Biological Environment			
Plankton			
Benthic species:			
- commercial scallops	Isolated individuals	Isolated individuals	Possible beds
- rock lobsters		Possible in patch reef	
Seagrass beds	Isolated & sparse	Isolated & sparse	
Fish:			
- BIA for great white shark			
Cetaceans:			
- BIA for pygmy blue whale			
- BIA for southern right whale			State waters only
- BIA for humpback whale			NSW portion

Pinnipeds	Foraging only	Foraging only	
Reptiles	Vagrants only	Vagrants only	Vagrants only
Seabirds	General foraging, flyovers, BIA for 7 species		
Shorebirds			
Marine pests	Possible	Possible	
Cultural Heritage Values			
Shipwrecks			
Indigenous heritage			
Socio-economic Environment			
Native Title			
Tourism	Possible game fishing		
Petroleum infrastructure			
Commercial fishing	Southern squid jig Shark gillnet/hook Trawl	Scallop Rock lobster Ocean access Ocean purse seine Inshore trawl	Scalefish hook Abalone
Recreational fishing	Possible game fishing	Mostly beach fishing	
Commercial shipping			

Red shading denotes no presence, green shading denotes presence.

5.1. Regional Context

The proposed Pelican 3DMSS acquisition area is located within the Southeast Shelf Transition provincial bioregion within the South-east marine region (DoE, 2015a). This region extends from east of Wilson's Promontory to north of Tathra (NSW) (Figure 5.2).

Victoria's marine environment has been classified into five bioregions, with the proposed acquisition area located within the Twofold Shelf bioregion (Figure 5.2). These bioregions are defined based on their distinct and unique habitats and biological communities, structured by a combination of physical, chemical and biological processes (Barton *et al.*, 2012).

The coastline adjacent to the bioregions (as classified at the Commonwealth and state scales) is exposed with long sandy beaches broken by rocky headlands and numerous coastal lagoons.

5.1.1. Climate

The region's climate is moist cool temperate (Barton *et al.*, 2012), with cool wet winters and cool summers. It is influenced by rain bearing cold fronts that move from south-west to north-east across the region, producing strong winds from the west, north-west and south-west. In winter, when the subtropical ridge moves northwards over the Australian continent, cold fronts generally create sustained west to south-westerly winds and frequent rainfall in the region (McInnes and Hubbert, 2003). In

summer, frontal systems are often more shallow and occur between two ridges of high pressure, bringing more variable winds and rainfall.

Temperature and Rainfall

Average monthly air temperatures at Lakes Entrance (48 km northeast of the proposed acquisition area, but the closest coastal town with a Bureau of Meteorology [BoM] weather station) range from 14.6°C in July to 23.8°C in February to (1965 to 2006) (BoM, 2017). Mean rainfall is 713 mm with the rainfall fairly evenly distributed throughout the year, with a mean minimum of 41.5 mm in February and a maximum of 71 mm in November (BoM, 2017).

Winds

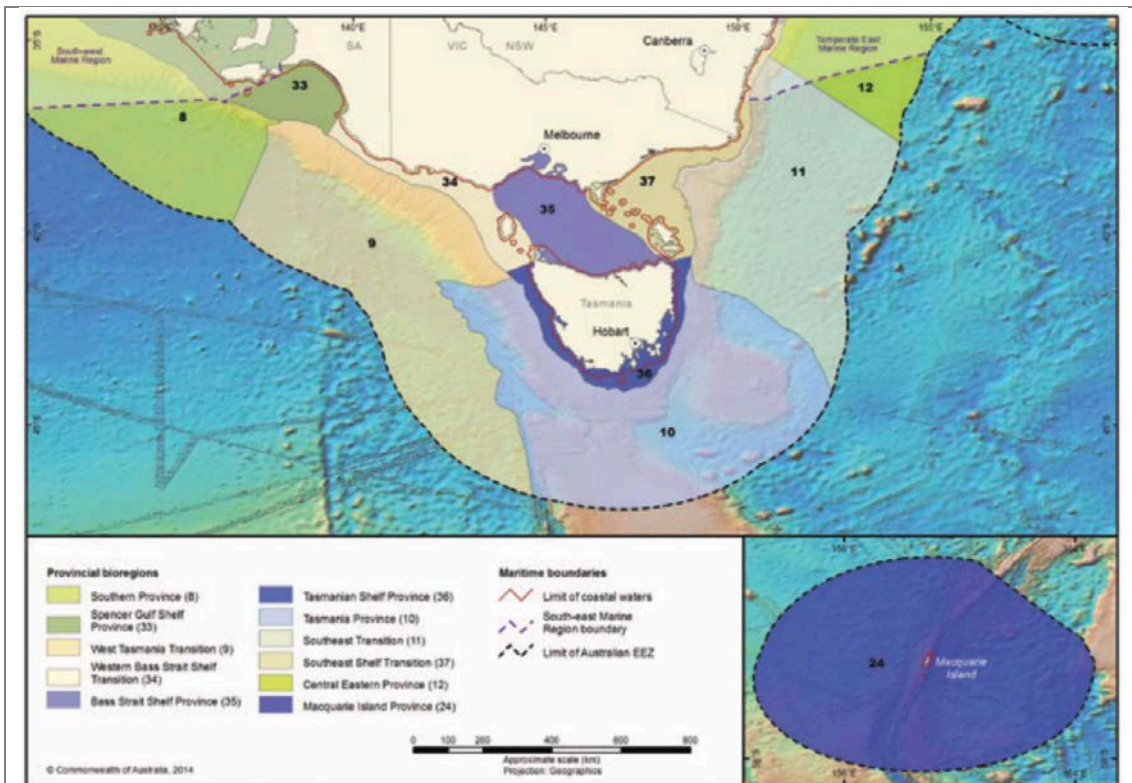
Bass Strait is located on the northern edge of the westerly wind belt known as the Roaring Forties. Occasionally, intense meso-scale low-pressure systems occur in the region, bringing very strong winds, heavy rain, and high seas. These events are unpredictable in occurrence, intensity and behaviour, but are most common between September and February (McInnes and Hubbert 2003).

RPS-APASA (2016) acquired high-resolution wind data from 2011 to 2015 (inclusive) for the operational area from the National Centre for Environmental Prediction Climate Forecast System Reanalysis (CFSR). Table 5.2 lists the monthly average and maximum winds derived from the CFSR station located within the operational area.

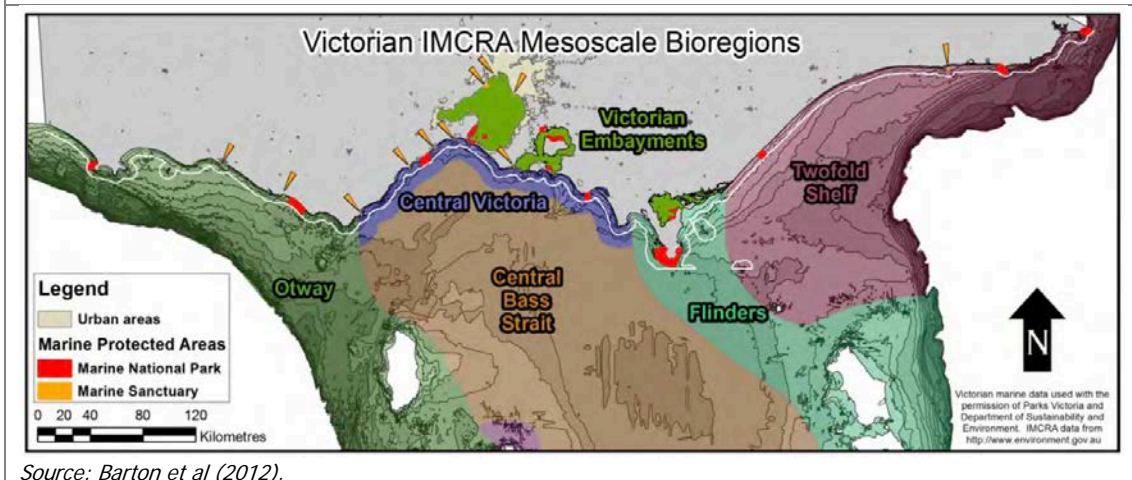
Table 5.2. Predicted average and maximum winds for the wind station within the operational area for 2011-15 (inclusive)

Month	Average current speed (m/s)	Maximum current speed (m/s)	General direction
January	6.7	19.5	East-west (variable)
February	6.4	21.9	East (variable)
March	6.0	19.8	East-west (variable)
April	5.7	17.9	West (variable)
September	6.9	22.9	West (variable)
October	6.6	18.4	West (variable)
November	6.6	18.7	East-west (variable)
December	6.7	19.0	East-west (variable)
Minimum	5.7	17.9	
Maximum	6.9	22.9	

Source: RPS APASA (2016).



Source: DoE (2015).



Source: Barton et al (2012).

Figure 5.2. The Southeast Shelf Transition provincial bioregion (top) and the Twofold Shelf Victorian marine bioregion (bottom)

5.1.2. Physical Environment

Geomorphology

The proposed Pelican 3DMSS acquisition area overlaps the seafloor 'slope' geomorphic unit as classified in the South-east Marine Region Profile (DoE, 2015a). The wider EMBA also encompasses a small area of geomorphic unit classified as 'terrace' in the far east.

Seabed

Regional

Bass Strait is concave-shaped, with a shallower rim on the eastern and western entrances to the strait and a deeper centre.

The substrate across Bass Strait comprises a variety of sediment types related to tidal currents, with sediment grain size linked to wave energy, with sediments becoming progressively finer with increasing distance from the shore, consisting of fine, muddy sands in the mid-shelf regions (Harris and Heap, 2009; Wilson and Poore, 1987).

Inner shelf sediments, such as those of the proposed acquisition area, generally consist of fine sands (Harris and Heap, 2009; DEDJTR, 2017a), with moderate and well-sorted sands confined to the nearshore zone (Harris and Heap, 2009).

Geoscience Australia's seafloor sediments database (known as MARS) classifies the proposed acquisition area as having sediment grain sizes ranging in diameter from 0.2 to 0.5 mm, with isolated pockets within the EMBA having sediment diameters up to 5 mm (Harris and Heap, 2009).

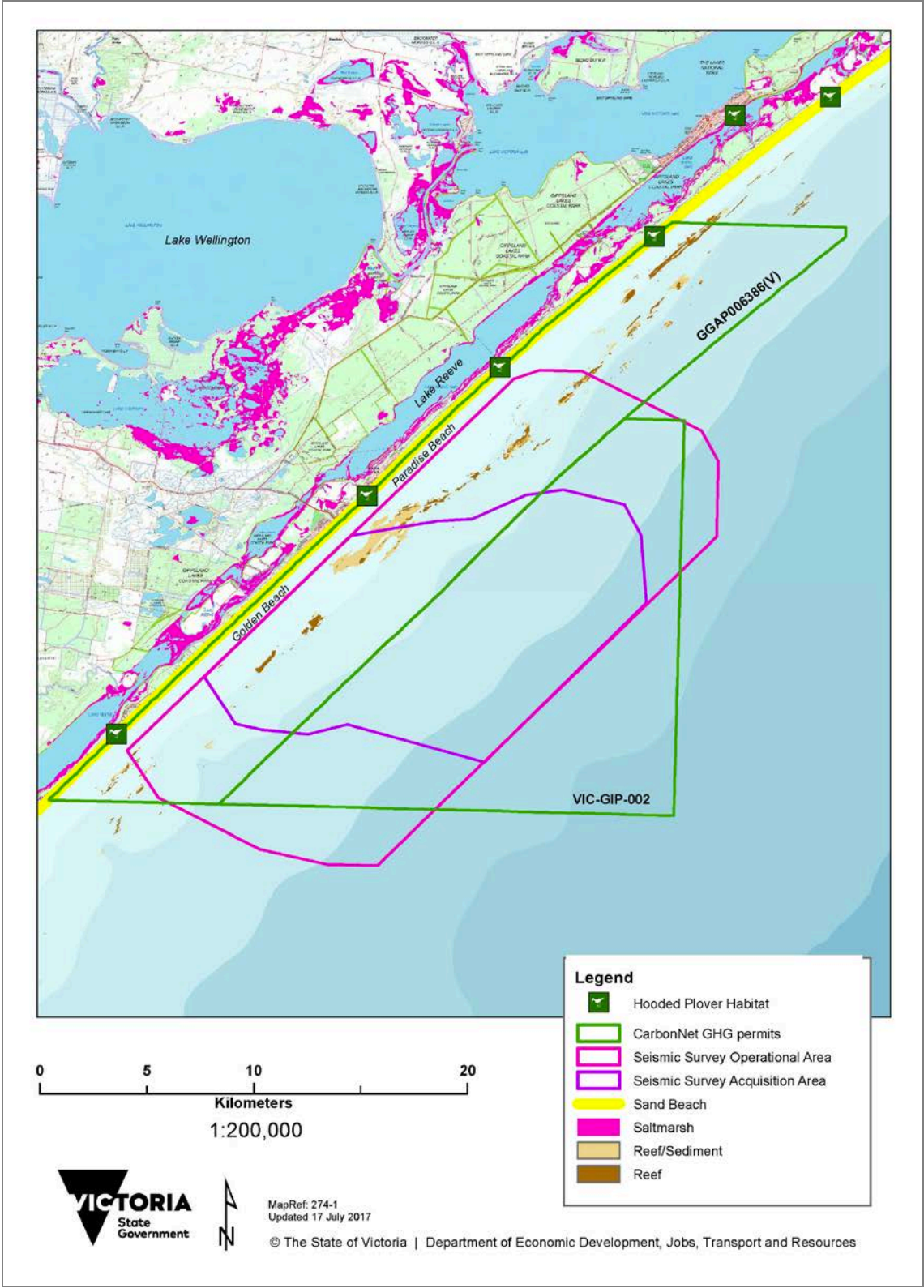
Local

The gradient of the proposed survey acquisition area is a very flat 0.2°, with the seabed depth difference being 30 m over a distance of 10 km perpendicular to the coast.

LiDAR (Light Detection and Ranging)-derived data on the sediments of the nearshore Victorian coastline was acquired in late 2008/early 2009 as part of the Victorian Government's Future Coasts Program. This data indicates that the majority of the proposed survey area comprises sandy sediments. A series of sand waves running perpendicular to the coast are present.

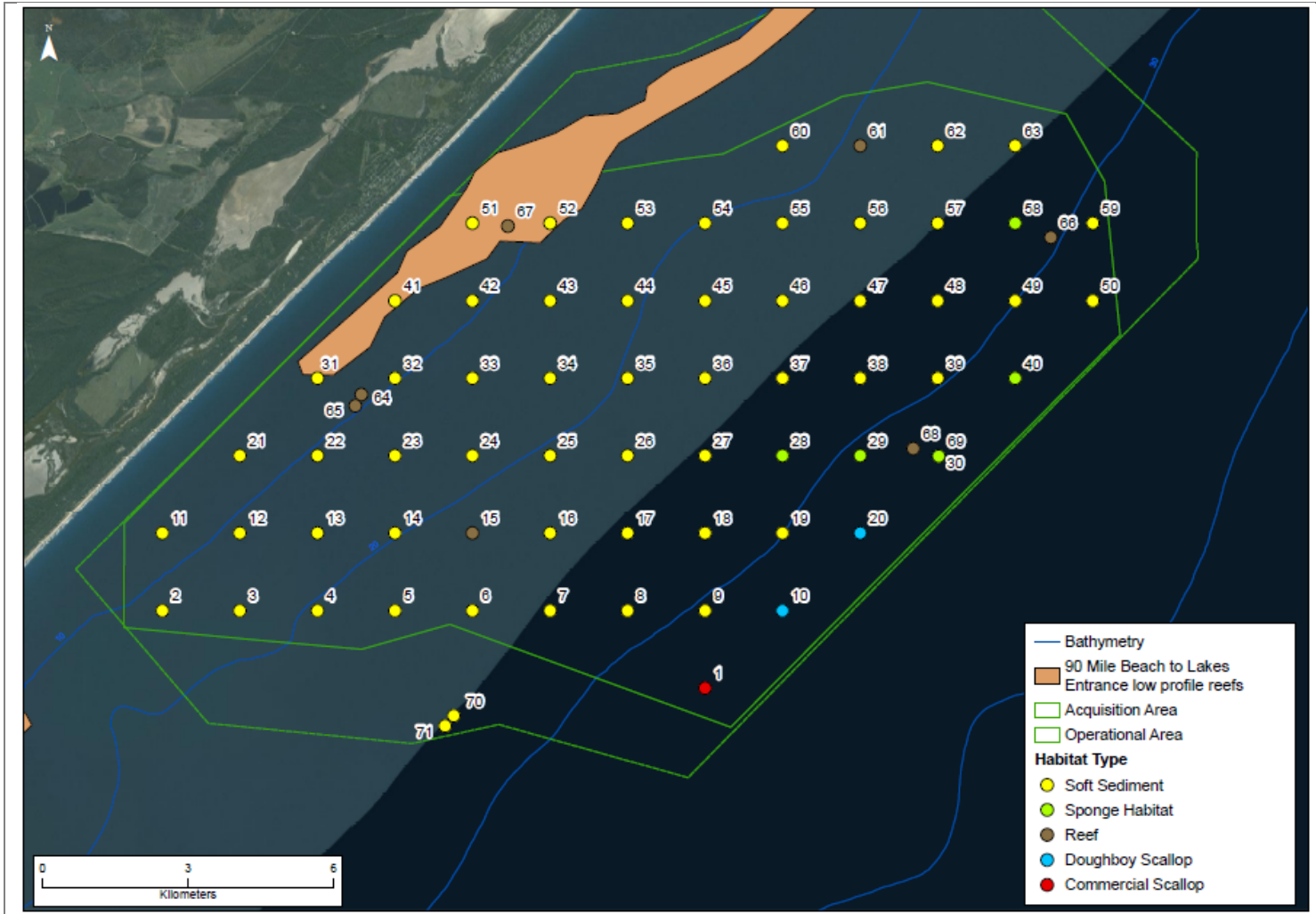
Intermittent and very narrow areas of low profile reefs (about 0.5 m to 1.5 m in height above the surrounding seabed) running parallel to the coast are scattered through the nearshore sandy sediments along the Ninety Mile Beach. These reefs comprise calcarenite and occur immediately behind the surf zone, in water depths ranging from 7 to 25 m (Burton *et al.*, 2012), and are likely to be often covered by mobile sand (Figure 5.3).

As presented in Figure 5.4, Photo 5.1, Photo 5.2, Photo 5.3, Photo 5.4, the marine habitat assessment (using non-intrusive towed camera) commissioned by CarbonNet and conducted in early April 2017 by Advisian found that the seabed throughout the proposed acquisition area is dominated by sand (fine, coarse and silty), with inshore reef present as discontinuous outcrops (not continuous reef as indicated by LiDAR mapping) and small isolated area of reef and rubble recorded further offshore. No reef bommies were noted during this habitat assessment.



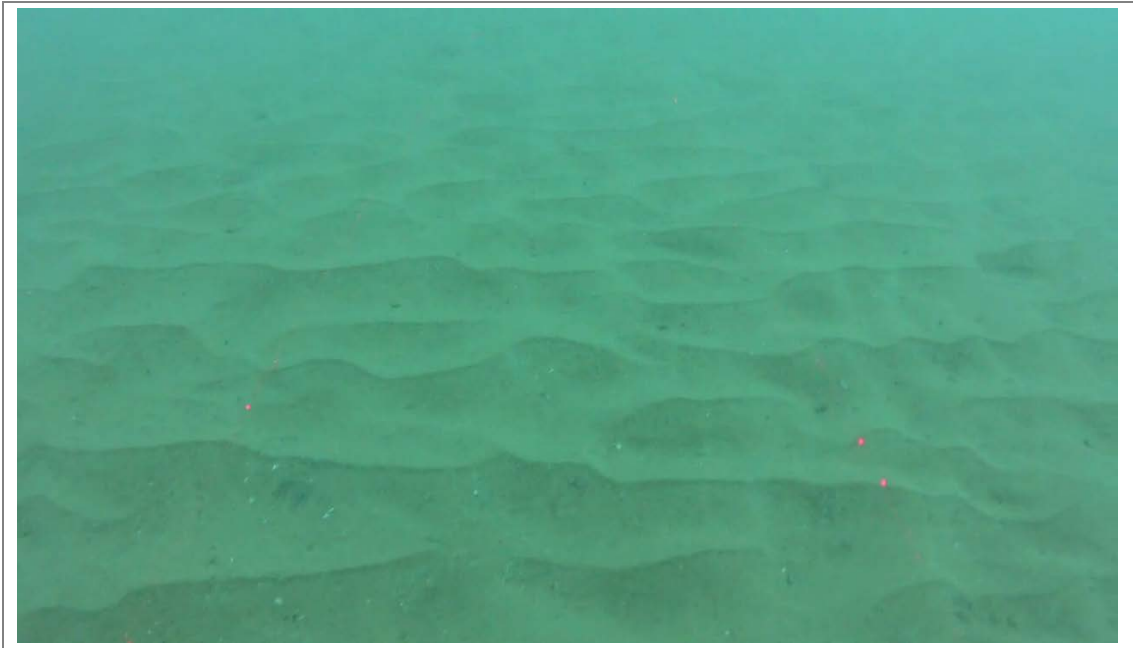
Source: DEDJTR (2017a).

Figure 5.3. Seabed and shoreline types and sensitivities in and around the proposed Pelican 3DMSS operational area



Source: Advisian (2017).

Figure 5.4. Sampling locations for the marine environmental assessment, indicating seabed types and habitat (noting a superseded version of the operational area)



Source: Advisian (2017).

Photo 5.1. Example of fine sand with ripples within the proposed acquisition area at a depth of 18 m (site 11)



Source: Advisian (2017).

Photo 5.2. Example of sand waves within the proposed acquisition area at a depth of 18 m (site 43)



Source: Advisian (2017). * Note red dots are laser pointers used for size estimations.

Photo 5.3. Example of coarse sediment with dead scallop shells within the proposed acquisition area at a depth of 23 m (site 62)



Source: Advisian (2017).

Photo 5.4. Example of sponge habitat and doughboy scallops within the proposed acquisition area at a depth of 30 m (site 39)

5.1.3. Oceanography

Water depths

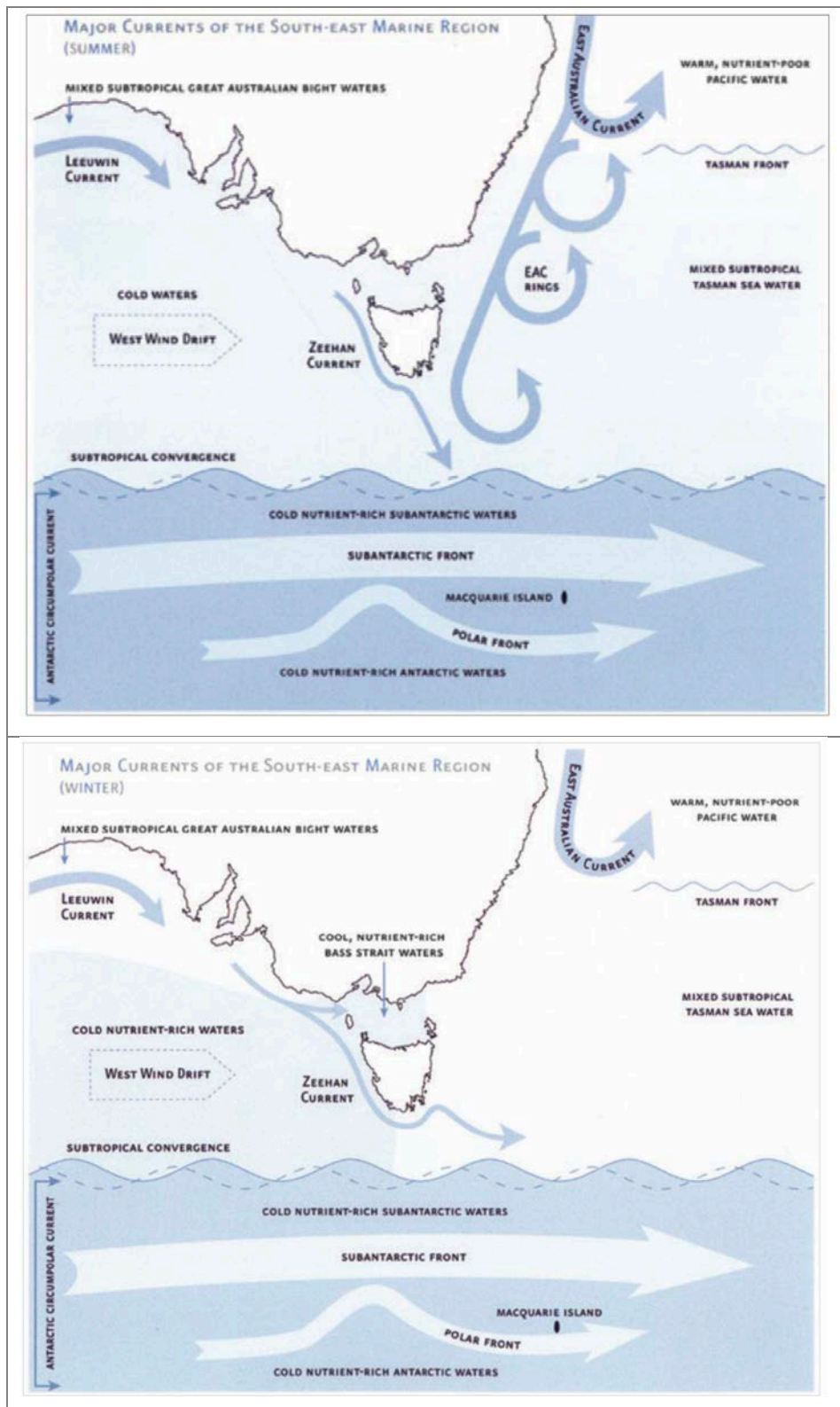
The proposed acquisition area is located in shallow water depths ranging from 15 m to 40 m in the Gippsland Basin. The bathymetry contours run consistently parallel to the coast across the proposed acquisition area.

Water Currents

Currents within Bass Strait are primarily driven by tides, winds and density-driven flows (RPS APASA, 2016). The region is oceanographically complex, with sub-tropical influences from the north and sub-polar influences from the south (DoE, 2015a). There is a slow easterly flow of waters in Bass Strait and a large anti-clockwise circulation (DoE, 2015a). Three key water currents influence Bass Strait:

1. The Leeuwin Current transports warm, sub-tropical water southward along the Western Australian (WA) coast and then eastward into the Great Australian Bight (GAB), where it mixes with the cool waters from the Zeehan Current running along Tasmania's west coast (DoE, 2015a). The Leeuwin and Zeehan currents are stronger in winter than in summer, with the latter flowing into Bass Strait during winter.
2. The East Australian Current (EAC) is up to 500 m deep and 100 km wide, flows southwards adjacent to the coast of NSW and eastern Victoria, and carries with it warm equatorial waters (DoE, 2015a). The EAC is strongest in summer when it can flow at a speed of up to 5 knots, but flows more slowly (2-3 knots) in winter where it remains at higher latitudes.
3. The Bass Strait Cascade occurs during winter along the shelf break, which brings nutrient-rich waters to the surface as a result of the eastward flushing of the shallow waters of the strait over the continental shelf mixing with cooler, deeper nutrient-rich water (DoE, 2015a).

Figure 5.5 represents the major ocean currents in south-eastern Australian waters during summer and winter.



Source: DoE (2015).

Figure 5.5. Major ocean currents in south-eastern Australian waters during summer (top) and winter (bottom)

Sea Temperature

The shallowness of Bass Strait means that its waters more rapidly warm in summer and cool in winter than waters of other nearby regions (DoE, 2015a). The sea surface temperatures in the area reflect the influence of warmer waters brought into Bass Strait by the EAC (IMCRA, 1998; Barton *et al.*, 2012).

Waters of eastern Bass Strait are generally well mixed, but surface warming sometimes causes weak stratification in calm summer conditions. During these times, mixing and interaction between varying water masses leads to variations in horizontal water temperature and a thermocline (temperature profile) develops.

RPS APASA (2016) reports that sea surface temperature in the region (based on the National Oceanographic Data Centre) varies annually from a minimum of 12.6°C to a maximum of 18.4°C. The average sea surface temperature for the September to April period is assumed to be 15°C.

Tides

Bass Strait is a relatively shallow area of the continental shelf, connecting the southeast Indian Ocean with the Tasman Sea. Bass Strait has a reputation for high winds and strong tidal currents (RPS APASA, 2016).

Tidal currents run parallel to the coast and follow a semi-diurnal pattern (Barton *et al.*, 2012), with some diurnal inequalities (Jones and Padman, 1983), with speeds generally ranging from 0.1 to 2.5 m/s (Fandry, 1983). However, Barton *et al.* (2012) report that strong tidal currents (2 to 2.5 knots) are characteristic of the area. Tidal variation is 0.9 m for spring tides and 0.6 m for neap tides (Barton *et al.*, 2012).

Tidal flows in Bass Strait come in from the east and west during a rising (flood) tide and flow out to the east and west during a falling (ebb) tide.

Waves

Bass Strait is a high-energy environment exposed to frequent storms and significant wave heights (Jones, 1980), though Barton *et al.* (2012) report wave energy in the Twofold Shelf Bioregion as relatively low. Storms may occur several times a month resulting in wave heights of 3 to 4 m or more.

Water Quality

The Regional Outfall Sewer has a discharge point at Delray Beach that extends into the western-most nearshore part of the proposed acquisition area. While no data is publicly available regarding the water quality of this release, it is expected to result in increased turbidity and nutrient levels (particularly nitrogen and phosphorous) within a mixing zone around the discharge point.

5.1.4. Ambient Ocean Sound

Physical and biological processes contribute to natural background sound. Physical processes include that of wind, waves, rain and earthquakes, whilst biological noise sources include vocalisations of marine mammals and other marine species.

Iceberg calving, shoaling and disintegration has recently been identified as a dominant source of low frequency (<100 Hz) noise in the Southern Ocean. Wind is also a major contributor to noise between 100 Hz and 30 kHz and can reach 85-95 dB re 1 μ Pa²/Hz under extreme conditions (WDCS, 2004). Rain may produce short periods of high underwater sound with a flat frequency spectra to levels of 80 dB re 1 μ Pa²/Hz and magnitude 4 earthquakes have been reported to have spectral levels reaching 119 dB re 1 μ Pa²/Hz at frequency ranges 5-15 Hz. It is noted that earthquakes of this magnitude are relatively frequent along Australia's continental

shelf in the southern margin (i.e. tens of small earthquakes per year) (McCauley & Duncan, 2001).

Turnpenny and Nedwell (1994) found that in some species continuous ambient sound alone resulted in auditory masking, and that sound had to be 20 dB above ambient sound to be audible.

In the Gippsland Basin specifically, underwater sound was measured in May 2008 at a range of locations offshore from the then proposed (and now operational) Victorian Desalination Project, located 160 km west-southwest of the proposed acquisition area. This monitoring found that in water depths of 18 m (with measurements taken at

7 m below the sea surface), the overall underwater ambient sound level was 117 dB between the frequencies of 20 Hz and 10 kHz. This sound level was unlikely to have been influenced by shipping traffic (shipping lanes are located 20 km to the south) and there were no other underwater marine sound sources generated by human activities (DSE, 2008). This level of ambient underwater sound is likely to be broadly similar to that expected within the proposed acquisition area.

Shoreline Sound

As the proposed survey will be carried out close to (1 km) the shoreline where there is significant surf, ambient sound levels will be significantly influenced by this mechanism. Wilson et al (1985; cited in Parsons & Duncan, 2009) showed that surf breaking onto beaches, parallel to the direction of wave front, can generate sound that propagates many kilometres seaward. The nearshore coastal environment of the proposed acquisition area is likely to be characterised by a significant ambient sound footprint.

5.2. Conservation Values and Sensitivities

The conservation values and sensitivities in and around the proposed survey acquisition area particularly, but also within the EMBA, are described in this section, with Table 5.3 providing an outline of the conservation categories includes.

Table 5.3. Conservation values in the EMBA

Category	Conservation classification	Section
Matters of NES under the EPBC Act	Commonwealth marine areas (including CMRs)	Section 5.2.1
	World Heritage-listed properties	Section 5.2.2
	National Heritage-listed places	Section 5.2.3
	Wetlands of international importance	Section 5.2.4
	Nationally threatened species and threatened ecological communities	Section 5.2.5 and throughout Section 5.4
	Migratory species	Throughout Section 5.4
	Commonwealth marine areas	Throughout Section 5.4
	Great Barrier Reef Marine Park	Not applicable.
	Nuclear actions	Not applicable.
	A water resource, in relation to coal seam gas development and large coal mining development	Not applicable.

Category	Conservation classification	Section
Other areas of national importance	Commonwealth heritage-listed places	Section 5.2.6
	Key Ecological Features	Section 5.2.7
	Nationally important wetlands	Section 5.2.8
Victorian protected areas	Marine National Parks and Sanctuaries	Section 5.2.9
	Coastal (onshore) conservation reserves	Section 5.2.10

5.2.1. Commonwealth Marine Reserves

The Beagle Commonwealth Marine Reserve (CMR) and East Gippsland CMR are located 88 km southwest and 207 km east of the proposed Pelican 3DMSS acquisition area, respectively. Only the latter is included with the EMBA, so this CMR is described below.

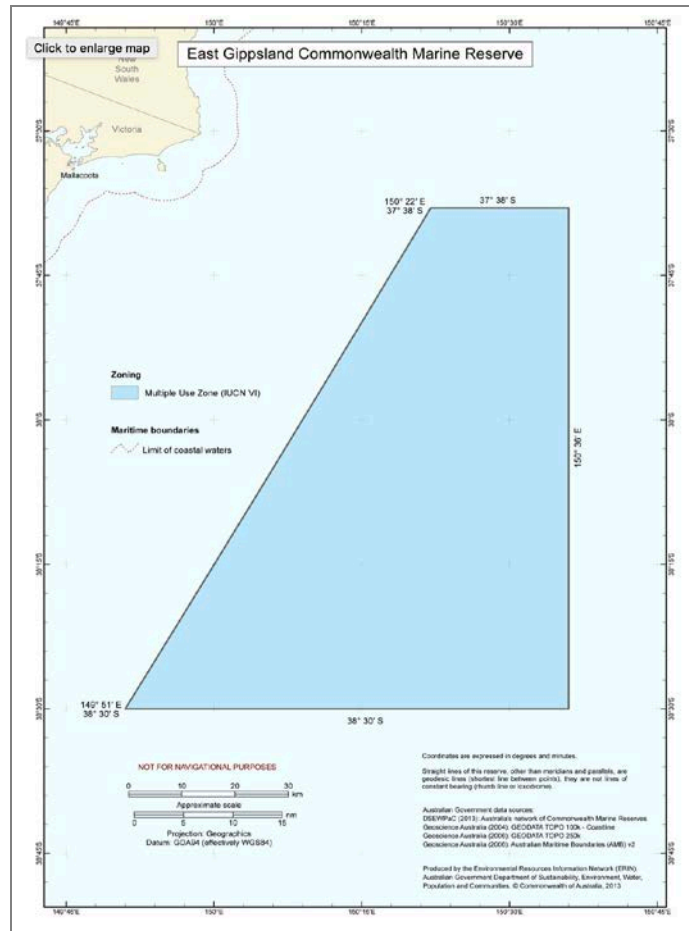
East Gippsland CMR

The East Gippsland Commonwealth Marine Reserve covers 4,137 km² of Commonwealth ocean territory and contains representative samples of an extensive network of canyons, continental slope, and escarpment in depths from 600 m to deeper than 4,000 m (DNP, 2013). The CMR is zoned entirely as Multiple Use (IUCN Category VI) (Figure 5.6, see also Figure 5.1 for location of the CMR in relation to the proposed acquisition area).

The area includes both warm and temperate waters brought about by seasonality changes in oceanographic patterns that influence biodiversity and local productivity. There are summertime incursions of the warm EAC and a wintertime cascade of cold water from Bass Strait that sinks along the upper slope and forms a temperature front that can account for a 5°C temperature difference (DNP, 2013). This cold front helps nutrients come to the surface and in turn supports a diverse phytoplankton community and other sea life.

The key values of the East Gippsland CMR are listed as:

- Examples of ecosystems, habitats and communities associated with the Southeast Transition and associated with the sea-floor features, these being abyssal plain/deep ocean floor, canyon, escarpment and knoll/abyssal hillslope;
- Features with high biodiversity and productivity, being the Bass Cascade and upwelling east of Eden;
- Important foraging area for wandering, black-browed, yellow-nosed and shy albatrosses, great-winged petrel, wedge-tailed shearwater, and cape petrel; and
- Important migration area for the humpback whale (DNP, 2013).



Source: DoEE (2017).

Figure 5.6. The East Gippsland CMR

5.2.2. World Heritage-Listed Properties

World Heritage Listed-properties are examples of sites that represent the best examples of the world's cultural and heritage, of which Australia has 19 properties (DoEE, 2017b). In Australia, these properties are protected under Chapter 5, Part 15 of the EPBC Act.

No properties on the World Heritage List occur within the EMBA. The nearest site is the Royal Exhibition Building and Carlton Gardens in Melbourne, an onshore property located 216 km to the northwest of the proposed acquisition area.

5.2.3. National Heritage-Listed Places

The National Heritage List is Australia's list of natural, historic and Indigenous places of outstanding significance to the nation (DoEE, 2017c). These places are protected under Chapter 5, Part 15 of the EPBC Act.

There are no National Heritage-listed places in Bass Strait, with the nearest places all located onshore (Australian Alps National Parks and Reserves and the Point Nepean Defence Sites and Quarantine Station Area).

5.2.4. Wetlands of International Importance

Australia has 65 Ramsar wetlands (as of January 2017) that cover more than 8.3 million hectares. Ramsar wetlands are those that are representative, rare or unique wetlands, or are important for conserving biological diversity, and are included on the List of Wetlands of International Importance developed under the Ramsar

Convention. These wetlands are protected under Chapter 5, Part 15 of the EPBC Act.

Within the EMBA are two wetlands of international importance, these being the 'Gippsland Lakes' and 'Corner Inlet' (Figure 5.7), described below.

Gippsland Lakes

The Gippsland Lakes Ramsar site is a system of lakes and swamps extending eastward from Sale to Lake Tyers, in some areas extending to the high-water mark of the ocean and cover 58,824 ha (ParksVic, 2003). The site is about 70 km long and 10 km wide (at its widest point) and was designated in 1982. At its nearest point, the Gippsland Lakes Ramsar site is located 2.75 km north of the proposed survey acquisition area.

Approximately one-third of the Gippsland Lakes Ramsar site is located within the Lakes National Park (2,390 ha) and Gippsland Lakes Coastal Park (17,584 ha), which are proclaimed under the *National Parks Act 1975* (Vic).

The Gippsland Lakes are separated from the sea by sand dunes and fringed on the seaward side by the Ninety Mile Beach. The Gippsland Lakes form the largest navigable inland waterway in Australia. These features create a distinctive regional landscape of wetlands and flat coastal plains that is of considerable environmental significance in terms of its landforms, vegetation and fauna (DoEE, 2017d). The lakes are linked to the sea by an artificial entrance at its eastern end, being Lakes Entrance.

The Gippsland Lakes Ramsar site contains three main habitat types; permanent saline/brackish pools, coastal brackish/saline lagoons and permanent freshwater marshes (ParksVic, 2003). A significant quantity of threatened, endangered, vulnerable or rare native fish communities, mammal, amphibian, and plant species exist within these habitats.

The permanence of the main lakes and the relatively regular flooding of the adjacent wetlands mean that this wetland system is an important drought refuge for many waterfowl. The lakes and their associated swamps and morasses regularly support an estimated 40,000 to 50,000 ducks, swans, coots and other waterfowl.

Most of the wetlands of the Gippsland Lakes are bordered by emergent reed beds dominated by common reed (*Phragmites australis*) or saltmarsh communities, with characteristic saltmarsh species including beaded glasswort (*Sarcocornia quinqueflora*) and sea rush (*Juncus kraussii*) (ParksVic, 2003).

There is a high concentration of archaeological sites in the Gippsland Lakes area including artefact scatters, shell middens, scarred trees, occupation sites, burials and axe-grinding grooves (ParksVic, 2003).

Parts of the Lakes system are heavily used for commercial and recreational fisheries and for other water-based recreation, while the immediate hinterland has been developed for agricultural uses and limited residential and tourism purposes (ParksVic, 2003).

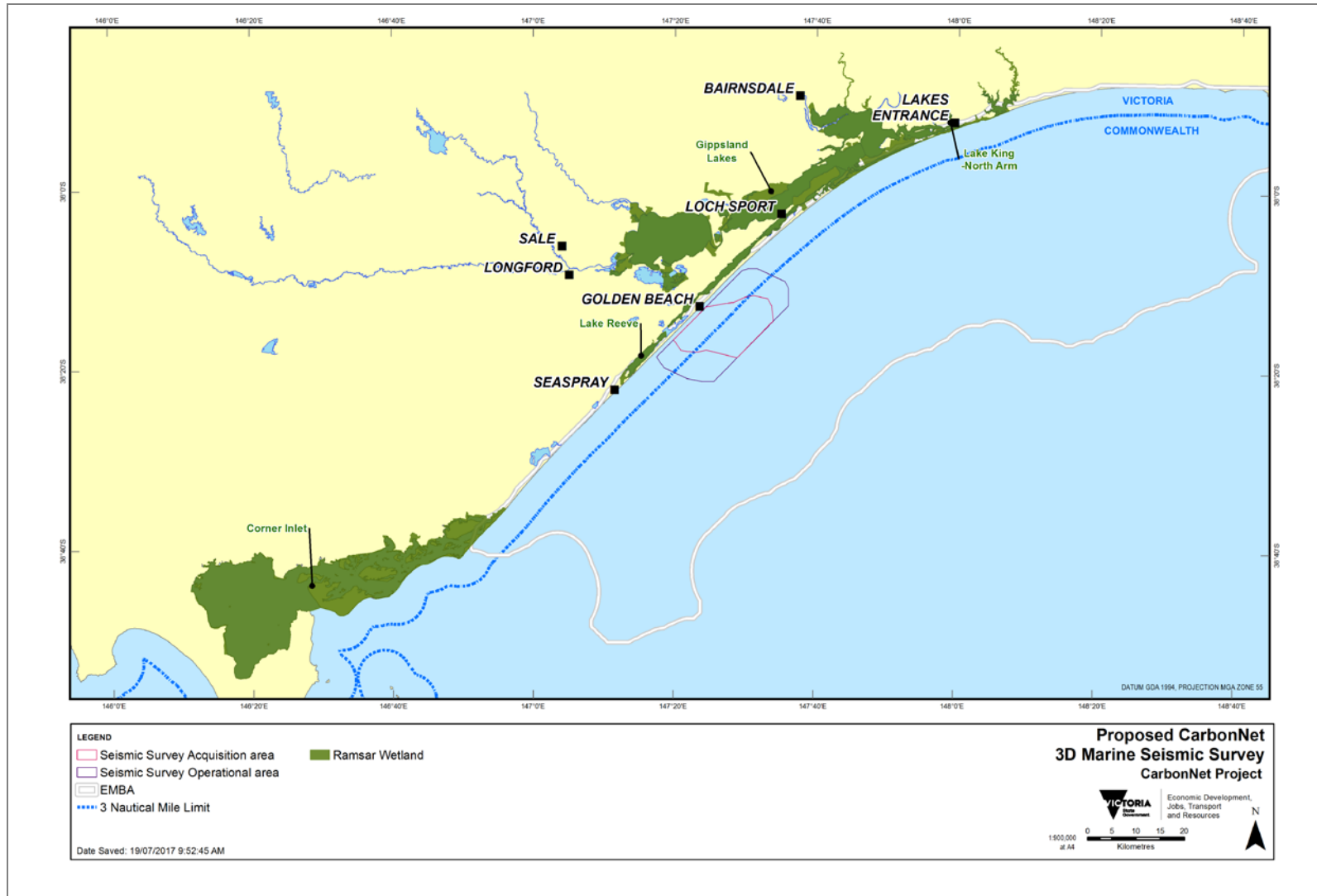


Figure 5.7. The Gippsland Lakes and Corner Inlet Ramsar sites

Corner Inlet

The Corner Inlet Ramsar site includes a chain of barrier islands, multiple beach ridges, lagoons and swamps, tidal creeks, tidal deltas and tidal washovers (DoEE, 2017d) on the west Gippsland coast, 47 km southwest of the proposed acquisition area (see Figure 5.7). The site was declared in 1982 and covers 67,192 ha. It represents the southern-most marine embayment and tidal mudflat system on mainland Australia (ParksVic, 2002).

Most of the Corner Inlet Ramsar site is included within the Nooramunga and Corner Inlet Marine and Coastal Parks, declared and managed under the *National Parks Act 1975* (Vic), with various islands included in the Wilsons Promontory National Park (ParksVic, 2002).

The mainland coast and several sandy islands are covered with mangroves, saltmarshes, sandy beaches and very extensive intertidal mudflats. The area contains the only extensive meadows of broad-leafed seagrass (*Posidonia australis*) in Victoria (DoEE, 2017d; ParksVic, 2002; O'Hara *et al*, 2002), though four species of seagrass occur within Corner Inlet (ParksVic, 2002). The saltmarsh and mangrove communities are of very limited distribution (DoEE, 2017d).

Corner Inlet supports more than 390 species of marine invertebrates and 390 species of native flora (DoEE, 2017d; ParksVic, 2002).

The Ramsar site also has a high diversity of bird species with 32 wader species recorded. Corner Inlet provides extensive tidal flats that are exposed at low tide, which are important feeding areas for waders. It is estimated that nearly 50% of the overwintering migratory waders in Victoria occur in Corner Inlet. ParksVic (2002) report that 24 bird species listed under JAMBA and 26 species listed under CAMBA have been recorded at the lakes. Important breeding habitat for the fairy tern (*Sternula nereis*), crested tern (*Thalasseus bergii*) and Caspian terns (*Hydroprogne caspia*) occurs along the shoreline of Corner Inlet, as well as being an important breeding and non-breeding site for pied oystercatchers (*Haematopus longirostris*) (ParksVic, 2002).

5.2.5. Threatened Ecological Communities

Threatened Ecological Communities (TECs) provide wildlife corridors and/or habitat refuges for many plant and animal species, and listing a TEC provides a form of landscape or systems-level conservation (including threatened species). The *Giant Kelp Marine Forests of South East Australia* is mapped as possibly occurring within the nearshore eastern parts of the EMBA (not within the proposed survey acquisition area) (Figure 5.8), and is protected as a matter of NES under the EPBC Act.

Giant kelp (*Macrocystis pyrifera*) is a large brown algae that grows on rocky reefs from the sea floor 8 m below sea level and deeper. Its fronds grow vertically toward the water surface, in cold temperate waters off southeast Australia. It is the foundation species of this TEC in shallow coastal marine ecological communities. The kelp species itself is not protected, rather, it is communities of closed or semi-closed giant kelp canopy at or below the sea surface that are protected (DSEWPC, 2012a).

Giant kelp is the largest and fastest growing marine plant. Its presence on a rocky reef adds vertical structure to the marine environment that creates significant habitat for marine fauna, increasing local marine biodiversity. Species known to shelter within the kelp forests include weedy sea dragons (*Phyllopteryx taeniolatus*), six-spined leather jacket (*Mesuchenia freycineti*), brittle star (*Ophiuroid* sp), urchins, sponges, blacklip abalone (*Tosia* spp) and southern rock lobster (*Jasus edwardsii*). The large biomass and productivity of the giant kelp plants also provides a range of

ecosystem services to the coastal environment. Giant kelp is a cold water species and as sea surface temperatures have risen on the east coast of Australia over the last 40 years, it has been progressively lost from its historical range (DSEWPC, 2012a).

Giant kelp requires clear, shallow water no deeper than approximately 35 m below sea level (DSEWPC, 2012a).

Some patches may occur within the eastern extent of the EMBA, east of Cape Conran (see Figure 5.8). Barton et al (2012) report that giant kelp (not forest) occurs within Point Hicks Marine National Park.

The proposed Pelican 3DMSS acquisition area comprises mostly sandy seabed, which is not a suitable substrate for giant kelp to attach to. The environmental habitat assessment commissioned by CarbonNet and conducted by Advisian did not observe any giant kelp within the proposed acquisition area.

5.2.6. Commonwealth Heritage-listed Places

Commonwealth Heritage-listed places are natural, indigenous and historic heritage places owned or controlled by the Commonwealth (DoEE, 2017e). In Australia, these properties are protected under Chapter 5, Part 15 of the EPBC Act.

No properties on the Commonwealth Heritage List occur within the EMBA. The nearest places are the Wilsons Promontory Lighthouse (120 km southwest of the proposed acquisition area) and the Gabo Island Lighthouse (215 km northeast of the proposed acquisition area). Though Gabo Island is located within the EMBA, as the lighthouse is located high above the waterline, the lighthouse itself is not considered part of the EMBA.

5.2.7. Key Ecological Features

Key Ecological Features (KEFs) are elements of the Commonwealth marine environment that based on current scientific understanding, are considered to be of regional importance for either the region's biodiversity or ecosystem function and integrity. KEFs have no legal status in decision-making under the EPBC Act, but may be considered as part of the Commonwealth marine area (DoEE, 2017f).

The National Conservation Values Atlas indicates that the EMBA intersects the 'Upwelling East of Eden' KEF, located 37 km to the east of the proposed survey acquisition area (Figure 5.9). The 'Big Horseshow Canyon' KEF, located 148 km east of the proposed survey acquisition area, is not intersected by the EMBA.

Upwelling east of Eden

Dynamic eddies of the EAC cause episodic productivity events when they interact with the continental shelf and headlands. The episodic mixing and nutrient enrichment events drive phytoplankton blooms that are the basis of productive food chains including zooplankton, copepods, krill and small pelagic fish (DoE, 2015a). The key value of the KEF is its high productivity and aggregations of marine life.

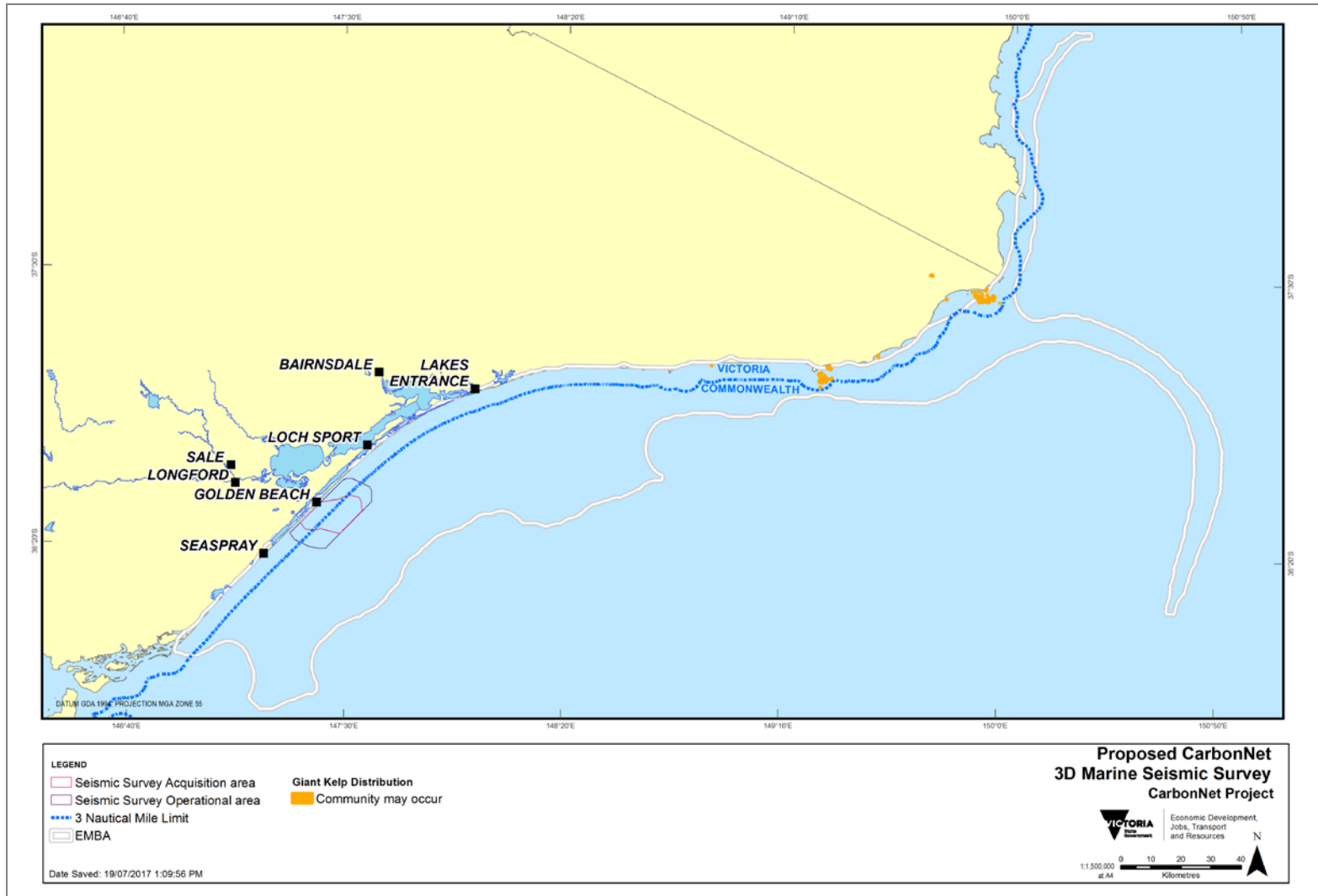


Figure 5.8. Occurrence of the Giant Kelp Marine Forests of South East Australia TEC within the EMBA

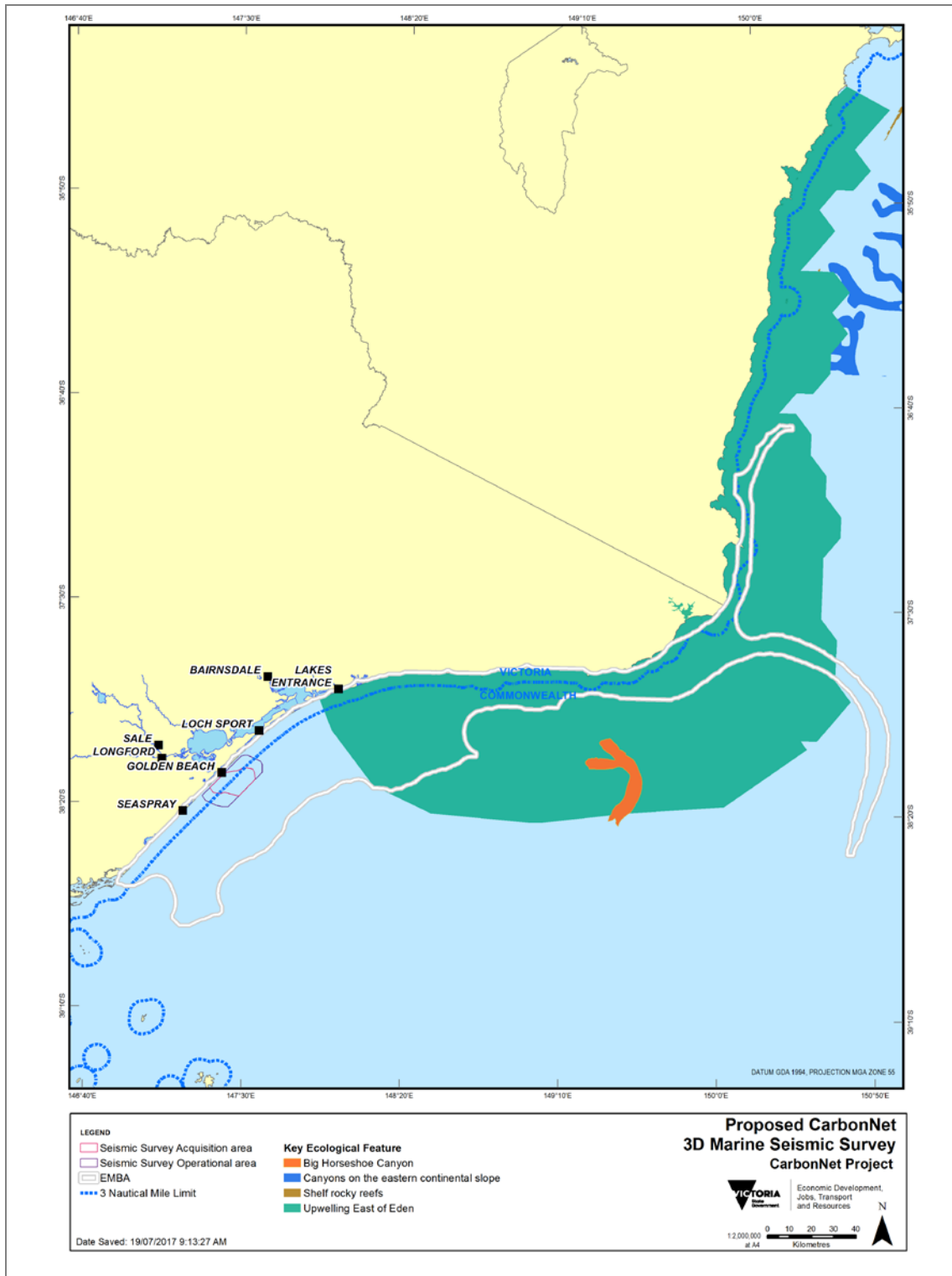


Figure 5.9. KEFs intersected by the EMBA

The upwelling supports regionally high primary productivity that supports fisheries and biodiversity, including top order predators, marine mammals and seabirds. This area is one of two feeding areas for blue whales and humpback whales, known to arrive when significant krill aggregations form. The area is also important for seals, other cetaceans, sharks and seabirds (DoE, 2015a).

5.2.8. Nationally Important Wetlands

Nationally important wetlands are considered important for a variety of reasons, including their importance for maintaining ecological and hydrological roles in wetland systems, providing important habitat for animals at a vulnerable stage in their life cycle, supporting 1% or more of the national population of any native plant or animal taxa or for its outstanding historical or cultural significance (DoEE, 2017g).

In Victoria, management of wetlands is regulated under various legislation, including the EPBC Act 1999 (Cth), FFG Act 1988, *Planning and Environment Act 1987*, *Catchment and Land Protection Act 1994* and *Water Act 1989*.

Several nationally important wetlands occur along the coast of the EMBA, which are shown in Figure 5.10 and listed and described in Table 5.4.

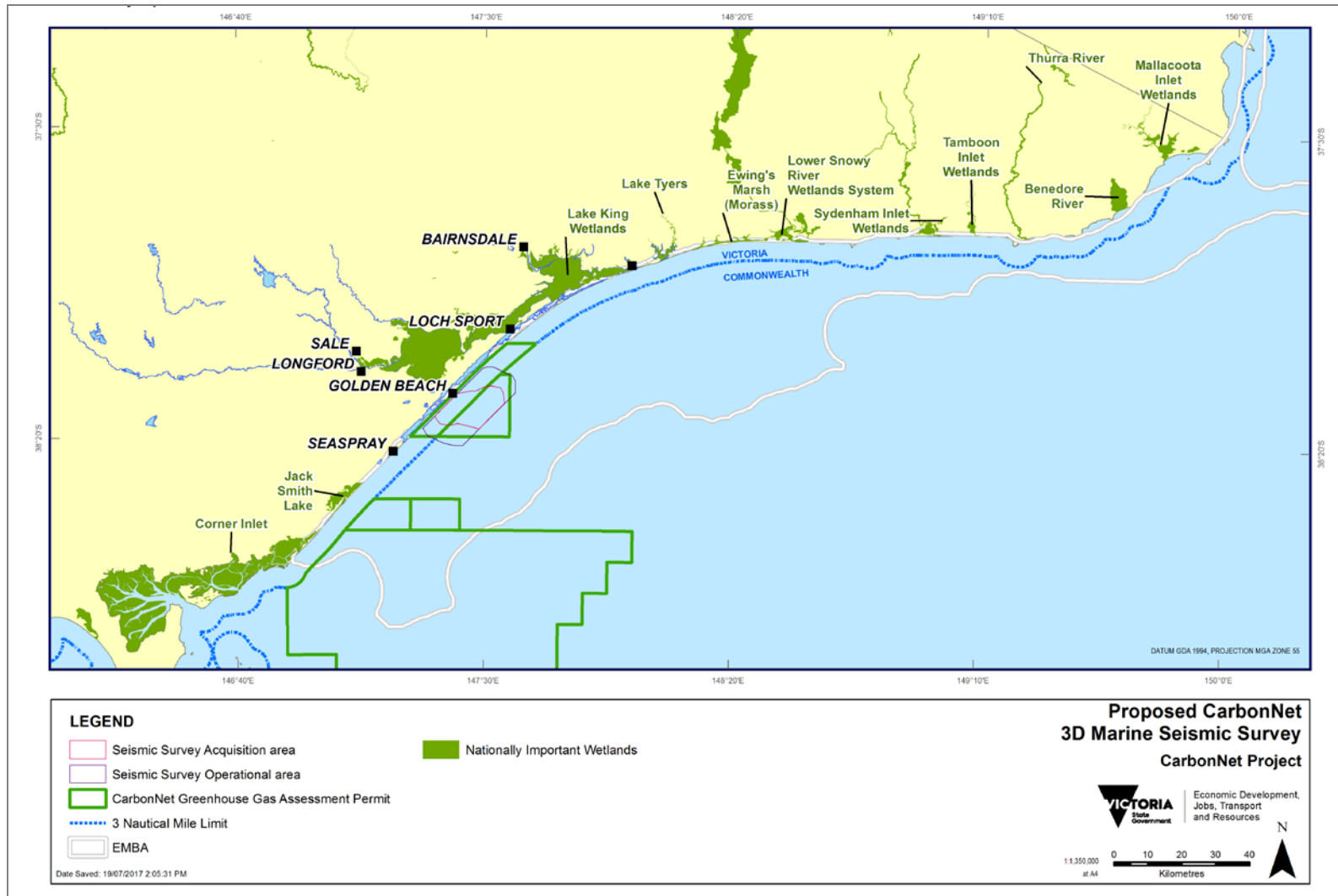


Figure 5.10. Nationally important wetlands located within the EMBA

Table 5.4. Nationally important wetlands in the EMBA

Wetland name, identification and distance from survey area	Connection to the sea	Brief description of significance and criteria for selection*
<p>Corner Inlet (VIC066) 47 km southwest of proposed acquisition area (to the eastern-most boundary)</p>	<p>Permanent, tidal.</p>	<p>Criteria for selection: 1, 3, 4, 5 (see the selection criteria at the end of this table). Covers an area of 51,500 ha in water depths from 0 – 10 m. The site is of international zoological significance due to its geographical position and of national geomorphological significance as an example of barrier island formation. Corner Inlet is the best example of a wetland enclosed by barrier islands in Victoria and it contains the most extensive intertidal flats in Victoria, which provide large feeding grounds for many waterfowl and wader species. Corner Inlet contains the most southerly occurrence of white mangrove (<i>Avicennia marina</i>) in the world and the only extensive bed of the broad-leafed seagrass (<i>Posidonia australis</i>) in Victoria. Sixty-one waterbird species have been recorded in Corner Inlet, with the white-bellied sea-eagle (<i>Haliaeetus leucogaster</i>) nesting on Islands off Port Albert and the orange-bellied parrot (<i>Neophema chrysogaster</i>) feeding in small numbers on the islands off Yanakie. The hooded plover (<i>Thinornis rubricollis</i>), little tern (<i>Sterna albifrons</i>) and fairy tern (<i>S. nereis</i>) have been recorded in Corner Inlet. Corner Inlet regularly has supported over 20% of the total known Victorian wader population and an estimated 50% of the over-wintering Victorian population of migratory wader species, and has supported more than 1% of the national wader population and may contain 15% of the world population of eastern curlew (<i>Numenius madagascariensis</i>).</p>
<p>Jack Smith Lake (VIC069) 26 km southwest of proposed acquisition area (to the eastern-most boundary)</p>	<p>Intermittently open. A drop board regulator acts as a control structure on an artificial ocean outlet to prevent flooding.</p>	<p>Criteria for selection: 1, 3, 4, 5. Covers an area of 2,730 ha in water depths from 0 – 5 m. Remnants of manna gum (<i>Eucalyptus viminalis</i>) open forest occur on the sandier soils with associated <i>Banksia</i> spp. The coastal vegetation communities have been cleared and grazed, although small patches of coast banksia (<i>Banksia integrifolia</i>) and saw banksia (<i>B. serrata</i>) still occur along the primary and secondary dune system. Extensive saltmarsh areas mainly comprise coast saw-sedge (<i>Gahnia filum</i>) and beaded glasswort (<i>Sarcocornia quinqueflora</i>). There have been 117 bird species, including 45 waterbird species, recorded at the site. This includes the orange-bellied parrot (sighted in 1980 and 1983) and records of the hooded plover that breeds on the nearby beach. Up to 10, 000 unidentified teal, 4,740 pacific black duck (<i>Anas superciliosa</i>), 2,900 grey teal (<i>A. gibberifrons</i>), 2,500 chestnut teal (<i>A. castanea</i>), 950 Australasian shoveler (<i>A. rhynchotis</i>) and 1,600 Eurasian coot (<i>Fulica atra</i>) have been counted. Sixteen species listed under the JAMBA and/or CAMBA have been recorded at the lake.</p>

Wetland name, identification and distance from survey area	Connection to the sea	Brief description of significance and criteria for selection*
<p>Lake King Wetlands (VIC071) 50 km northeast of proposed acquisition area (to the entrance)</p>	<p>Via the artificial entrance, Lakes Entrance.</p>	<p>Criteria for selection: 1, 2, 3, 4, 5. Covers an area of 7,100 ha in water depths from 0 – 2 m. The Lake King Wetlands are fine examples of a large coastal lagoon system and contain two sites of geological/ geomorphological significance: the Mitchell River silt jetties (international) and the Tambo River Delta (state). The Mitchell River Delta silt jetties are one of the finest examples of a digitate delta in the world; these silt jetties almost separate Jones Bay from Lake King. The Tambo River Delta is a major example of the processes of delta growth. Forty-six waterbird species have been recorded in Lake King, including little tern, fairy terns, eastern curlews, and white-bellied sea-eagles. Lake King has supported 1% of the national population of the little tern, 5% of the state population of common tern (<i>Sterna hirundo</i>), and 10% of the regional population of black swan (<i>Cygnus atratus</i>) (up to 10,000).</p>
<p>Lake Tyers (VIC086) 58 km northeast of proposed acquisition area (to the mouth)</p>	<p>Tidal delta, occasionally open to the sea.</p>	<p>Criteria for selection: 1, 3, 5. Part of the Gippsland Lakes Ramsar site. Covers an area of 1,186 ha in water depths from 0 – 2 m. "Moss balls", small spheres comprising densely interwoven filaments of a green alga <i>Cladophora echinis</i>, are thought to only occur at this site and Mullacky Swamp in Australia. Fifty-four waterbird species have been recorded at Lake Tyers, including little tern, fairy tern, hooded plover, blue-billed duck (<i>Oxyura australis</i>), white-bellied sea-eagle and Australasian bittern (<i>Botaurus poiciloptilus</i>). Up to 4,000 black swans (<i>Cygnus atratus</i>), 50 white-fronted terns (<i>Sterna striata</i>) and 140 little terns have been recorded at the lake.</p>
<p>Ewing's Marsh (Morass) (VIC132) 84 km northeast of proposed acquisition area (to the western-most boundary)</p>	<p>Formerly an open lagoon supplied with seawater and fresh water floods, but now virtually enclosed within a barrier.</p>	<p>Criteria for selection: 1, 3, 5. Part of the Gippsland Lakes Ramsar site. Covers an area of 1,326 ha in water depths from 0 – 2 m. The creeks entering the marsh differ from others in East Gippsland in that they are completely enclosed by the barrier and have no tidal connection to estuaries at Lake Tyers or the lower Snowy River. The marsh has 443 plant taxa (including 43 introduced) recorded, which consists of four vegetation classes; Wet Swale Herbland/Sedgeland (endemic to this wetland), Coastal Lagoon Wetland (including Aquatic Sedgeland/Grassland), Riparian Scrub Complex and Coast Saltmarsh. Part of the Ewing's Marsh wetland is within the 'Hospital Creek and Dinner Creek areas (Ewing's Marsh)' listing of State zoological significance. Forty-three waterbird species have been recorded at Ewing's Marsh.</p>

Wetland name, identification and distance from survey area	Connection to the sea	Brief description of significance and criteria for selection*
<p>Lower Snowy River Wetlands System (VIC087) (connected to Ewing's Marsh) 95 km northeast of proposed acquisition area (to the mouth)</p>	<p>Periodically closed due to variations in river flows.</p>	<p>Criteria for selection: 1, 2, 3, 5. Covers an area of ~2,000 ha in water depths from 0 – 4 m. The wetlands consist of extensive saltmarsh flats and reed beds, paperbark thicket, mud flats and seagrass beds and thus supports a diverse faunal assemblage. The wetlands are an excellent example of a floodplain system consisting of a diverse range of habitats and contain extensive areas of swamp paperbark (<i>Melaleuca ericifolia</i>), reed beds, salt marsh and mudflats that have been cleared or badly degraded elsewhere throughout the Snowy River floodplain. Lake Corringale provides important spawning ground and nursery habitat for fish such as Australian bass (<i>Macquaria novemaculeuta</i>), which migrate between marine, estuarine and freshwater environments (Koehn & O'Connor 1990). The hooded plover, ground parrot (<i>Pezoporus wallicus</i>), white-bellied sea-eagle, eastern curlew, Australian grayling (<i>Prototroctes maraena</i>), spotted galaxias (<i>Galaxias truttaceus</i>) and striped gudgeon (<i>Gobiomorphus australis</i>) have been recorded in the wetlands. Ten bird species protected under the JAMBA and CAMBA use the wetlands.</p>
<p>Sydenham Inlet Wetlands (VIC134) 134 km northeast of proposed acquisition area (to the mouth)</p>	<p>Closes frequently, between one and four occasions annually.</p>	<p>Criteria for selection: 1, 3, 5. Comprises Sydenham Inlet, Mud Lake and Swan Lake, covering an area of 1,216 ha in water depths from 0 – 25 m, with 7 km of river channel. Located within Sydenham Inlet - Cape Conran Coastal Park. Two hundred and sixty-six (266) plant taxa have been recorded in the Sydenham Inlet area, including a significant seagrass meadow community consisting of dwarf grass-wrack (<i>Zostera muelleri</i>) and eel-grass (<i>Vallisneria americana</i>). The inlet is listed as being of local and scientific interest for zoology, comprising 57 waterbird species, 39 fish species, including common galaxias (<i>Galaxias maculatus</i>), southern pygmy perch (<i>Nannoperca australis</i>), black bream (<i>Acanthopagrus butcheri</i>), Tamar River goby (<i>Favonigobius tamarensis</i>), Port Jackson glassfish (<i>Ambassis jacksoniensis</i>), and green-back flounder (<i>Rhombosolea tapirina</i>), two mammal species, seven reptile species and seven amphibian species. Large numbers of waterbirds have been recorded including 1,960 unidentified teal, 400 unidentified grebes, 2,300 black swans, 656 Pacific black ducks, 100 Arctic terns (<i>Sterna paradisea</i>) and 80 little terns. Seventeen threatened waterbird species occur in heathlands adjacent to the wetland area, and five waterbird species including the Australasian bittern, white-bellied sea-eagle and little tern have been noted as breeding in the area. Ten bird species protected under the JAMBA and CAMBA use the wetlands.</p>

Wetland name, identification and distance from survey area	Connection to the sea	Brief description of significance and criteria for selection*
<p>Tamboon Inlet Wetlands (VIC135) 145 km east-northeast of proposed acquisition area (to the mouth)</p>	<p>Intermittently open to the ocean, normally separated from the sea by a sand barrier.</p>	<p>Criteria for selection: 1, 3, 5. Covers an area of 669 ha (including the inlet and Lake Furnell) in water depths from 0 – 5 m, with 17 km of river channel. Ninety-six (96) plant taxa have been recorded in the Tamboon Inlet area, and the inlet is fringed by Riparian Scrub Complex and Coast Saltmarsh. Tamboon Inlet is listed as of local and scientific interest for zoology. Forty-five (45) waterbird species have been recorded in the Inlet, along with 54 native fish (including 48 estuarine or marine species such as the Australian anchovy (<i>Engraulis australis</i>), river garfish (<i>Hyporhamphus regularis</i>), tupong (<i>Pseudaphritis urvillii</i>), estuary perch (<i>Macquaria colonorum</i>) and black sole (<i>Synaptura nigra</i>)), two genera of freshwater crayfish, one species of freshwater shrimp, six mammal species, six reptile species and nine amphibian species. Small to moderate numbers of little terns have nested on the ocean and inlet beaches in several seasons since at least the early 1970s. Ten bird species protected under the JAMBA and CAMBA use the wetlands.</p>
<p>Thurra River (VIC155) 160 km east-northeast of proposed acquisition area (to the mouth)</p>	<p>Likely to be open to the sea for most of the year.</p>	<p>Criteria for selection: 1, 3, 5. Covers an area of 2,920 ha with 73 km of reach (and 200 m wide corridor either side of the reach). The Thurra River Estuary, lower reach and Point Hicks region is classified as a site of state geological and geomorphological significance. The river is in a near-pristine condition with the dominant plant community of the reach being lowland sclerophyll forest and riparian forest. There are 29 threatened flora species and 37 fauna species within the West Thurra River reach and its associated corridor. Significant fauna species include the green and golden grass frog and the Australian grayling.</p>
<p>Benedore River (VIC154) 177 km east-northeast of proposed acquisition area (to the mouth)</p>	<p>River mouth is often dammed by beach sand.</p>	<p>Criteria for selection: 1, 2, 3, 4, 5. Covers an area of 3,360 ha with 13 km of reach (with an average corridor width of 400 m). The Benedore River is unregulated, contains no artificial barriers to fish movement and is considered to be in pristine condition. Its catchment classified as a site of regional geological and geomorphological significance due to its relatively undisturbed condition. The dominant floral community of the corridor is lowland sclerophyll forest. The upper reach has warm temperate rainforest in the riparian zone, and the lower reach is riparian forest. There are 16 threatened flora species within the Benedore River and its associated corridor, and 25 threatened fauna species, including the little tern.</p>

Wetland name, identification and distance from survey area	Connection to the sea	Brief description of significance and criteria for selection*
<p>Mallacoota Inlet Wetlands (VIC133) 206 km east-northeast of proposed acquisition area (to the entrance)</p>	<p>Tidal movement at the entrance, but probably impeded by the very shallow entrance channel. The entrance is rarely blocked.</p>	<p>Criteria for selection: 1, 3, 5, 6.</p> <p>Covers an area of 3,797 ha, comprising Mallacoota Inlet, Lake Barracoota and Howe Flat, with 20 km of river channel.</p> <p>Mallacoota Inlet is fringed by Lowland Forest, a variety of other forest and woodland types, cleared land and small patches of Riparian Scrub Complex, Coast Saltmarsh and Estuarine Wetland.</p> <p>Eighty-nine (89) waterbird species have been recorded in the Mallacoota Inlet area, including up to 2,400 black swans, 700 chestnut teal, 36 banded lapwings (<i>Vanellus tricolor</i>), 150 greenshanks, 100 Pacific gulls, 35 Caspian terns and 80 little terns.</p> <p>Twenty-six threatened (26) waterbird species have been recorded from the Inlet and lower Genoa River including the great egret (<i>Ardea alba</i>), intermediate egret (<i>Ardea intermedia</i>), little egret (<i>Egretta garzetta</i>), Australasian bittern, black bittern (<i>Ixobrychus flavicollis</i>) Cape Barren goose (<i>Cereopsis novaehollandiae</i>), white-bellied sea-eagle, painted snipe (<i>Rostratula benghalensis</i>), hooded plover, eastern curlew, fairy tern and little tern.</p> <p>Threatened fish and crustacea recorded in the area include the freshwater herring (<i>Potamalosa richmondia</i>), Australian bass (<i>Macquaria novemaculeata</i>), striped gudgeon, empire gudgeon (<i>Hypseleotris compressa</i>) and the Mallacoota burrowing crayfish.</p> <p>The Australian pelican, black swan, white-bellied sea-eagle, black bittern, pied oystercatcher (<i>Haematopus longirostris</i>), red-capped plover (<i>Charadrius ruficollis</i>), and the Caspian, little, fairy and crested terns have been recorded breeding in the Inlet. Thirteen bird species protected under the JAMBA and CAMBA use the wetlands.</p>

* Key to criteria for selection

1. It is a good example of a wetland type occurring within a biogeographic region in Australia.
2. It is a wetland that plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex.
3. It is a wetland that is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail.
4. The wetland supports 1% or more of the national populations of any native plant or animal taxa.
5. The wetland supports native plant or animal taxa or communities that are considered endangered or vulnerable at the national level.
6. The wetland is of outstanding historical or cultural significance.

Source: DoEE (2017g).

5.2.9. Victorian Marine Protected Areas

Victoria has 24 marine national parks and sanctuaries that were established, are protected and managed under the *National Parks Act 1982 (Vic)* by Parks Victoria.

The five marine protected areas located in the EMBA are shown in Figure 5.11 and described in Table 5.5, moving west to east along the coast.

There are no marine parks in the NSW coastal waters of the EMBA.

5.2.10. Onshore Protected Areas

Victoria

Victoria has 45 national parks and 26 state parks that were established, are protected and managed under the *National Parks Act 1982 (Vic)*, *Crown Lands (Reserves) Act 1978 (Vic)* and *Parks Victoria Act 1998 (Vic)* by Parks Victoria.

There are seven onshore protected areas located in the Victorian portion of the EMBA, which are shown in Figure 5.11. These are described in Table 5.6, moving west to east along the coast. They are briefly described here because their boundaries extend to the low water mark of the coastline.

NSW

The diesel spill EMBA extends into the southern coast of New South Wales (NSW), and is predicted to make isolated contact with the shoreline of the Ben Boyd National Park and Nadgee Nature Reserve, shown in Figure 5.11 and described in Table 5.6. These parks are briefly described here because their boundaries extend to the low water mark of the coastline. The EMBA intersects:

- Nadgee Nature Reserve – southern most part near the Victorian border, with the coastline dominated by rocky cliffs and platforms with isolated sandy beaches.
- Ben Boyd National Park – Green Cape (exclusively rocky cliffs and platforms).

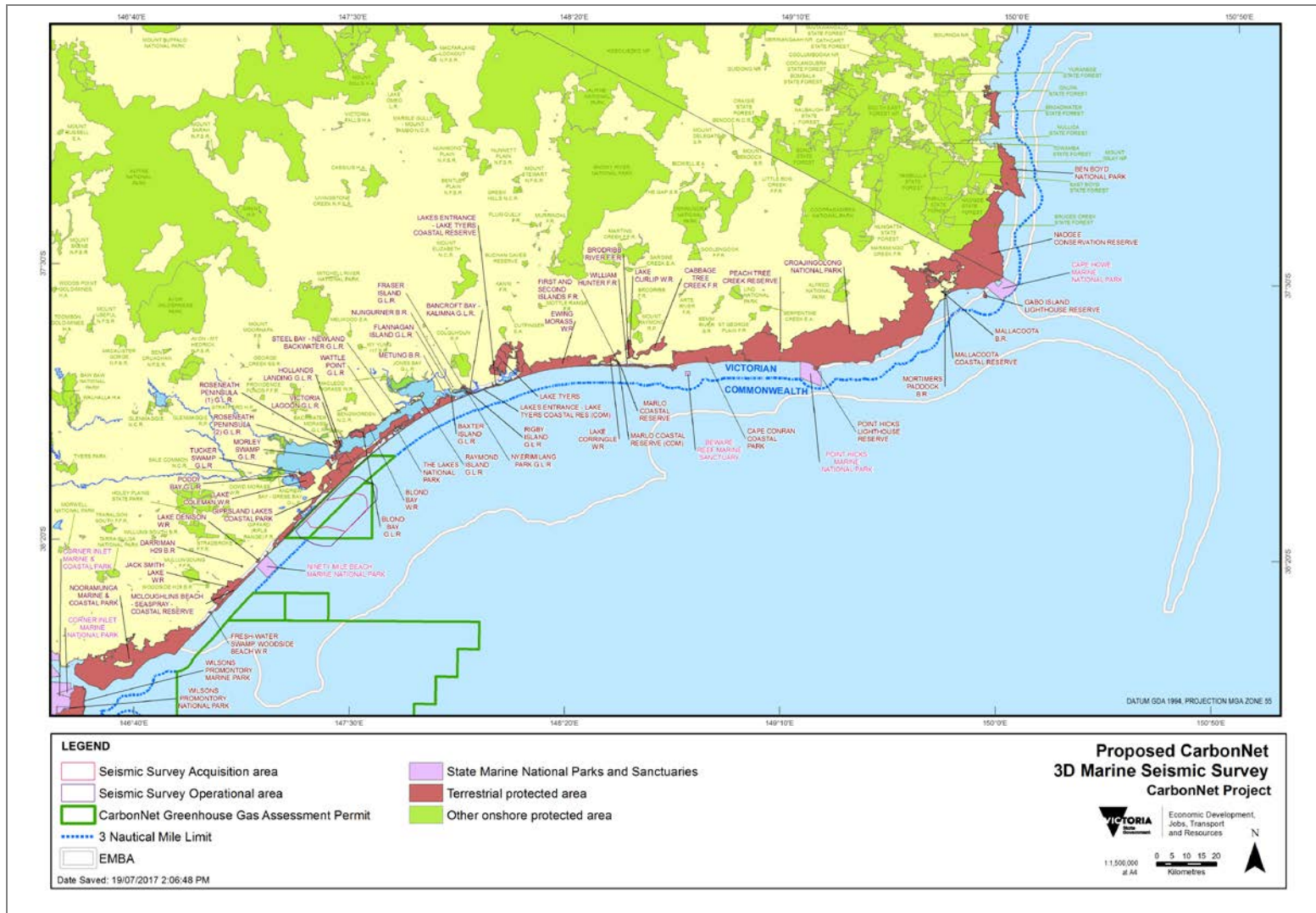


Figure 5.11. State onshore and marine protected areas within the EMBA

Table 5.5. Victorian marine protected areas within the EMBA

Conservation area	General description
<p>Nooramunga Marine and Coastal Park</p> <p><i>46 km west of proposed acquisition area</i></p> <p>IUCN Category VI</p> <p>No ParksVictoria Management Plan in place</p>	<p>Location and area</p> <p>Nooramunga Marine and Coastal Park covers an area of 30,170 ha in Corner Inlet. The park is also protected as a Ramsar wetland (see Section 5.2.4).</p> <p>Physical attributes</p> <p>The park consists of shallow marine waters, intertidal mudflats and a series of over forty sand islands.</p> <p>Habitats</p> <p>The Nooramunga Marine and Coastal Park, along with the Corner Inlet Marine and Coastal Park to its west, contain the largest stands of white mangrove and saltmarsh areas in Victoria. The saltmarshes are dominated by beaded and shrubby glassworts. Seagrass meadows also occur throughout the park.</p> <p>Seaward of the mangroves are extensive areas of intertidal mud and sand flats. An immense range of marine plants and invertebrates can be found here that provide food for the thousands of migratory wading birds that arrive each year from their northern hemisphere breeding grounds.</p> <p>Marine biodiversity</p> <p>The seagrass meadows provide habitat to over 300 marine invertebrates, including a range of large crabs, seastars, sea snails, iridescent squid and many fish including pipefish, stingarees, flathead, whiting and flounder. Finfish such as snapper, King George whiting, flathead, garfish and salmon are caught by recreational fishers.</p> <p>Shoreline biodiversity</p> <p>Thirty-two (32) migratory wader species have been recorded in the park, including the largest concentrations of bar tailed godwit (<i>Limosa lapponica</i>) and great knot (<i>Calidris tenuirostris</i>) in south-eastern Australia. These birds feed over the mudflats at low tide. At high tide, large flocks of waders congregate on the sand spits at the ends of the barrier islands.</p> <p>In summer the ocean beaches and sand provide nesting habitat for pied oystercatchers, crested terns, Caspian terns, fairy terns and the hooded plovers.</p>
<p>Ninety Mile Beach Marine National Park</p>	<p>Location and area</p> <p>The Ninety Mile Beach Marine National Park (MNP) covers an area of 2,750 ha, and extends along approximately 5 km of coastline and offshore for 5 km from the high water mark. The park protects an internationally significant sandy environment, recognised for its exceptionally high diversity of marine invertebrates.</p>

Conservation area	General description
<p>14.5 km west of proposed acquisition area</p> <p>IUCN Category II</p> <p>ParksVictoria Management Plan in place (2006)</p>	<p>Key natural values</p> <p>The park's key natural values are listed as:</p> <ul style="list-style-type: none"> • Very high diversity of marine invertebrates, including the large endemic southern Australia seastar <i>Coscinasterias muricata</i> and the soft coral <i>Pseudogorgia godeffroyi</i>; • Scattered low calcarenite reefs providing habitat for a distinctive marine invertebrate fauna, especially sponges, with sparse flora communities of small red algae; and • Important habitat for threatened shorebird species, including species listed under international migratory bird agreements. <p>Physical attributes</p> <p>The low subtidal calcarenite reefs scattered throughout the park support a unique invertebrate biota, including colourful sponge gardens. The long sandy beach (the area between the high water and low water marks are included in the park) provide extensive habitat for shorebirds, including international migratory waders and the threatened hooded plover.</p> <p>Habitats</p> <p>The Ninety Mile Beach Marine National Park supports four distinct marine ecological communities; these being intertidal sandy beach, subtidal sandy sediment, subtidal reef and open waters.</p> <p>Marine biodiversity</p> <p>More than 800 different species were found within 10 m² of Ninety Mile Beach sand (compared to 300-400 per 10 m² in comparable habitats), making it one of the most biologically diverse marine environments in the world.</p> <p>Intertidal sand communities along the Ninety Mile Beach are species-poor, which is typical of coarse-grained, steep-faced, high-energy beaches.</p> <p>The subtidal reefs support a community dominated by invertebrates, particularly sponges and sea squirts. Seaweeds are largely absent, possibly because of frequent scouring by shifting sand. The reefs themselves are likely to be periodically covered and uncovered by sand.</p> <p>The waters of the park have aggregations of juvenile white shark (<i>Carcharodon carcharias</i>), snapper (<i>Pagrus auratus</i>), Australian salmon (<i>Arripis</i> spp.), long-finned pike (<i>Dinolestes lewini</i>) and short-finned pike (<i>Sphyaena novaehollandiae</i>). The southern right whale, Australian fur seals and New Zealand fur-seals are known to frequent the park.</p> <p>Shoreline biodiversity</p> <p>The Ninety Mile Beach is a potentially important area for the endangered hooded plover (listed as vulnerable in Victoria). However,</p>

Conservation area	General description
	<p>their numbers between McLoughlins Point and Seaspray on biannual counts between 2000 and 2006 declined markedly from 40 to three, with none observed during the 2004 and 2006 survey. The loss of roosting and nesting areas due to beach erosion may be a major factor. The area is also used by other threatened shorebirds, including crested terns, Caspian terns, pied oystercatchers and sanderlings.</p>
<p>Beware Reef Marine Sanctuary <i>115 km east-northeast of proposed acquisition area</i></p> <p>IUCN Category II</p> <p>ParksVictoria Management Plan in place (2006)</p>	<p>Location and area</p> <p>The Beware Reef Marine Sanctuary covers 220 ha and lies 5 km offshore southeast of Cape Conran, in water depths ranging 0 and 40 m.</p> <p>Key natural values</p> <p>The park's key natural values are listed as:</p> <ul style="list-style-type: none"> • A diversity of habitats, including subtidal and intertidal reefs, exposed reefs and subtidal soft sediment. • A haul-out area for Australian Fur Seals and New Zealand Fur Seals. • A diversity of invertebrates and fish species. • A reef environment, including shipwrecks, rich in marine biota. • Threatened fauna, including several bird species and marine mammals. • Outstanding landscapes, seascapes and spectacular underwater scenery. • Excellent opportunities for scientific investigation and learning. • Opportunities to build knowledge of marine protected areas and their management and to further understand marine ecological function and changes over time. <p>Physical attributes</p> <p>It is composed of a permanently exposed granite reef that emerges from the sandy floor approximately 28 m deep. The reef is 70m long above water and continues for 1 km below the water to the southeast. The reef is characterised by numerous bisecting subtidal gutters.</p> <p>There are also three shipwrecks within the park.</p> <p>Habitats</p> <p>Beware Reef Marine Sanctuary supports five known marine ecological communities, these being subtidal soft sediment, subtidal reef, intertidal reef, exposed reef and pelagic communities. The substrate relief is high profile reef, with a substrate texture consisting of</p>

Conservation area	General description
	<p>broken reef, gutters, outcrops, coarse sand, medium sand, shell rubble and grit.</p> <p>Marine biodiversity</p> <p>Subtidal soft sediment communities are the most widespread within the sanctuary, likely to support (though unconfirmed through surveys) various polychaete, isopod, amphipod, cumacean and cephalopod species. Species such as spotted stingaree, gurnard, flathead, common gurnard perch, banded stingaree and school whiting may have a seasonal presence in and around the sanctuary.</p> <p>Thick stands of bull kelp dominate lower intertidal reef communities of the sanctuary, with the cunjevoi sea squirt (<i>Pyura stolonifera</i>) being the dominant invertebrate on the intertidal reef.</p> <p>A variety of brown algae occupy waters less than 10 m deep, along with red coralline turf algae and bull kelp on the edges of the reef. In deeper waters (13–20 m), long striped <i>Ecklonia</i> dominates the flora. There are mixed stands of the canopy-forming brown algae crayweed and common kelp. An abundant and diverse assemblage of invertebrates is occupy the subtidal reef area, including anemones, encrusting sponges, large finger sponges, colonial and stalked ascidians, urchins, blacklip abalone, sea whips and red bait crabs. There are high densities of the suspension feeding feather star <i>Cenolia trichoptera</i>. Butterfly perch (<i>Caesioperca lepidoptera</i>) occurs in high numbers in the sanctuary, with other fish species present include blue throat wrasse, purple wrasse, Maori wrasse, Port Jackson shark, wobbegong shark and weedy sea dragon.</p> <p>Australian fur seals and New Zealand fur seals use the reef platform as a haul-out site for most of the year. Little penguins rest on the platform throughout the year, and it is a common roosting and feeding area for seabirds, particularly cormorants.</p> <p>Marine mammals such as southern right whales, humpback whales, killer whales, bottlenose dolphins and common dolphins are transient visitors to the sanctuary.</p>
<p>Point Hicks Marine National Park</p> <p><i>151 km east-northeast of proposed acquisition area</i></p>	<p>Location and area</p> <p>The Point Hicks MNP covers 3,810 ha and extends along 9.6 km of coastline and offshore from the high water mark to the 3 nm state waters limits to water depths of 88 m.</p> <p>Key natural values</p> <p>The park's key natural values are listed as:</p> <ul style="list-style-type: none"> • A diversity of habitats, including subtidal and intertidal reefs, subtidal soft sediment and sandy beaches; • A very high diversity of fauna, including intertidal and subtidal invertebrates; • Co-occurrence of eastern temperate, southern cosmopolitan and temperate species, as a result of the mixing of warm

Conservation area	General description
<p>IUCN Category II</p> <p>ParksVictoria Management Plan in place (2006)</p>	<p>eastern and cool southern waters;</p> <ul style="list-style-type: none"> • A range of rocky habitats; • Mammal mammals such as dolphins, whales and fur seals; • Transient reptiles from northern waters, including turtles and sea snakes; • Threatened fauna, including whales and several bird species; • Outstanding landscapes, seascapes and underwater scenery; • Outstanding active coastal landforms, such as granite reefs and mobile sand dunes; • Excellent opportunities for scientific investigation and learning; and • Outstanding opportunities to build knowledge of marine protected areas and their management and to further understand marine ecological function and changes over time. <p>Physical attributes</p> <p>Point Hicks MNP contains various rocky habitats, ranging from large boulders up to 6 m tall to clusters of small rocks and stones comprised of basalt, granite and calcarenite. The reefs directly below Point Hicks, Whaleback Rock and Satisfaction Reef are the best-known geological features of the park. Point Hicks itself is a granite headland with a wide rocky and bouldery shore formed up to 10,000 years ago.</p> <p>Habitats</p> <p>Point Hicks MNP supports five known marine ecological communities, these being subtidal soft sediment, subtidal reef, intertidal reef, sandy beaches and, pelagic communities.</p> <p>Marine biodiversity</p> <p>Subtidal soft sediment areas within the park are unvegetated, although large numbers of cerith molluscs have been observed in waters shallower than 46 m, in contrast to the absence of macrofauna at depths of 62–83 m. Most subtidal reef areas are close to the shore, although significant reefs occur at Whaleback Rock near the eastern boundary and Satisfaction Reef near the western boundary.</p> <p>A prominent biological component of the subtidal reef areas is kelp and other seaweeds. Large species of brown algae, such as common kelp and crayweed, are present along the open coast in dense stands. Giant species of seaweeds such as string kelp and bull kelp also occur (ParksVic, 2006). The front reefs and Whaleback Reef, which have high relief gutters of up to 15 m have high</p>

Conservation area	General description
	<p>sessile invertebrate diversity and abundance on the vertical walls.</p> <p>A diverse assemblage of sessile invertebrates inhabits these subtidal reef areas, including sponges, bryozoans, corals, gorgonians and octocorals. A survey within the holdfasts of common kelp just outside the park found a rich assemblage of bryozoans and hydroids, and between the holdfasts numerous species of sponges and ascidians were present. Also recorded were large invertebrates including sea stars, several ophiuroids, crinoids, gastropods, fan worms and nudibranchs.</p> <p>An important characteristic of Point Hicks MNP is its canopy-forming algae (a mixture of crayweed <i>Phyllospora comosa</i> and common kelp <i>Ecklonia radiata</i>) and small understorey algae. The reef beneath the canopy varies from encrusting and erect sponges to small fleshy red algae. The invertebrate community includes moderate abundances of blacklip abalone (<i>Haliotis rubra</i>) and the red bait crab (<i>Plagusia chabrus</i>).</p> <p>Fish assemblages are dominated by blue-throat wrasse and purple wrasse. Other common species include rock cale, herring cale, banded morwong, zebra fish and Port Jackson sharks. Pelagic fish, including school whiting, sparsely spotted stingaree, piked dog shark, gummy sharks, salmon and tailor are believed to feed in subtidal soft sediment areas within the park. Transient mammals such as southern right whales, humpback whales, killer whales, Australian fur seals, New Zealand fur seals, bottlenose dolphins and common dolphins are transient visitors to the park.</p> <p>Shoreline biodiversity</p> <p>The marine park provides important feeding and roosting habitat for several threatened bird species such as the hooded plover, little egret and fairy tern.</p>
<p>Cape Howe Marine National Park</p> <p><i>222 km east-northeast of proposed acquisition area</i></p> <p>IUCN Category</p>	<p>Location and area</p> <p>The Cape Howe MNP covers 4,060 ha and extends along 4.8 km of coastline and offshore from the high water mark to the 3 nm state waters limit to water depths of 105 m.</p> <p>Key natural values</p> <p>The park's key natural values are listed as:</p> <ul style="list-style-type: none"> • Diversity of habitats including subtidal and intertidal reefs, subtidal soft sediment and sandy beaches; • Co-occurrence of eastern temperate, southern cosmopolitan and temperate species, as a result of the mixing of warm eastern and cool southern waters; • Marine mammals such as whales, dolphins, Australian fur seals and New Zealand fur seals;

Conservation area	General description
II ParksVictoria Management Plan in place (2006)	<ul style="list-style-type: none"> • Transient reptiles such as green turtles from northern waters; • Threatened fauna including whales and birds; • Foraging area for a significant breeding colony of Little Penguins from neighbouring Gabo Island; • Outstanding active coastal landforms within and adjoining the park, such as granite and sandstone reefs; • Outstanding landscapes, seascapes and spectacular underwater scenery; • Victoria's most easterly Marine National Park abutting one of only three wilderness zones on the Victorian coast • Excellent opportunities for scientific investigation and learning; and • Outstanding opportunities to build knowledge of marine protected areas and their management, and to further understand marine ecological function and changes over time. <p>Physical attributes</p> <p>The Croajingolong National Park, which adjoins the Cape Howe MNP, is one of the most significant conservation reserves in Victoria for protecting an outstanding variety of coastal landform features and examples of active geomorphic processes</p> <p>The waters of the park contain both high-profile granite and low-profile sandstone reefs.</p> <p>Habitats</p> <p>Cape Howe MNP supports five known marine ecological communities, these being subtidal soft sediment, subtidal reef, intertidal reef, sandy beaches and pelagic communities.</p> <p>Marine biodiversity</p> <p>The long-spined black sea urchin, found at Cape Howe in high abundances, grazes on erect algae species such as bubble weed, creating barren habitats where encrusting coralline algae flourish. The herring cale inhabits the subtidal reefs of the park where it feeds on kelp and can influence the structure of algal species growing in the area.</p> <p>Subtidal soft sediment communities are the most widespread communities in the park, with the diversity of invertebrates expected to be high. The shallow subtidal reef is dominated by a mixture of crayweed (<i>Phyllospora comosa</i>) and bull kelp (<i>Durvillaea potatorum</i>), the reef further offshore tends to be dominated by <i>P. comosa</i>.</p> <p>Intertidal rocky platforms occur along the eastern section of the park's coastline. Dominant algae species such as sea lettuce,</p>

Conservation area	General description
	<p>Neptune's necklace and various coralline red algae are present. Bull kelp occurs on the intertidal fringe. Upper intertidal rocks are unvegetated. A range of invertebrate species dominate the area, including barnacles, sea stars and elephant snails.</p> <p>The subtidal reefs are dominated by warm temperate species that are common in southern NSW but rare elsewhere in Victoria. The brown algae bubble weed forms monospecific stands and dominates the granite reefs at 5–12 m depth. Barren habitats with unvegetated substrates and encrusting coralline algae dominate, particularly along the eastern boundary of the park. In waters deeper than 34 metres, no macroflora grows but sparse red algae grows on low-profile sandstone reefs.</p> <p>Common fish are herring cale (<i>Odax cyanomelas</i>), the leatherjacket (<i>Meuschenia freycineti</i>), striped mado (<i>Atypichthys strigatus</i>), banded morwong (<i>Cheilodactylus spectabilis</i>) and the damselfishes <i>Parma microlepis</i> and <i>Chromis hypsilepis</i>. Its deep (30 to 50 m) sandstone reefs are heavily covered with a diverse array of sponges, ascidians and gorgonians.</p> <p>Transient mammals such as southern right whales, humpback whales, killer whales, Australian fur seals, New Zealand fur seals, bottlenose dolphins and common dolphins are transient visitors to the park.</p> <p>Shoreline biodiversity</p> <p>The park contains foraging areas for little penguins from neighbouring Gabo Island, which supports a significant breeding colony with an estimated 35,000 breeding pairs. Hooded plovers have been observed along the shoreline of the park, and other threatened birds recorded in the area include white-bellied sea eagle, Australasian gannet, Caspian tern and little tern.</p>
	<p><u>IUCN categories</u></p>
	<p>Ia – Strict nature reserve. Protected areas that are strictly set aside to protect biodiversity and also possibly geological/geomorphological features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring.</p>
	<p>Ib – Wilderness area. Protected areas that are usually large, unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition.</p>
	<p>II - National Park. Protected areas are large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible, spiritual, scientific, educational, recreational, and visitor opportunities.</p>
	<p>III - Natural Monument or Feature. Protected areas are set aside to protect a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature such as a cave or even a living feature such as an ancient grove. They are generally quite small protected areas</p>

Conservation area	General description
	and often have high visitor value.
	<p>IV - Habitat/Species Management Area. Protected areas aim to protect particular species or habitats and management reflects this priority. Many Category IV protected areas will need regular, active interventions to address the requirements of particular species or to maintain habitats, but this is not a requirement of the category.</p>
	<p>V - Protected Landscape/Seascape. A protected area where the interaction of people and nature over time has produced an area of distinct character with significant, ecological, biological, cultural and scenic value, and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values</p>
	<p>VI - Protected area with sustainable use of natural resources. Protected areas conserve ecosystems and habitats together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area</p>

Sources: ParksVic (2006a,b;c;d), Barton et al (2012), IUCN (2017).

Table 5.6. Coastal (onshore) protected areas within the EMBA

Conservation area	General description
Victoria	
<p>McLoughlins Beach – Seaspray Coastal Reserve</p> <p><i>15 km southwest of proposed acquisition area</i></p> <p>IUCN Category VI</p>	<p>This park encompasses the foreshore between McLoughlins Beach and Seaspray, including a narrow portion of the sea.</p> <p>There is no management plan for this coastal reserve and a paucity of information about the reserve’s values. It was known to be an area of importance for hooded plover nesting, and is popular with recreational fishers (with salmon, flathead, snapper and tailor being the main catch species).</p> <p>There is no management plan in place for this reserve.</p>
<p>Gippsland Lakes Coastal Park</p> <p><i>1 km north of proposed acquisition area</i></p> <p>IUCN Category VI</p> <p>ParksVictoria</p>	<p>Location and area</p> <p>This park is a narrow coastal reserve, covering 17,584 ha along the Ninety Mile Beach (including the beach itself, assumed to be to the low water mark) from Seaspray to Lakes Entrance.</p> <p>Key natural values</p> <p>The park’s key natural values are listed as (use of the term ‘parks’ in this section references the adjacent Lakes National Park):</p> <ul style="list-style-type: none"> • Supports valuable remnants of vegetation communities that have been disturbed throughout much of their range, including Coast Banksia Woodland, Heath Tea-tree Heathland and Hairy Spinifex Grassland. • Lake Reeve is of international significance and is a site of special scientific interest. This long, shallow lagoon is fringed by salt marsh with a number of plant species ‘relatively uncommon in Victoria east of Seaspray.’ • Six significant flora and over 20 significant fauna species have been recorded within the Parks. • Lake Reeve provides important breeding habitat for a number of waterfowl species and is one of Victoria’s five most

Conservation area	General description
<p>Management Plan in place (1998)</p>	<p>important areas for waders.</p> <ul style="list-style-type: none"> • The wetlands are important nursery areas for many fish species. • The Parks contain sites of National, State and regional geological and geomorphological significance mainly associated with the evolution of the barrier system that formed the Gippsland Lakes. • The Gippsland Lakes area, which includes the Parks, is recorded as a significant regional landscape by the National Trust of Australia. <p>Physical attributes</p> <p>Gippsland Lakes Coastal Park takes in extensive coastal dune systems, woodlands and heathlands, as well as water bodies such as Lake Reeve and Bunga Arm. These water bodies (listed as Ramsar wetlands, see Section 5.2.4) are protected from ocean processes via the dune barrier system that range in height between 5 and 8 m.</p> <p>Habitats</p> <p>The coastal vegetation strip is identified as containing Littoral Rainforest and Coastal Vine Thickets of Eastern Australia.</p> <p>Shoreline biodiversity</p> <p>More than 190 species of birds have been recorded on Sperm Whale Head. Although there have been few dedicated fauna surveys, 26 species of native mammals, 17 of reptiles and 11 of amphibians have been recorded in the Parks. Gippsland Lakes Coastal Park is considered the most important site in Victoria for the endangered New Holland mouse (<i>Pseudomys novaehollandiae</i>). As its optimum habitat appears to be heathy woodland actively regenerating after burning, careful long-term management using fire to create a mosaic of different age-classes of vegetation is an important objective.</p> <p>Lake Reeve attracts the largest concentration of migratory waders in East Gippsland and is one of the five most important areas for waders in Victoria. The lakes and surrounding wetlands are an important drought refuge for many species of waterbirds in south-eastern Australia, and are of international significance for waterbird habitat. Both Parks contain important breeding, feeding and roosting sites for many significant species, including the hooded plover.</p>
<p>Lake Tyers State Park 60 km northeast</p>	<p>Location and area</p> <p>Lake Tyers State Park extends from Lake Tyers Beach to Mount Nowa Nowa. The beach area and dunes runs adjacent to the town of Lake Tyers. The beach is located at the mouth of the Lake Tyers estuary, and is part of the Gippsland Lakes Ramsar site (see</p>

Conservation area	General description
<p><i>of proposed acquisition area</i></p> <p>IUCN Category - unknown</p> <p>Beach Foreshore Management Plan in place (East Gippsland Shire Council, 2015)</p>	<p>Section 5.2.4).</p> <p>Key natural values</p> <p>Lake Tyers beach provides important estuarine habitat for a broad range of flora and fauna species and is listed on the Directory of Important Wetlands in Australia (see Section 5.2.7). Seagrass beds are important nursery habitat for estuarine fish species. Nationally listed Littoral Rainforest communities, shoreline vegetation, fringing wetlands and the coastal barrier dunes between the estuary and Bass Strait are of particular ecological and geomorphological significance.</p> <p>Physical attributes</p> <p>A thin sand spit divides the lake from the ocean, with tall eucalypt forests surround the northern shores of Lake Tyers.</p> <p>Shoreline biodiversity</p> <p>Shoreline birds found in the park include the rufous night-heron and the Australasian Bittern.</p>
<p>Ewing Morass Wildlife Reserve</p> <p><i>69 km northeast of proposed acquisition area</i></p> <p>No Management Plan in place</p>	<p>Location and area</p> <p>The Ewing Morass Wildlife Reserve adjoins the Lake Tyers State Park and extends from Pettman Road to Corringale Creek, extending from the high water mark north into heavily forested hinterland, half way between the coastline and the Princes Highway.</p> <p>Key natural values</p> <p>This reserve is primarily reserved for the purposes of duck hunting, with the species normally present including the Pacific black duck, grey teal, mountain duck and chestnut teal.</p> <p>Physical attributes</p> <p>The shoreline of this park consists of wide sandy beaches, part of the Ninety Mile Beach.</p>
<p>Marlo Coastal Reserve</p> <p><i>89 km east-northeast of proposed acquisition area</i></p>	<p>There is no publicly available formal written information regarding the Marlo Coastal Reserve.</p> <p>Information from the Draft Marlo Foreshore Management Plan (DSE, 2013) indicates that the reserve covers the Marlo River and adjacent banks, extending seawards only so far as the sand dunes.</p> <p>There is no management plan in place for this reserve.</p>

Conservation area	General description
IUCN Category – unlikely to be classified.	
<p>Cape Conran Coastal Park <i>89 km east-northeast of proposed acquisition area</i></p> <p>IUCN Category II</p> <p>ParksVic Management Plan in place (2005)</p>	<p>Location and area</p> <p>Cape Conran Coastal Park covers an area of 11,700 ha and is bounded by Marlo Coastal Reserve to the west, Croajingolong National Park to the east (eastern shore of Sydenham Inlet), State forest and private property to the north, and the Tasman Sea, at low water mark, to the south. It includes Sydenham Inlet but excludes the foreshore reserve. The park forms part of the Gippsland Lakes Ramsar site (see Section 5.2.4).</p> <p>Key natural values</p> <p>The park's key natural values are listed as:</p> <ul style="list-style-type: none"> • Rich and diverse vegetation, including damp and lowland forest, woodlands, various types of heathland, swamp, coastal and riparian communities. • The Dock Inlet catchment, a pristine example of a coastal stream system with Cape Conran Coastal Park and associated wetlands terminating in a freshwater coastal lagoon. • The undisturbed Yeerung River supporting predominantly native fish is one of only two entirely lowland rivers in the region draining directly to the sea. • Almost 50 species of threatened fauna including six endangered nationally, and 14 bird species listed under international migratory bird agreements. • At least 40 species of threatened flora, including the Bonnet Orchid and Leafless Tongue-orchid which are both vulnerable nationally. • Extensive heathland areas in excellent condition harbouring populations of threatened fauna, including the Ground Parrot and Smoky Mouse. • Sydenham Inlet, part of the Bemm Heritage River corridor, supporting expansive seagrass meadows that provide important habitat for fish and waterbirds. • High scenic values associated with the diverse geological formations of the park's headlands, its coastal estuaries and heathy plains.

Conservation area	General description
	<ul style="list-style-type: none"> • Excellent examples of coastal dynamics such as sand movement, wave action and river outflows. <p>Physical attributes</p> <p>The coastal environs of the park are typified by dunes, lagoons and swamps, with some sections of rocky shorelines at Cape Conran and Pearl Point. There are a number of landforms of geomorphological significance, including the Dock Inlet catchment, a pristine coastal stream system terminating in a freshwater coastal lagoon. The rocky headland protrusions of Cape Conran, Point Ricardo and Pearl Point break the continuity of a long expanse of vegetated dune-backed sandy coastline.</p> <p>Habitats</p> <p>The coastal shoreline of the park comprises wide sandy beaches, with dense forest vegetation in the foredunes, with the small area of Cape Conran comprising steep rocky cliff face.</p> <p>Marine biodiversity</p> <p>The seagrass beds within Sydenham Inlet sustain a diverse range of native fish, and are critical to the maintenance of regional fish populations. The decline of seagrass beds elsewhere due to factors including sedimentation and boating activity indicates the importance of monitoring the Sydenham Inlet seagrass as a basis for long-term protection of these values.</p> <p>Shoreline biodiversity</p> <p>A total of 170 species of birds, including 33 threatened species, have been recorded within the park (mostly forest species). Fourteen species of migratory birds, recorded in the park, are listed under international migratory bird agreements. The white-bellied sea-eagle frequents the coast and estuaries, and hooded plovers and little terns nest on the ocean beaches.</p>
<p>Croajingolong National Park</p> <p><i>137 km east-northeast of proposed acquisition area</i></p> <p>IUCN Category</p>	<p>Location and area</p> <p>Croajingolong National Park covers an area of 88,355 ha and extends along 100 km of the coast, from Sydenham Inlet in the west to the NSW border in the east, with the mean low water mark of the coast forming the park's southern boundary.</p> <p>Key natural values</p> <p>The park's key natural values are listed as:</p> <ul style="list-style-type: none"> • A wide variety of highly significant coastal landforms including tidal inlets, estuaries and lagoons, dune-blocked lake and swamp systems, freshwater interdune lakes, extensive sand dunes and sand sheets, and prominent rocky cliffs. • Many sites recognised for their geological and geomorphological significance. • Habitats supporting over 1,000 recorded native plant species, 87 of which are listed as threatened in Victoria and have their

Conservation area	General description
<p>II</p> <p>ParksVictoria Management Plan in place (1996)</p>	<p>primary stronghold in the Park.</p> <ul style="list-style-type: none"> • Ninety species of orchids, including all five of Australia's lithophytic and epiphytic orchids. • Significant and well-developed sites of Warm Temperate Rainforest in the lower reaches of a number of rivers - of note Wau Wauka Creek, Harrisons Creek and Dowell Creek. • Coastal Heathland, a community considered to be extremely species rich, and covering up to 10% of the park. • Habitats supporting 43 species of threatened native fauna, including the little tern, ground parrot, eastern bristle-bird, eastern broad-nosed bat, and Australian fur seal. • The Skerries, one of only four Australian Fur Seal colonies in the State and an important breeding site for penguins and other seabirds. • Records for the Park of one third of Victoria's, and one quarter of Australia's, bird species. • Some of the richest amphibian habitats in Victoria. • Highly significant coastal streams and catchments which are relatively undisturbed, with an absence of introduced fish species and good populations of native fish species. • Localities with among the highest wilderness quality in the State, outside the Mallee, and two of the three coastal wilderness areas in Victoria. <p>Physical attributes</p> <p>The park protects a variety of coastal landform features and examples of active geomorphic processes. The topography of the Park is generally flat, most being less than 300 m, and a substantial area less than 150 m above sea level. Two major physiographic units are represented in the Park, these being coastal tablelands and coast dune complexes (some vegetated and some mobile).</p> <p>Habitats</p> <p>Cool Temperate Rainforest, Warm Temperate Rainforest and Coastal Heathland are the key habitats of the park.</p> <p>Shoreline biodiversity</p> <p>The ocean beaches of the park attract migratory seabirds and waders, including little, crested and fairy terns and the hooded plover, while the wetlands provide habitat for a rich assemblage of waterfowl and native fish such as spotted galaxias, gudgeon, bass and the Australian grayling.</p>

Conservation area	General description
NSW	
<p>Nadgee Nature Reserve</p> <p><i>225 km northeast of proposed acquisition area</i></p> <p>IUCN Category Ia</p> <p>NSW NPWS Management Plan in place (2003)</p>	<p>Key natural values</p> <p>The park's key natural values are listed as:</p> <ul style="list-style-type: none"> • The only coastal wilderness area in NSW. • A variety of coastal landforms, including dissected low tablelands, coastal plain, estuaries and lagoons, cliffs and sea caves. • Coastline has national significance for its diversity of geology and geomorphological features. • The catchments of all creeks and rivers are contained wholly in the reserve (except for a small area). • Features a complex variety of plant communities, including rainforest, tall open forest, woodland, coastal scribe and estuarine wetlands. • Contains several threatened plant species listed under the NSW <i>Threatened Species Conservation Act 1995</i>, and provide security for another 54 species of conservation significance. Also supports 11 vegetation types considered to be rare or vulnerable. • Contains 48 species of native mammal, 216 bird species, 28 reptile species and 16 amphibians. • Intertidal rock platforms have a rich, well-developed littoral fauna and Nadgee Point/Black Head has the most diverse biota of any headland in NSW south of Narooma. • Contains some extensive Aboriginal shell middens in sand dunes. <p>Shoreline biodiversity</p> <p>Seabirds reported as using the rock platforms and beaches include short-tailed shearwater, crested and little terns, hooded plover, pied oystercatcher and gannet. No records of fish species living adjacent to the reserve, with no commercial fishing taking place in the reserve's lakes and estuaries.</p>
<p>Ben Boyd National Park</p> <p><i>240 km northeast of</i></p>	<p>Key natural values</p> <p>The park's key natural values are listed as:</p> <ul style="list-style-type: none"> • Superb coastal scenery. • Contains some of the oldest rocks on the NSW coast. The barrier sand in Merimbula Bay in the northern section of the park are regionally significant as one of only four major stationary barriers in southern NSW.

Conservation area	General description
<p><i>proposed acquisition area</i></p> <p>IUCN Category II</p> <p>NSW NPWS Management Plan in place (2010)</p>	<ul style="list-style-type: none"> • A diverse array of coastal habitats including forest, woodland, heathland, sandy and rocky coastline and estuaries. A concentration of significant species occurs at Saltwater Creek. Slatmarsh and mangrove woodland are also present in the estuaries. • Contains 30 threatened fauna species, including the hooded plover. Nearly 150 bird species have been recorded, with 48 of these being waterbirds. • Contains more than 50 Aboriginal sites, mostly shell middens. <p>Shoreline biodiversity</p> <p>Seabirds reported as using the coastline of the park include fleshy-footed shearwater, pied and sooty oystercatchers and hooded plover.</p>
<p><u>IUCN categories</u></p>	
<p>Ia – Strict nature reserve. Protected areas that are strictly set aside to protect biodiversity and also possibly geological/geomorphological features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring.</p>	
<p>Ib – Wilderness area. Protected areas that are usually large, unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition.</p>	
<p>II - National Park. Protected areas are large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible, spiritual, scientific, educational, recreational, and visitor opportunities.</p>	
<p>III - Natural Monument or Feature. Protected areas are set aside to protect a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature such as a cave or even a living feature such as an ancient grove. They are generally quite small protected areas and often have high visitor value.</p>	
<p>IV - Habitat/Species Management Area. Protected areas aim to protect particular species or habitats and management reflects this priority. Many Category IV protected areas will need regular, active interventions to address the requirements of particular species or to maintain habitats, but this is not a requirement of the category.</p>	

Sources: ParksVic (1998), East Gippsland Shire Council (2015), ParksVic (2005), DNRE (1996), NSW NPWS (2003), NWS NPWS (2010).

5.3. Coastal Environment

The physical coastal environment described in this section is defined by the extent of the EMBA. This stretches from McLoughlins Beach (the eastern extent of Corner Inlet) east to the Victorian/New South Wales (NSW) border, with some contact at Cape Green in southern NSW.

The environmental features of the coast immediately adjacent to the proposed survey acquisition area are illustrated in Figure 5.3, which shows that the seabed in the state waters portion of the survey area is dominated by sandy sediment with sparse reef (likely to be low-profile carbonate reef, see Section 5.1).

5.3.1. Shoreline Types

The western part of the coastline within the EMBA is dominated by the Ninety Mile Beach, a 90 mile (145 km) long stretch of sandy beach on the seaward side of a narrow, tall, vegetated sand dune system. These sand dunes provide important habitat for hooded plovers (see Section 5.4.8) and roosting sites for other shorebird species.

Around the Lake Tyers area, the coastline is intermittently interspersed with short sections of mixed sand/shore platforms.

5.3.2. Estuaries

There are 21 estuaries along the coastline of the EMBA. Moving from west to east, these are:

- Jack Smith Lake estuary – intermittently open;
- Lake Dennison estuary – intermittently open;
- Merriman Creek estuary – intermittently open;
- Lakes Entrance – permanently open;
- Bunga River – intermittently open;
- Lake Tyers – intermittently open;
- Snowy River – permanently open;
- Yeerung River – intermittently open;
- Sydenham Inlet – intermittently open;
- Tamboon Inlet – intermittently open;
- Thurra River – intermittently open;
- Mueller River – intermittently open;
- Wingan Inlet – permanently open;
- Easby Creek – intermittently open;
- Red River – intermittently open;
- Benadore River – intermittently open;
- Seal Creek – intermittently open;
- Shipwreck Creek – intermittently open;

- Betka River – intermittently open;
- Davis Creek – intermittently open; and
- Mallacoota Inlet – permanently open.

Many of these estuary entrances open only during spring flooding as a result of snow melts upstream, and provide nesting, roosting and feeding sites for colonies of several shorebird species, including the hooded plover and little tern. Only four estuaries are permanently open, these being Lakes Entrance, Snowy River, Wingan Inlet and Mallacoota Inlet.

5.3.3. Intertidal Habitats

Sand is the dominant intertidal substrate within the EMBA.

Intertidal shore platforms are intermittently found along the coastline at Cape Conran, Clinton Rocks, Point Hicks, Petrel Point, Rame Head, Wingan Point, Sandpatch Point and the coastline of Gabo Island.

Intertidal and subtidal rock reefs are intermittently found along the coastline, becoming intermittent subtidal features just east of the Snowy River estuary. Rocky reef substrates mapped along the Gippsland coastline, moving from west to east along the EMBA, are located at:

- Ricardo Beach (west of Cape Conran);
- Cape Conran and East Cape;
- Off Yeerung River;
- Beware Reef (reef and reef sediment);
- Pearl Point;
- Point Hicks area;
- Off Mueller River;
- Croajingalong Reefs;
- Petrel Point;
- Rame Head;
- Sandpatch Point;
- Extensive patch reef and reef sediment from the Red River estuary east to the Victorian/NSW border, up to 30 m deep.

5.3.4. Offshore Islands

Three offshore islands occur in the eastern-most part of the EMBA. Their environmental values are described herein.

The Skerries

The Skerries are a granite outcrop located opposite Wingan Inlet (177 km northeast of the proposed acquisition area). This outcrop forms the basis of the formerly proposed Skerries Special Management Area (SMA), an area of 50 ha that includes waters 200 m offshore from the outcrops (ECC, 2000). They form part of the Croajingolong National Park. The Skerries are an important breeding habitat for Australian fur seals (~11,500 individuals) and New Zealand fur seals (~300 individuals), with the breeding season being mid-October to late December. It also provides breeding habitat for crested terns (ECC, 2000; DEDJTR, 2017a).

Special Management Areas have no legislation, and were proposed as part of the Environment Conservation Council 2000 review of Victoria's marine, coastal and estuarine areas.

Tullaberga Island

Tullaberga Island is a small granitic outcrop located 7 km to the east of Mallacoota Inlet and 1 km offshore, 214 km east-northeast of the proposed acquisition area. It rises

10-15 m above sea level and is surrounded by a rocky platform, with small areas covered thinly by beach and sand dunes (VRO, 2017). The island provides important habitat for little penguins, with about 900 breeding penguins nesting on the island from May to January. It also provides seabird breeding habitat (DEDJTR, 2017a).

Gabo Island

Gabo Island is the eastern-most island in the EMBA, comprising pink granite and covering an area of 154 ha, located 500 m off the coast (ParksVic, 2012). The island is considered to be of state zoological significance due to the presence of what is thought to be the largest breeding colony of little penguins in the world at 35,000 individuals (ParksVic, 2012; DEDJTRA, 2017a). Large seabird populations, including short-tailed shearwaters, provide a source of food for raptors such as white-bellied sea-eagles, whistling kites, marsh harriers and brown falcons (ParksVic, 2012). The rocky shore platform provides haul-out sites for Australian fur seals (~30-50 individuals) and New Zealand fur seals (ParksVic, 2012; DEDJTR, 2017a). The proposed Gabo Island SMA is located on the northwest side of the island, covering 23 ha of water, in recognition of the little penguin colony, and the temperate reef communities that surround natural reef and a shipwreck within the harbour (ECC, 2000).

5.3.5. Proposed Special Management Areas

Two of the three proposed SMAs present in the EMBA are described in Section 5.3.4. The proposed Mallacoota Inlet SMA is a 340-ha area that includes the tidal delta area at the entrance to the inlet, and the Goodwin Sands. Mallacoota Inlet is the largest estuarine lagoon system in south-eastern Australia (ECC, 2000). The inlet includes three seagrass species, with *Zostera muelleri* being the dominant subtidal vegetation. A variety of shorebirds breed in the area, including Caspian, little, fairy and crested terns (ECC, 2000).

5.4. Biological Environment

The results of the PMST and VBA database searches provide the key means by which species are identified for the area, and are discussed in this section.

Additionally, Biologically Important Areas (BIAs) are identified for those species that may occur within the survey area and EMBA. BIAs are spatially defined areas, defined by the DoEE based on expert scientific knowledge, where aggregations of individuals of a species are known to display biologically important behaviour such as breeding, foraging, resting or migration (DoEE, 2017h). The BIAs do not represent a species' full distribution range.

5.4.1. Benthic Assemblages

Regional knowledge

The seascape of the region is composed of a series of massive sediment flats, interspersed with small patches of reef, bedrock and consolidated sediment (Wilson and Poore, 1987). OSRA mapping for the Ninety Mile Beach indicates that there is an absence of hard substrate or emergent reefs in the region.

The sediment flats are generally devoid of emergent fauna but benthic invertebrates such as polychaetes, bivalves, molluscs and echinoderms are present (Wilson and Poore, 1987). There are also a number of burrowing species, which inhabit the soft seabed, including tubeworms, small crustaceans, nematodes, nemerteans and seapens (PBEES, 2001).

Bass Strait

Surveys of benthic invertebrates in Bass Strait (Poore *et al.*, 1985; Wilson and Poore, 1987) have shown:

- Crustaceans and polychaetes dominate the infaunal communities, many of which are unknown species.
- The high diversity of a wide range of invertebrate groups has been a recurrent observation of all surveys in Bass Strait and diversity is high compared with equivalent areas of the northern hemisphere.
- Many species are widely distributed across the Strait, suggesting heterogeneous sediments and many microhabitats.
- Some invertebrate groups are allied with fauna from Antarctic seas. In winter, when the east coast of Tasmania is supplied with water from the sub-Antarctic, the overlap with the East Australia current contributes to the high diversity.

Parry *et al* (1990) also found high diversity and patchiness of benthos sampled off Lakes Entrance, where a total of 353 species of infauna was recorded. Crustaceans (53%), polychaetes (32%) and molluscs (9%) dominated sample results.

Barton *et al* (2012) report that in the Ninety Mile Beach Marine National Park (14.5 km west of the proposed acquisition area), reefs are dominated by invertebrates, including sponges, ascidians (sea squirts) and smaller bryozoans (resembling coral) and hydroids (colonies of tiny jellies attached to a feather-like base). Given the park's proximity, this may be expected to be representative of invertebrates present within rocky reefs in the proposed acquisition area.

A search of the VBA database indicates that 30 benthic fauna species have been recorded in the EMBA. These species comprise sea snails, sea stars, sea urchins, sea slugs, rock lobsters and limpets. None of these species are listed as threatened under the FFG Act.

Benthic fauna studies (i.e., dredge samples) were undertaken for the area offshore from Ninety Mile Beach at Seaspray for the Tasmanian Gas Pipeline (2000) (12 km west of the proposed acquisition area) in similar sandy substrates to those which have been observed at the survey area. In water depths from 17-20 m (similar to parts of the proposed acquisition area), it was found that there were mobile sands with irregular ripples that contained a variety of small mobile animals such as crustaceans, bivalves, sponges, worm tubes and polychaete worms.

Proposed acquisition area

The marine habitat assessment commissioned by CarbonNet and undertaken by Advisian in early April 2017 found the following benthic assemblages within the proposed acquisition area:

- Isolated and sparse seagrass beds (sampling sites 4, 13, 16, 44 and 60) (example shown in Photo 5.5);
- Isolated occurrences of sponge gardens (sampling sites 28-30, 40, 58, 69) (example shown in Photo 5.6).
- Isolated occurrence of *Pseudogorgia godeffroyi* (sampling sites 27, 32, 34, 50 and 51), an unusual soft coral found only in Victoria between McGaurans Beach and Delray Beach (ECC, 2000) (example shown in Photo 5.7).
- A small patch of unmapped, flat low profile offshore reef with no ledges or crevices, located between sampling locations 29 and 30 (immediately seaward of the 30 m isobath and on the western side of Esso's Bream to shore gas pipeline). This reef is dominated by sponges and ascidians (such as stalked ascidian *Pyura spinifera*) and smaller bryozoans, hydroids and the odd clump of red algae, with the occasional *Chlamys* scallop attached to the reef (not commercial scallops) (example shown in Photo 5.8). The offshore reefs at sites 61, 66 and 68 are described as being less than 50 cm in height above the surrounding seabed, while the inshore reefs at sites 64, 65 and 67 are described as being about 0.5 m to 1.5 m in height above the surrounding seabed.
- Live commercial scallops (*Pecten fumatus*) were noted in low abundance (non-commercial beds) at site 1 (32 m water depth) with dead scallops observed at site 62 (23 m water depth) (example shown in Photo 5.9).
- Southern rock lobsters (*Jasus edwardsii*) were not observed at all, even in areas of mapped reef (sites 31, 41, 51, 52, 67) and unmapped areas of reef observed during the survey (at sites 15, 16, 32, 58, 64-66, 68).

Of the 71 sites sampled in the marine habitat assessment, 58 of them (82%) are classified as soft sediment (fine to coarse sand and gravels/shell) (Advisian, 2017), so it is reasonable to conclude that the majority of the proposed acquisition area has a sandy seabed.



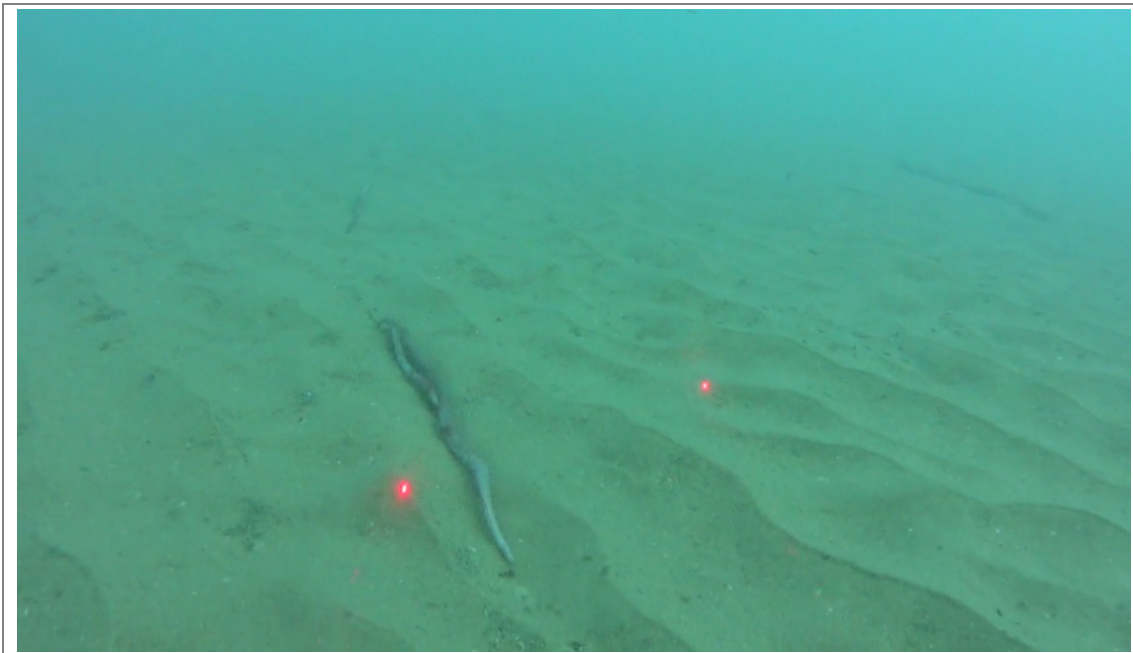
Source: Advisian (2017).

Photo 5.5. Examples of benthic assemblages found within the proposed acquisition area – sparse seagrass beds (water depth of 20 m, site 44)



Source: Advisian (2017).

Photo 5.6. Examples of benthic assemblages found within the proposed acquisition area – sponge garden (water depth of 27 m, site 28)



Source: Advisian (2017).

Photo 5.7. Examples of benthic assemblages found within the proposed acquisition area – soft coral *Pseudorgorgia godeffroyi* (in foreground) (water depth of 15 m, site 51)



Source: Advisian (2017).

Photo 5.8. Examples of benthic assemblages found within the proposed acquisition area – flat low profile reef (water depth of 29 m, site 29)



Source: Advisian (2017).

Photo 5.9. Examples of benthic assemblages found within the proposed acquisition area – sparse presence of commercial scallops, as circled (water depth of 32 m, site 1)

Scallops

Commercial scallops (*Pecten fumatus*) are present throughout Bass Strait, with a distribution along the southeast Australian coast from central NSW, Victoria, SA and Tasmania. They are found partially buried in soft sediment ranging from mud to coarse sand. Scallops aggregate into beds, with healthy scallops recessing their convex right valve beneath the sediment such that the flat left valve is level or slightly below the sediment surface (AFMA, 2017a; Przeslawski *et al.*, 2016b). Commercial scallops are mainly found at depths of 10-20 m but may also occur to depths of 120 m. While mainly sedentary, scallops can swim by rapidly opening and closing their shells, usually when disturbed by predators (AFMA, 2017a). Scallops feed on prey and detritus, while they are prey for starfish, whelks and octopus (AFMA, 2017a).

Scallops reach reproductive maturity after one year but do not spawn until the second year. Commercial scallops usually have a life span of less than 7 years, but wild populations have been known to die off rapidly after 3-5 years (AFMA, 2017a). Adult scallops normally spawn over an extended period between June and November (a sudden increase in water temperature is thought to trigger spawning), with individuals producing up to one million eggs (AFMA, 2017a). In Victoria, a spawning peak appears to take place in spring (September, October and November) (DPI, 2005). Information provided by SIV indicates spawning occurs from September to December. Larval scallops drift as plankton for up to six weeks before first settlement, with peak settlement occurring in mid-late September (AFMA, 2017a; Przeslawski *et al.*, 2016b). They attach to a hard surface such as seaweed or mussel and oyster shells and remain attached until reaching around 6 mm in length. The small scallops then detach themselves and settle into sediments and bury in so that

only the top flat shell is visible. The juvenile scallops grow quickly and reach marketable size within 18 months (VFA, 2017). Scallop settlement is highly variable both temporally and spatially (VFA, 2017).

Natural mortality for commercial scallops is variable, with a study from Port Phillip Bay indicating an annual mortality rate of 40%, with other studies in the 1980s indicating a mortality rate of 11-51% (DPI, 2005).

The VFA has advised CarbonNet that very little commercial fishing for scallops has been undertaken in the proposed acquisition area in the last five years (see Section 5.6.3), with SIV indicating that no scallop harvesting has occurred over the last 7-8 years. While the dominance of sandy sediments throughout the proposed acquisition area provides abundant suitable scallop habitat and makes it possible that scallops occur, it is unlikely that commercially viable beds of scallops are present based on the available data.

As noted earlier in this section, the CarbonNet-commissioned marine habitat assessment observed only one location within the proposed acquisition area where commercial scallops were present (with doughboy scallops present in two locations), and in very low abundance that would not be considered a commercial bed for fishing purposes.

The VSFA and SIV have advised CarbonNet that scallop beds, important to the continued sustainability of the fishery, are believed to currently occur within the proposed acquisition area (see also 'Victorian managed fisheries' in Section 5.6.3).

To address the uncertainty as to the presence and extent of scallops in and around the survey area, CarbonNet has committed to a pre- and post-MSS habitat assessment, and is contributing to a whole of scallop fishery stock assessment being undertaken by the VFA.

The EIA in Chapter 7 addresses this uncertainty by taking a precautionary approach to the existence of scallops and predicts impact as if scallops were present at abundances caught during the 1998-2003 period (see also 'Victorian managed fisheries' in Section 5.6.3) and is thus considered a conservative approach when considering impacts.

Southern rock lobster

The southern rock lobster (*Jasus edwardsii*) is found on coastal reefs from the south-west coast of Western Australia to the south coast of New South Wales, including Tasmania and the New Zealand coastline. Southern rock lobsters are found to depths of 150 m (DPI, 2009). In the Gippsland region, southern rock lobster habitat occurs as patchy, discontinuous low-profile reef running parallel to the coast.

The life cycle of the rock lobster is complex. After mating in autumn, fertilised eggs are carried under the tail of the female for approximately three months before being released, typically between September and November. Once released, rock lobster larvae, or phyllosoma, live in the plankton and undergo eleven developmental stages over a period of one to two years while being carried by ocean currents. During metamorphosis, juvenile rock lobster shift from a planktonic to a benthic existence (DPI, 2009).

Rock lobsters grow by moulting or shedding their exoskeleton. The frequency of the moulting cycle declines with age from five moults a year for newly settled juveniles to once a year for mature adults. Males grow faster and larger than females, reaching 160 mm in carapace length after ten years. Females generally reach 120 mm in the

same period. Growth rates also vary spatially, with growth faster in the east than in the west (DPI, 2009).

Adult rock lobsters are carnivorous and feed mostly at night on a variety of bottom dwelling invertebrates such as molluscs, crustaceans and echinoderms. Major predators include octopus and various large fish and sharks. In Victoria, the abundance of rock lobster decreases from west to east reflecting a decreasing area of suitable rocky reef habitat (DPI, 2009). Rocky reef is present as scattered patches in and around the operational area in waters less than 20 m (see Section 5.1.2), so it is possible that southern rock lobsters occur in this habitat (see Figure 5.5).

As noted earlier in this section, the CarbonNet-commissioned marine habitat survey did not observe any southern rock lobsters in any reef areas (noting that they are a cryptic species that takes shelter in rocky crevices when not feeding at night). However, anecdotal information provided from the commercial fishing industry and the VFA indicates that a limited amount of rock lobsters are caught from the patch reef (timing and frequency are unknown) towards the northeast of the proposed acquisition area.

5.4.2. Flora

Literature searches, combined with OSRA mapping, indicate that marine flora, such as seagrasses and kelp, are generally not abundant in the extensive areas of subtidal sand flats in the nearshore waters of the EMBA. This is likely to be due to the high energy nature of the Gippsland coastline and the mobile nature of sands, which prevents many species being able to anchor themselves.

A search of the VBA database indicates that 50 marine flora species (macroalgae, excluding seagrass species) have been recorded in the EMBA, with none of these species listed as threatened under the FFG Act.

Areas where marine flora does occur, typically on hard substrates such as rocky reef, are described in Section 5.2.5 (TECs) and Section 5.2.9 (Victorian marine protected areas). Barton et al (2012) report that in the Ninety Mile Beach MNP (14.5 km west of the proposed acquisition area), reefs have sparse floral communities of small red algae. Given the park's proximity, this may be expected to be representative of flora present on rocky reefs in the proposed acquisition area.

As noted earlier in this section, the CarbonNet-commissioned marine habitat assessment observed some isolated and sparse seagrass beds in the operational area (sampling sites 4, 13, 16, 44 and 60) (see Photo 5.5). Large brown algae (*Ecklonia radiata* and *Sargassum*) was noted at site 67 (inshore reef area).

5.4.3. Plankton

Plankton is a key component in oceanic food chains, and comprises two elements; phytoplankton and zooplankton, as described herein.

Phytoplankton (photosynthetic microalgae) drift with the currents, though some species have the ability to migrate short distances through the water column using ciliary hairs. Phytoplankton biomass is greatest at the extremities of Bass Strait (particularly in the northeast) where water is shallow and nutrient levels are high.

Zooplankton is the faunal component of plankton, comprised of small crustaceans (such as krill) and fish larvae that feed on zooplankton. Zooplankton include species that drift with the currents and also those that are motile. More than 170 species of zooplankton have been recorded in eastern and central Bass Strait, with copepods making up approximately half of the species encountered (Watson & Chaloupka, 1982). Although a high diversity of zooplankton has been recorded, Kimmerer and McKinnon (1984) found that seven dominant species make up 80% of individuals.

5.4.4. Fish

It is estimated that there are over 500 species of fish found in the waters of Bass Strait, including a number of species of importance to commercial and recreational fisheries (LCC, 1993). Fish species commercially fished in and around the proposed survey are listed in Section 5.6.2. Other fish species known to occur within protected areas of the EMBA are listed in Section 5.2.8 (Victorian marine protected areas).

There are 39 fish species (31 of which are seahorses and pipefish) recorded in the EPBC Act PMST as potentially occurring in the EMBA (Table 5.7). The threatened and migratory species are described in this section.

A search of the VBA database indicates that 68 fish species have been recorded in the EMBA, with none of these species listed as threatened under the FFG Act (one species listed as threatened is a freshwater species) or under the EPBC Act. These species include perches (*Caesioperca* spp.), leatherjacket (*Meuschenia* spp.), wrasse (*Notolabrus* spp. and *Pseudolabrus* spp.), sweeps (*Scorpiis* spp.) and stingarees (*Urolophus* spp.) among others.

Table 5.7. EPBC Act-listed fish that may occur in the EMBA

Scientific name	Common name	EPBC Act status			BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species		
Freshwater						
<i>Galaxiella pusilla</i>	Dwarf galaxias	V	-	-	-	AS
<i>Prototroctes maraena</i>	Australian grayling	V	-	-	-	RP, AS
Oceanic						
<i>Carcharias taurus</i>	Grey nurse shark (east coast population)	CE	-	-	-	AS
<i>Carcharodon carcharias</i>	Great white shark	V	Yes	-	B/N	RP, AS
<i>Epinephelus daemeli</i>	Black rockcod	V	-	-	-	NSW only
<i>Isurus oxyrinchus</i>	Shortfin mako	-	Yes	-	-	-
<i>Lamna nasus</i>	Porbeagle	-	Yes	-	-	-
<i>Rhincodon typus</i>	Whale shark	V	Yes	-	-	Expired
Pipefish, seahorses and seadragons						
<i>Heraldia nocturna</i>	Upside-down pipefish	-	-	Yes	-	-
<i>Hippocampus abdominalis</i>	Big-belly seahorse	-	-	Yes	-	-
<i>Hippocampus breviceps</i>	Short-head seahorse	-	-	Yes	-	-

Scientific name	Common name	EPBC Act status			BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species		
<i>Hippocampus minotaur</i>	Bullneck seahorse	-	-	Yes	-	-
<i>Hippocampus whitei</i>	White's seahorse	-	-	Yes	-	-
<i>Histiogamphelus briggsii</i>	Crested pipefish	-	-	Yes	-	-
<i>Histiogamphelus cristatus</i>	Rhino pipefish	-	-	Yes	-	-
<i>Hypselognathus rostratus</i>	Knifesnout pipefish	-	-	Yes	-	-
<i>Kaupus costatus</i>	Deepbody pipefish	-	-	Yes	-	-
<i>Kimblaeus bassensis</i>	Trawl pipefish	-	-	Yes	-	-
<i>Leptoichthys fistularius</i>	Brushtail pipefish	-	-	Yes	-	-
<i>Lissocampus caudalis</i>	Australian smooth pipefish	-	-	Yes	-	-
<i>Lissocampus runa</i>	Javelin pipefish	-	-	Yes	-	-
<i>Maroubra perserrata</i>	Sawtooth pipefish	-	-	Yes	-	-
<i>Mitotichthys semistriatus</i>	Halfbanded pipefish	-	-	Yes	-	-
<i>Mitotichthys tuckeri</i>	Tucker's Pipefish	-	-	Yes	-	-
<i>Notiocampus ruber</i>	Red pipefish	-	-	Yes	-	-
<i>Phycodurus eques</i>	Leafy seadragon	-	-	Yes	-	-
<i>Phyllopteryx taeniolatus</i>	Common seadragon	-	-	Yes	-	-
<i>Pugnaso curtirostris</i>	Pugnose pipefish	-	-	Yes	-	-
<i>Solegnathus robustus</i>	Robust pipehorse	-	-	Yes	-	-
<i>Solegnathus spinosissimus</i>	Spiny pipehorse	-	-	Yes	-	-
<i>Stigmatopora</i>	Spotted pipefish	-	-	Yes	-	-

Scientific name	Common name	EPBC Act status			BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species		
<i>argus</i>						
<i>Stigmatopora nigra</i>	Widebody pipefish	-	-	Yes	-	-
<i>Stigmatopora olivacea</i>	A pipefish	-	-	Yes	-	-
<i>Stipecampus cristatus</i>	Ringback pipefish	-	-	Yes	-	-
<i>Syngnathoides biaculeatus</i>	Double-end pipehorse	-	-	Yes	-	-
<i>Urocampus carinirostris</i>	Hairy pipefish	-	-	Yes	-	-
<i>Vanacampus margaritifer</i>	Mother-of-pearl pipefish	-	-	Yes	-	-
<i>Vanacampus phillipi</i>	Port Phillip pipefish	-	-	Yes	-	-
<i>Vanacampus poecilolaemus</i>	Longsnout pipefish	-	-	Yes	-	-

Definitions

<i>Listed threatened species:</i>	A native species listed in Section 178 of the <i>EPBC Act</i> as either extinct, extinct in the wild, critically endangered, endangered, and vulnerable or conservation dependent.
<i>Listed migratory species:</i>	A native species that from time to time is included in the appendices to the Bonn Convention and the annexes of JAMBA, CAMBA and ROKAMBA, as listed in Section 209 of the <i>EPBC Act</i> .
<i>Listed marine species:</i>	As listed in Section 248 of the <i>EPBC Act</i> .

Key

EPBC status (@ Dec 2016)	V	Vulnerable
	E	Endangered
	CE	Critically endangered
BIA	A	Aggregation
	D	Distribution (i.e., presence only)
	F	Foraging
	M	Migration
Recovery plans	CA	Conservation Advice
(under the EPBC Act 1999)	CMP	Conservation Management Plan
	RP	Recovery Plan
(under the FFG Act 1988)	AS	Action Statement

Dwarf galaxias (*Galaxiella pusilla*) (EPBC Act: Vulnerable, FFG Act: Threatened)

Habitat suitable to the dwarf galaxias is slow flowing and still, shallow, permanent and temporary freshwater habitats such as swamps, drains and the backwaters of streams and creeks, often (but not always) containing dense aquatic macrophytes and emergent plants (Saddler *et al.*, 2010; DELWP, 2015a). Given the marine nature of the activity, this species will not be encountered within the proposed acquisition area.

The rivers noted by DELWP (2015) as being important to the species are not intersected by the EMBA. This species is not listed in the VBA search for the EMBA.

Australian grayling (*Prototroctes maraena*) (EPBC Act: Vulnerable, FFG Act: Threatened)

The Australian grayling is a dark brown to olive-green fish attaining 19 cm in length. The species typically inhabits the coastal streams of New South Wales, Victoria and Tasmania, migrating between streams and the ocean (Backhouse *et al.*, 2008; DELWP, 2015b). The species spends most of its life in freshwater (DELWP, 2015b), and migrates to lower reaches of rivers to spawn in autumn (Museums Victoria, 2017), though timing is dependent on many variables including latitude and varying temperature regimes (Backhouse *et al.*, 2008), with increased stream flows also thought to initiate migration (DELWP, 2015b).

The Australian Grayling Action Statement (DELWP, 2015b) lists several rivers intersected by the EMBA (at their mouths, when open) as important locations for the species. The species may therefore be present in the EMBA in the rare event that creek and river mouths are open during summer.

The National Recovery Plan for the Australian Grayling (Backhouse *et al.*, 2008) and The Australian Grayling Action Statement (DELWP, 2015b) list the threatening processes to this species as barriers to movement, river regulation, poor water quality, siltation, introduced fish, climate change, diseases and fishing. These impacts will not result from proposed MSS.

This species is not listed in the VBA search for the EMBA.

Grey nurse shark (*Carcharias taurus*) (EPBC Act: Critically endangered, FFG Act: Threatened)

The grey nurse shark is a large robust species that has become critically endangered due to commercial fishing, spearfishing and protective beach meshing (DoE, 2014; Museums Victoria, 2017). It was historically widespread in sub-tropical and warm temperate seas and previously recorded from all Australian states except Tasmania, and have all but disappeared from Victorian waters (Museums Victoria, 2017). Only one record of the species occurs from Gippsland, at Mallacoota Inlet in the early 1970s (DSE, 2003a).

The species currently has a broad inshore distribution throughout sub-tropical to cool temperate waters on the continental shelf, with separate east coast and west coast populations (DSE, 2003a; DoE, 2014). The east coast population extends from central Queensland to southern NSW, occasionally as far south as the NSW/Victoria border (DoE, 2014), which coincides with the BIA for their distribution and breeding (October to November).

Preferred habitat for grey nurse sharks is inshore rocky reefs or islands, generally aggregating near the seabed in water depths of 10-40 m in deep sandy or gravel-filled gutters, or in rockcaves (DSE, 2003a; DoE, 2014). There are no aggregation sites located off the Victorian coast (DoE, 2014).

Given the current distribution of the grey nurse shark, it is unlikely to occur within the proposed acquisition area or the EMBA. This species is not listed in the VBA search for the EMBA.

Great white shark (*Carcharodon carcharias*) (EPBC Act: Vulnerable, FFG Act: Threatened)

The great white shark is widely distributed and located throughout temperate and sub-tropical waters, with their known range in Australian waters including all coastal areas except the Northern Territory (DSEWPaC, 2013).

Studies of great white sharks indicate that they are usually solitary animals, largely transient and only temporarily resident (e.g., days to weeks) in areas it inhabits (DSE, 2003b; DSEWPaC, 2013). However, individuals are known to return to feeding grounds on a seasonal basis (Klimley & Anderson, 1996). The species moves seasonally along the south and east Australian coasts, moving northerly along the coast during autumn and winter and returning to southern Australian waters by early summer.

Observations of adult sharks are more frequent around fur seal and sea lion colonies, including Wilsons Promontory (approximately 97 km southwest of the proposed acquisition area) and the Skerries (approximately 177 km northeast of the proposed acquisition area) (DSE, 2003b).

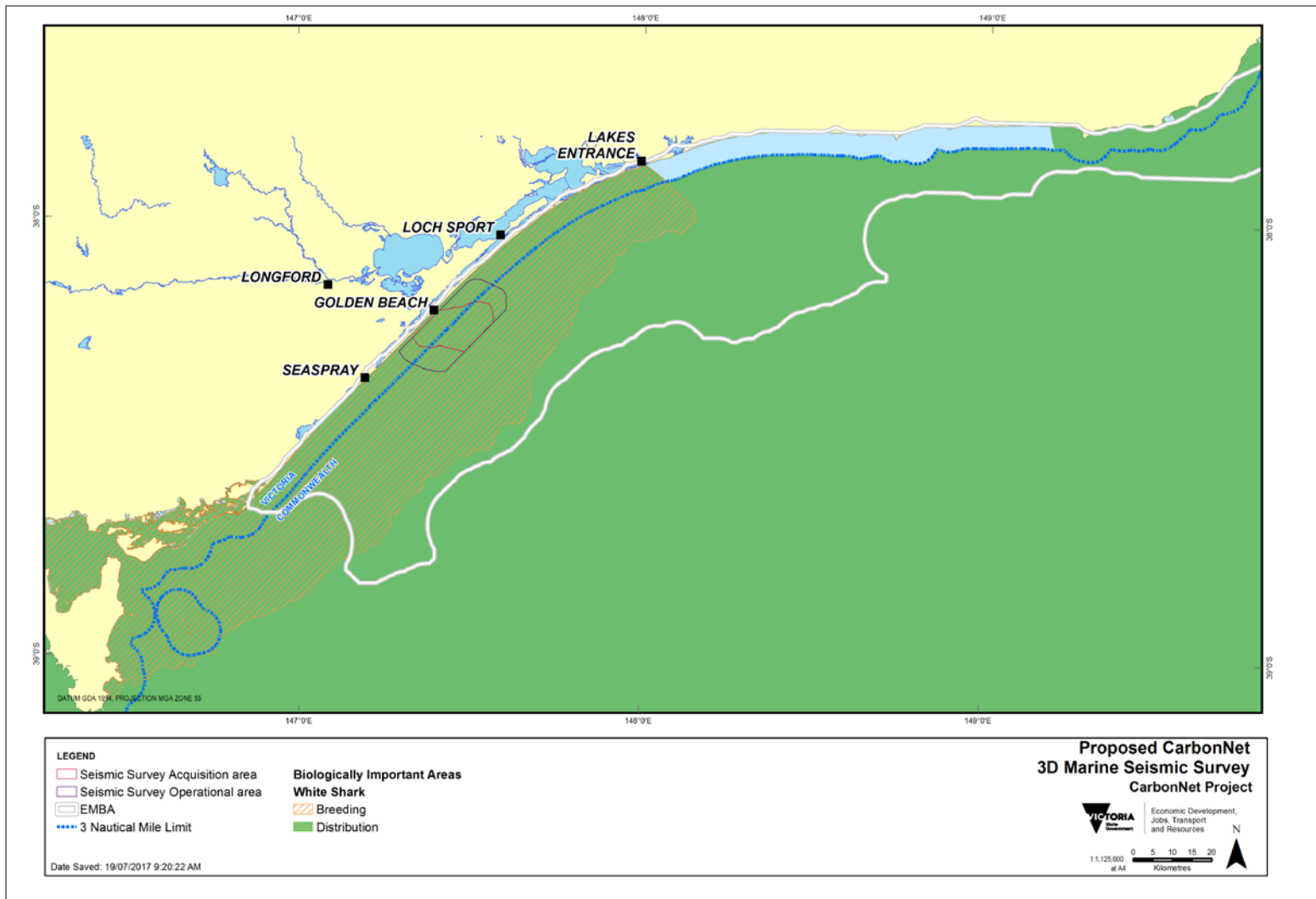
Juveniles are known to congregate in certain key areas including the Ninety Mile Beach area (including Corner Inlet and Lakes Entrance), where a BIA for breeding is overlapped by the proposed survey area (Figure 5.12).

Museums Victoria (2017) indicates that Corner Inlet may be an important nursery area for the eastern population of great white sharks, mostly from mid-summer through to autumn (DSEWPaC, 2013). A BIA (distribution only) for the great white shark covers the entire southeast marine region, with the nearest feeding BIA being around Kangaroo Island in South Australia (870 km to the west-northwest).

Key threats to the species, as listed in the White Shark Recovery Plan (DSEWPC, 2013) and Great White Shark Action Statement (DSE, 2003b) are mortality from targeted fishing, accidental fishing bycatch and illegal fishing, and mortality from shark control activities (such as beach meshing and drumlining), none of which will take place during the proposed MSS. Similarly, the MSS will have no impact on the 10 objectives for protection listed in the plan.

Given their transitory nature and the proximity of known congregation areas, great white sharks may occur within the proposed acquisition area and EMBA, and they may have a seasonale overlap if the survey is conducted during early summer.

This species is not listed in the VBA search for the EMBA.



Source: National Conservation Values Atlas (DoEE, 2017a).

Figure 5.12. BIA for the great white shark

Black rockcod (*Epinephelus daemeli*) (EPBC Act: Vulnerable, FFG Act: Not listed)

The black rockcod is a large cod species distributed in warm temperate to temperate marine waters of south-eastern Australia, from southern Queensland to Mallacoota in Victoria (206 km northeast of the proposed acquisition area), and rarely west of this point (Museums Victoria, 2017). The species inhabits caves, gutters and crevices generally to depths of 50 m, with juveniles found inshore. Individuals are highly territorial and have small home ranges (Museums Victoria, 2017). The black rockcod is a protogynous hermaphrodite, meaning it changes sex from female to male during its life cycle. The species has declined in number due to angling and spearfishing (Museums Victoria, 2017).

Given their known distribution, the black rockcod is not likely to be present within the proposed acquisition area, but may occur in suitable habitat within the EMBA. This species is not listed in the VBA search for the EMBA.

Shortfin mako shark (*Isurus oxyrinchus*) (EPBC Act: Listed migratory, FFG Act: Not listed)

The shortfin mako shark is a pelagic species with a circum-global, wide-ranging oceanic distribution in tropical and temperate seas (Mollet *et al.*, 2000), though the timing of occurrence is not reported. It is widespread in Australian waters, commonly found in water with temperatures greater than 16°C (Museums Victoria, 2017). Populations of the shortfin mako are considered to have undergone a substantial decline globally. These sharks are common by-catch species of commercial fisheries (Mollet *et al.*, 2000).

Due to their widespread distribution in Australian waters, shortfin mako sharks may be encountered in the proposed acquisition area and EMBA, albeit in low numbers. This species is not listed in the VBA search for the EMBA.

Porbeagle shark (*Lamna nasus*) (EPBC Act: Listed migratory, FFG Act: Not listed)

The porbeagle shark is widespread in the southern waters of Australia (Museums Victoria, 2017), though the timing of occurrence is not reported. The species preys on bony fishes and cephalopods, and is an opportunistic hunter that regularly moves up and down in the water column, catching prey in mid-water as well as at the seafloor. It is most commonly found over food-rich banks on the outer continental shelf, but does make occasional foray close to shore or into the open ocean, down to depths of approximately 1,300 m. It also conducts long-distance seasonal migrations, generally shifting between shallower and deeper water (Pade *et al.*, 2009).

Due to their widespread distribution in Australian waters, porbeagle sharks may be encountered in the proposed acquisition area and EMBA, albeit in low numbers. This species is not listed in the VBA search for the EMBA.

Whale shark (*Rhincodon typus*) (EPBC Act: Vulnerable, listed migratory, FFG Act: Not listed)

The whale shark is the world's largest fish and one of only three filter-feeding shark species (TSSC, 2015a). They have a broad distribution in warm and tropical waters of the world, and in Australia are known only to occur on the west coast of Western Australia, with a feeding aggregation occurring off the Ningaloo Reef between March and July each year (TSSC, 2015a). The species is not known to migrate through Bass Strait, and it is highly unlikely to occur within the proposed acquisition area or the EMBA.

Sygnathids (EPBC Act: Listed marine species, FFG Act: Not listed)

Thirty-one of the marine ray-finned fish species identified in the EPBC Act PMST are sygnathiformes, which includes seahorses, seadragon, pipehorse and pipefish. The majority of these fish species are associated with seagrass meadows, macroalgal seabed habitats, rocky reefs and sponge gardens located in shallow, inshore waters (e.g., protected coastal bays, harbours and jetties) less than 50 m deep (Museums Victoria, 2017). They are sometimes recorded in deeper offshore waters, where they depend on the protection of sponges and rafts of floating seaweed such as *Sargassum*.

The PMST species profile and threats profiles indicate that the sygnathiforme species listed for the EMBA are widely distributed throughout southern, south-eastern and south-western Australian waters. The diverse range of ecological niches afforded by the shallow waters of the proposed acquisition area and the EMBA would be expected to provide suitable habitat for these listed species. No sygnathids are recorded in the VBA database within the EMBA and none were observed within the sparse seagrass beds during the CarbonNet-commissioned marine environmental assessment undertaken in early April 2017 (noting however that they can be very difficult to sight).

Potential Site-attached Species

The CarbonNet-commissioned marine habitat assessment found patch reef and sponge gardens at various sites within the proposed acquisition area (see Figure 5.6). Site-attached species observed during this survey found:

- Site 61 – reef habitat containing butterfly perch (*Caesioperca lepidoptera*), wrasse (*Labridae* sp.), goatfish (*Upeneichthys vlamingii*) and bearded rock cod (*Pseudophycis* sp.);
- Sites 29 and 39 – sponge habitat containing butterfly perch (*C. lepidoptera*), morwong (*Cheilodactylus* sp.), cowfish (*Arcana* sp.) and boarfish (*Pentaceropsis recurvirostris*);
- Sites 64 and 65 – reef habitat containing butterfly perch (*C. lepidoptera*), and boarfish (*P. recurvirostris*).

Other Fish Species of Stakeholder Concern

During stakeholder consultation, some commercial fisheries associations and individual fishers have expressed concerns about the effect of the proposed Pelican 3DMSS on their target species (see Chapter 4), which are described below. None of the following species are listed as threatened under the EPBC Act or FFG Act unless otherwise noted.

School shark

The school shark (*Galeorhinus galeus*) is a small and slender shark distributed from southern Queensland to Perth in WA, preferring coastal waters (but also found in waters up to 800 m deep). The species is highly migratory and bottom-dwelling in nature (though it does range through the water column), and juvenile sharks are found in shallow inshore bays in Victoria (Museums Victoria, 2017; AFMA, 2015).

Adult school sharks feed on bony fish, squid and octopus, while juveniles feed on crustaceans, polychaete worms, gastropods and echinoderms (Museums Victoria, 2017). They are a very long-lived species (up to 55 years), with males maturing at 8-10 years and females maturing at 10-15 years.

During consultation with the SSFAssn, they stated that a possible pupping ground for this species occurs to the south of the proposed acquisition area. AFMA (2015)

states that school sharks have been recorded to pup in a variety of sheltered bays and inlets in Victorian and Tasmania and that heavily pregnant females are found in warm shallow waters, thought to promote embryo growth (AFMA, 2015). Stevens and Last (1997) notes that school sharks gave birth during November and December in protected bays and channels on low energy coastlines in Victoria and Tasmania (such as Port Phillip Bay, Westernport Bay and Corner Inlet). From March onwards, juveniles move out of inshore bays into deeper waters (Stevens and Last, 1997). Stevens and Last (1997) note that research cruises undertaken by MAFRI in 1973-76 and the CSIRO in 1994-96 have found pups in open coastal waters, some of which (such as the Ninety Mile Beach) coincide with areas considered by the fishing industry to be pupping grounds.

Females have a mean litter size of 28 pups (Museums Victoria, 2017) every three years after reaching 16 years in age (AFMA, 2015). The FRDC (2017) lists the species as overfished.

Gummy shark

The gummy shark (*Mustelus antarcticus*) is a small slender demersal shark, which along with the school shark (see below) is an important commercial (and recreational) fisheries species (see Section 5.6.3) as it provides much of the 'flake' sold in fish and chip shops in southern Australia (Museums Victoria, 2017). This species is distributed from southern Queensland to Shark Bay in Western Australia, inhabiting estuaries and coastal waters in water depth typically up to 80 m (Museums Victoria, 2017; AFMA, 2017a). They can live up to 16 years, with females producing litters of about 14 pups (occasionally up to 40 pups) (Museums Victoria, 2017; AFMA, 2017a).

Gummy sharks feed mostly on cephalopods and crustaceans and also bony fishes. The SSFAssn notes that a possible pupping ground for this species occurs to the south of the proposed acquisition area. Stevens and Last (1997) state that nursery areas for the gummy shark are less specific than those for school shark, though there were catches of pups in their sampling study in Port Phillip Bay and Westernport Bay.

Blue warehou

The blue warehou (*Seriolella brama*) is listed as 'conservation dependent' under the EPBC Act (and does not appear under the PMST list) and is commercially fished in the area (in the Southern and Eastern Scalefish Fishery). The decline of blue warehou throughout its Australian distribution is reported as severe (at least 80%) (TSSC, 2015b). It is an opportunistic predator of pelagic invertebrates. One study reported pyrosomes (free-floating colonial tunicates) as the predominant prey item, with another study reporting that the diet at any one site varied with depth and the distribution and abundance of prey species (TSSC, 2015b). The main threat to this species is its 'high catchability', that is, high vulnerability to fishing (TSSC, 2015b).

The main spawning period for the eastern stock of this species is reported as occurring between May and August each year and occurs over a wide range of areas, including southern NSW and eastern Victoria. Larvae disperse widely during the winter and spring months within shelf and slope waters, as far as Kangaroo Island off the South Australian coast and the western and eastern coastlines of Tasmania (TSSC, 2015b).

Jackass morwong

The jackass morwong (*Nemadactylus macropterus*) is a perch that grows to 80 cm in length, lives in waters up to 400 m deep with a distribution in all southern Australian shelf waters. It lives close to the seabed and is commonly associated with reefs, and is most commonly caught in water depths between 80 m and 170 m (deeper than the

proposed acquisition area) (Museums Victoria, 2017; AFMA, 2017a). This species is not listed under the EPBC Act.

Jackass morwong reach reproductive maturity at 3 years of age, with spawning occurring multiple times from late summer to autumn and females producing up to one million eggs per spawning season (AFMA, 2017a). They have an extended pelagic post-larval stage (referred to as 'paperfish') with metamorphosis into juveniles occurring after 9-12 months (AFMA, 2017a).

This species has been observed in association with sponge gardens in the region (see Section 5.4.1) and is commercially fished in the Scalefish Hook Sector (part of the Southern and Eastern Scalefish and Shark Fishery, see Section 5.6.3). They feed at night on polychaete worms, crustaceans and molluscs, and are preyed on by fish, sharks and marine mammals (AFMA, 2017a).

Pilchard/sardine

Pilchards and sardines are terms often used interchangeably for small, oily fish in the herring family. In the Bass Strait context, Australian sardine (*Sardinops sagax*) is also referred to as Australian pilchard, blue pilchard, pilchard, and blue bait among others (Museums Victoria, 2017).

The FRDC (2017) suggests that the sardine population in Gippsland waters is part of the eastern Australian stock. The peak spawning season for this stock occurs from August to September from Sandy Cape in northeast Tasmania to just south of Newcastle in NSW, with information provided by one commercial fisher indicating spawning occurs inshore. Information provided by SIV indicates spawning occurs from November to February.

Sardines have a maximum life span of up to nine years. They are a highly fecund, fast-growing species that reaches a maximum length of approximately 20-25 cm, with half of the population reaching sexual maturity at approximately 150 mm in size (DEH, 2004; FRDC, 2017). Pilchards are the key prey species for little penguins and southern bluefin tuna, as well as crested terns (DEH, 2004; FRDC, 2017).

Populations of pilchards fluctuate markedly and mass mortality events have occurred in the fishery in 1995 and 1998-99, affecting the entire southern Australian pilchard population. These events were caused by a herpes virus (DEH, 2004; FRDC, 2017).

Salmon

Australian salmon (*Arripis trutta*) occurs in Australian waters from southern Queensland to western Victoria and northern Australia. It is distinct from the WA population (*A. truttaceus*) (Museums Victoria, 2017; FRDC, 2017). They grow up to 80-90 cm in length and live up to 12 years, mature at about 4 years of age and weigh up to 9 kg, more commonly reaching 3-4 kg (Museums Victoria, 2017; FRDC, 2017). This species migrates for thousands of kilometres along the coastline and form large schools along oceanic beaches and exposed coastal areas (Museums Victoria, 2017). Salmon prey on krill, copepods and polychaetes as juveniles and shift to consuming pilchards and anchovies as adults. They in turn are prey to cetaceans and large shark species.

Salmon spawn in the surf zone during late spring and summer, nominally November to February (Museums Victoria, 2017), with the strength of the EAC and Leeuwin Current influencing the distribution of spawning, larval dispersal and the strength and distribution of juvenile recruitment (FRDC, 2017). They spawn in batches rather than all at once.

Mackerel

It is thought that jack mackerel (*Trachurus declivis*) is the species referred to by fishers, as other mackerel fisheries are generally restricted to tropical waters. This is

a widespread pelagic schooling species distributed around the southeastern and southern coasts of Australia in waters 20-300 m deep, growing up to 50-65 cm in length, weighing up to 1.6 kg and living up to 17 years (AFMA, 2017a; Museums Victoria, 2017). Jack mackerel prey on krill, other planktonic crustaceans (such as copepods) and lantern fish, and are in turn preyed on by larger fish such as tuna, barracouta and gemfish.

Spawning occurs during late spring to early summer, with females spawning several times in a season, releasing about 34,000 eggs per event (AFMA, 2017a).

Tiger flathead

Based on the description of commercial fisheries in Section 5.6.3, the key flathead species caught commercially and recreationally off the Victorian coast is the tiger flathead (*Platycephalus richardsoni*). This species is endemic to the continental shelf and slope of south-eastern Australia and is found in water depths ranging from 10-400 m (Museums Victoria, 2017; AFMA, 2017a). It grows to a maximum length of 70 cm and has a maximum weight of 3 kg, but more commonly reaches 1.3 kg in weight. Tiger flathead feed on other fish and benthic crustaceans, and unusually for flathead, they possess a swim bladder that allows them to feed in the water column (Museums Victoria, 2017).

Tiger flathead reach reproductive maturity at 3-5 years of age, and spawning occurs over an extended period from spring to autumn, with timing dependent on location. Information provided by SIV indicates spawning occurs from December to February. Females produce 1.5-2.5 million eggs per spawning season (AFMA, 2017a).

Southern sand flathead

The southern sand flathead (*Platycephalus bassensis*) is endemic to temperate coastal waters of southern Australia, and is common in Victoria. About 95% of catch effort is recreational (FRDC, 2017). This flathead lives on sandy, muddy or shelly bottoms in shallow coastal bays to depths of about 100 m (Museums Victoria, 2017). This species grows to a maximum length of 55 cm and weighs up to 1.3 kg. Southern sand flathead is an ambush predator that feeds on other fish and benthic crustaceans (Museums Victoria, 2017). Females spawn from late winter to December, with eggs and larvae being pelagic.

Dusky flathead

The dusky flathead (*Platycephalus fuscus*) is a common flathead in eastern Australia (from Cairns in Queensland to the Gippsland Lakes), found on sandy and silty bottoms in estuaries, coastal bays and sheltered reefs in water depths up to 25 m (Museums Victoria, 2017). It is the largest Australian flathead species, growing to a maximum length of 1.2 m and can attain a weight of 15 kg (but typically less than 6 kg) and is noted as being a very important recreational fish target (Museums Victoria, 2017). The FRDC (2017) notes that most catches of this species in Victoria are in the Gippsland Lakes

The dusky flathead is predator that feeds on other fish, crustaceans and sand-dwelling squid (Museums Victoria, 2017). Females take about 4 years to reach sexual maturity and release between 294,000 to 3.95 million eggs (Museums Victoria, 2017) or up to 4.8 million eggs (FRDC, 2017) during spawning (spawning period is not defined).

Yelloweye mullet

The yelloweye mullet (*Aldrichetta forsteri*) is the most common mullet species found in southern Australian waters, and is a small fish usually growing to about 30 cm in length (Museums Victoria, 2017; FRDC, 2017). This species forms schools in shallow waters (up to 10 m) over sandy and muddy bottoms or seagrass beds in bays and

estuaries (Museums Victoria, 2017). Yelloweye mullet feeds on plant, animal and detrital material, with the adults mostly scavenging on organic matter, and juveniles feeding on plankton and small benthic invertebrates. The eastern population spawns during summer (Museums Victoria, 2017).

In Victoria, the greatest catches of yelloweye mullet are from the Gippsland Lakes, Corner Inlet and Port Phillip Bay, with catches in the Gippsland Lakes (mostly by mesh net) declining over the last 30 years. The estimated catch across Victoria for 2015/16 was 35 tonnes (FRDC, 2017).

Whiting

Based on the description of commercial fisheries in Section 5.6.3, the key whiting species caught in the EMBA is the eastern school whiting (*Sillago flindersi*). This species lives up to 7 years and grows to about 33 cm in length and up to 200 grams in weight (AFMA, 2017a). Eastern school whiting is a benthic species found in tidal flats to waters as deep as 180 m and are normally associated with sandy seabed. They prey on crustaceans, molluscs and polychaetes and are in turn preyed upon by larger fish, birds and dolphins (AFMA, 2017a).

Eastern school whiting reach reproductive maturity at about 2 years of age, with spawning occurring from October to March in eastern Bass Strait, with females producing 30,000-110,000 eggs per spawning season and spawning twice each year in deeper waters (AFMA, 2017a). Information provided by SIV indicates spawning occurs from September to February.

5.4.5. Cetaceans

The PMST indicates that 23 whale species and seven dolphin species may reside within or migrate through the EMBA (Table 5.8). A description of species listed in Table 5.8 is focused on threatened and migratory species.

A search of the VBA database indicates that seven whale species (minke, blue, southern right, humpback, sperm, pygmy sperm and false killer whales) and three dolphin species (common, killer whale and bottlenose dolphins) have been recorded in the EMBA. All these species are captured under the PMST as listed in Table 5.8.

Table 5.8. EPBC Act-listed cetaceans that may occur in the EMBA

Scientific name	Common name	EPBC Act status			FFG Act status	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Whales							
<i>Balaenoptera acutorostrata</i>	Minke whale	-	-	Yes	-	-	-
<i>Balaenoptera bonaerensis</i>	Antarctic minke whale	-	Yes	Yes	-	-	-
<i>Balaenoptera borealis</i>	Sei whale	V	Yes	Yes	-	-	CA
<i>Balaenoptera edeni</i>	Bryde's whale	-	Yes	Yes	-	-	-
<i>Balaenoptera musculus</i>	Blue whale (pygmy)	E	Yes	Yes	T	F	RP, AS

Scientific name	Common name	EPBC Act status			FFG Act status	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
<i>Balaenoptera physalus</i>	Fin whale	V	Yes	Yes	-	-	CA
<i>Berardius arnuxii</i>	Arnoux's beaked whale	-	-	Yes	-	-	-
<i>Caperea marginata</i>	Pygmy right whale	-	Yes	Yes	-	F	-
<i>Eubalaena australis</i>	Southern right whale	E	Yes	Yes	T	M/R	CMP, AS
<i>Globicephala macrorhynchus</i>	Short-finned pilot whale	-	-	Yes	-	-	-
<i>Globicephala melas</i>	Long-finned pilot whale	-	-	Yes	-	-	-
<i>Kogia breviceps</i>	Pygmy sperm whale	-	-	Yes	-	-	-
<i>Kogia simus</i>	Dwarf sperm whale	-	-	Yes	-	-	-
<i>Megaptera novaeangliae</i>	Humpback whale	V	Yes	Yes	T	-	CA, AS
<i>Mesoplodon bowdoini</i>	Andrew's beaked whale	-	-	Yes	-	-	-
<i>Mesoplodon densirostris</i>	Blainville's beaked whale	-	-	Yes	-	-	-
<i>Mesoplodon grayi</i>	Grey's beaked whale	-	-	Yes	-	-	-
<i>Mesoplodon hectori</i>	Hector's beaked whale	-	-	Yes	-	-	-
<i>Mesoplodon layardii</i>	Strap-toothed beaked whale	-	-	Yes	-	-	-
<i>Mesoplodon mirus</i>	True's beaked whale	-	-	Yes	-	-	-

Scientific name	Common name	EPBC Act status			FFG Act status	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
<i>Physeter macrocephalus</i>	Sperm whale	-	Yes	Yes	-	-	-
<i>Pseudorca crassidens</i>	False killer whale	-	-	Yes	-	-	-
<i>Ziphius cavirostris</i>	Cuvier's beaked whale	-	-	Yes	-	-	-
Dolphins							
<i>Delphinus delphis</i>	Common dolphin	-	-	Yes	-	-	-
<i>Grampus griseus</i>	Risso's dolphin	-	-	Yes	-	-	-
<i>Lagenorhynchus obscurus</i>	Dusky dolphin	-	Yes	Yes	-	-	-
<i>Lissodelphis peronii</i>	Southern right whale dolphin	-	-	Yes	-	-	-
<i>Orcinus orca</i>	Killer whale	-	-	Yes	-	-	-
<i>Tursiops aduncus</i>	Indian Ocean bottlenose dolphin	-	-	Yes	-	-	-
<i>Tursiops truncatus</i>	Bottlenose dolphin	-	-	Yes	-	-	-

Definitions

<i>Listed threatened species:</i>	A native species listed in Section 178 of the <i>EPBC Act</i> as either extinct, extinct in the wild, critically endangered, endangered, and vulnerable or conservation dependent.
<i>Listed migratory species:</i>	A native species that from time to time is included in the appendices to the Bonn Convention and the annexes of JAMBA, CAMBA and ROKAMBA, as listed in Section 209 of the <i>EPBC Act</i> .
<i>Listed marine species:</i>	As listed in Section 248 of the <i>EPBC Act</i> .

Key

EPBC Act status (@ Dec 2016)	V	Vulnerable
	E	Endangered

	CE	Critically endangered
FFG Act status (@ Sept 2017)	T	Threatened
BIA	A	Aggregation
	D	Distribution (i.e., presence only)
	F	Foraging
	M	Migration
Recovery plans	CA	Conservation Advice
	CMP	Conservation Management Plan
	RP	Recovery Plan

Antarctic minke whales (*Balaenoptera bonaerensis*) (EPBC Act: Listed migratory, FFG Act: Not listed)

The Antarctic minke whale (*Balaenoptera bonaerensis*) has been found in all Australian states except the Northern Territory (NT) and occupies cold temperate to Antarctic offshore and pelagic habitats between 21°S and 65°S (Bannister *et al.*, 1996). In summer the species is found in pelagic waters from 55°S to the Antarctic ice edge. During winter the species retreat to breeding grounds between 10-30°S, occupying oceanic waters exceeding 600 m depth and beyond the continental shelf break (DoEE, 2017i).

Mating occurs from June through December, with a peak in August and September and calving occurs during late May and early June in warmer waters north of the Antarctic Convergence (DoEE, 2017i). The species primarily feeds in the Antarctic during summer on Antarctic krill and does not appear to feed much while in the breeding grounds of lower latitudes (DoEE, 2017i).

No BIA for the Antarctic minke whale has been identified in, or in proximity to the proposed acquisition area. Given the species preferred habitat (deep water) and summer distribution, the likelihood of its occurrence within the proposed acquisition area and EMBA is considered to be low.

Sei whale (*Balaenoptera borealis*) (EPBC Act: Vulnerable, listed migratory, FFG Act: Not listed)

Sei whales are considered a cosmopolitan species, ranging from polar to tropical waters, but tend to be found in deeper waters (not often near the coast) than other species of large whales. This species is not often recorded in Australian waters (TSSC, 2015c).

Their global population is estimated to have declined by 80% over the previous three-generation period (TSSC, 2015c). The proportion of the global population in Australian waters is unknown as there are no estimates for sei whales in Australian waters.

Sei whales show well-defined migratory movements between polar, temperate and tropical waters. Migratory movements are essentially north-south with little longitudinal dispersion. Sei whales do not penetrate the polar waters as far as the blue, fin, humpback and minke whales (Horwood, 1987), although they have been observed very close to the Antarctic continent.

There are no known mating or calving areas in Australian waters, with the species presumed to breed in low-latitude waters (TSSC, 2015c). Sei whales move between Australian waters and Antarctic feeding areas, sub-Antarctic feeding areas (e.g., Subtropical Front), and tropical and sub-tropical breeding areas. Sei whales feed intensively between the Antarctic and sub-tropical convergences and mature animals

may also feed in higher latitudes. Sei whales feed on planktonic crustacea, in particular copepods and amphipods. Below the Antarctic convergence, sei whales feed exclusively upon Antarctic krill (*Euphausia superba*) (TSSC, 2015c).

The conservation advice for the sei whale nominates anthropogenic noise as a minor threat to the species.

Based upon the species preference for offshore waters, the absence of a BIA for the species in Australia, and the nearshore location of the survey area, it is considered unlikely that this species occurs within the proposed acquisition area or the EMBA.

Bryde's whale (*Balaenoptera edeni*) (EPBC Act: Listed migratory, FFG Act: Not listed)

Bryde's whale is a species restricted to tropical and temperate waters (generally found between latitudes of about 40°N and 40°S) and have been recorded off all Australian states (Bannister *et al.*, 1996). Bryde's whales can be found in both oceanic and inshore waters with the only key localities recognised in Australia being in the northern parts of the continent (DoEE, 2017i).

Population estimates are not available for Bryde's whales, globally or in Australia, and no migration patterns have been documented in Australian waters (DoEE, 2017i). Offshore populations have been recorded in depths of between 500 and 1,000 m. The species has been recorded around the Abrolhos Islands (WA) and in Queensland. Bannister *et al* (1996) states that they are likely to be found along the east and west coasts of Australia, and less so along the south coast.

With the absence of a BIA for the species in Australia and their key localities confined to the northern parts of Australia, it is not considered likely that this species occurs within the proposed acquisition area or the EMBA.

Pygmy blue whale (*Balaenoptera musculus*) (EPBC Act: Endangered, listed migratory, FFG Act: Threatened)

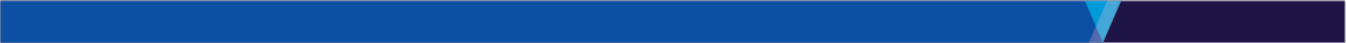
Blue whales are the largest living animals on earth, growing to a length of over 30 m, weighing up to 180 tonnes and living up to 90 years (DoE, 2015b). The DoE (2015b) recognises three overlapping populations, being:

- Antarctic blue whale population – all those Antarctic blue whales occupying or passing through Australian waters;
- Indo-Australian pygmy blue whale – all those pygmy blue whales occupying or passing through waters from Indonesia to western and southern Australia; and
- Tasman-Pacific pygmy blue whale – all those putative pygmy blue whales occupying or passing through waters in southeast Australia and the Pacific Ocean.

The Tasman-Pacific pygmy blue whale (*B. musculus. brevicauda*) is the sub-species that migrates through Bass Strait, found in waters north of 55°S (DSEWPC, 2012b). Blue whales are a highly mobile species that feed on krill (euphausids, *Nyctiphanes australis*).

A BIA for 'likely foraging' for the pygmy blue whale covers most of Bass Strait, including the proposed acquisition area, with known foraging areas (abundant food source/annual high use area) occurring off the southwest Victorian coast (Figure 5.13).

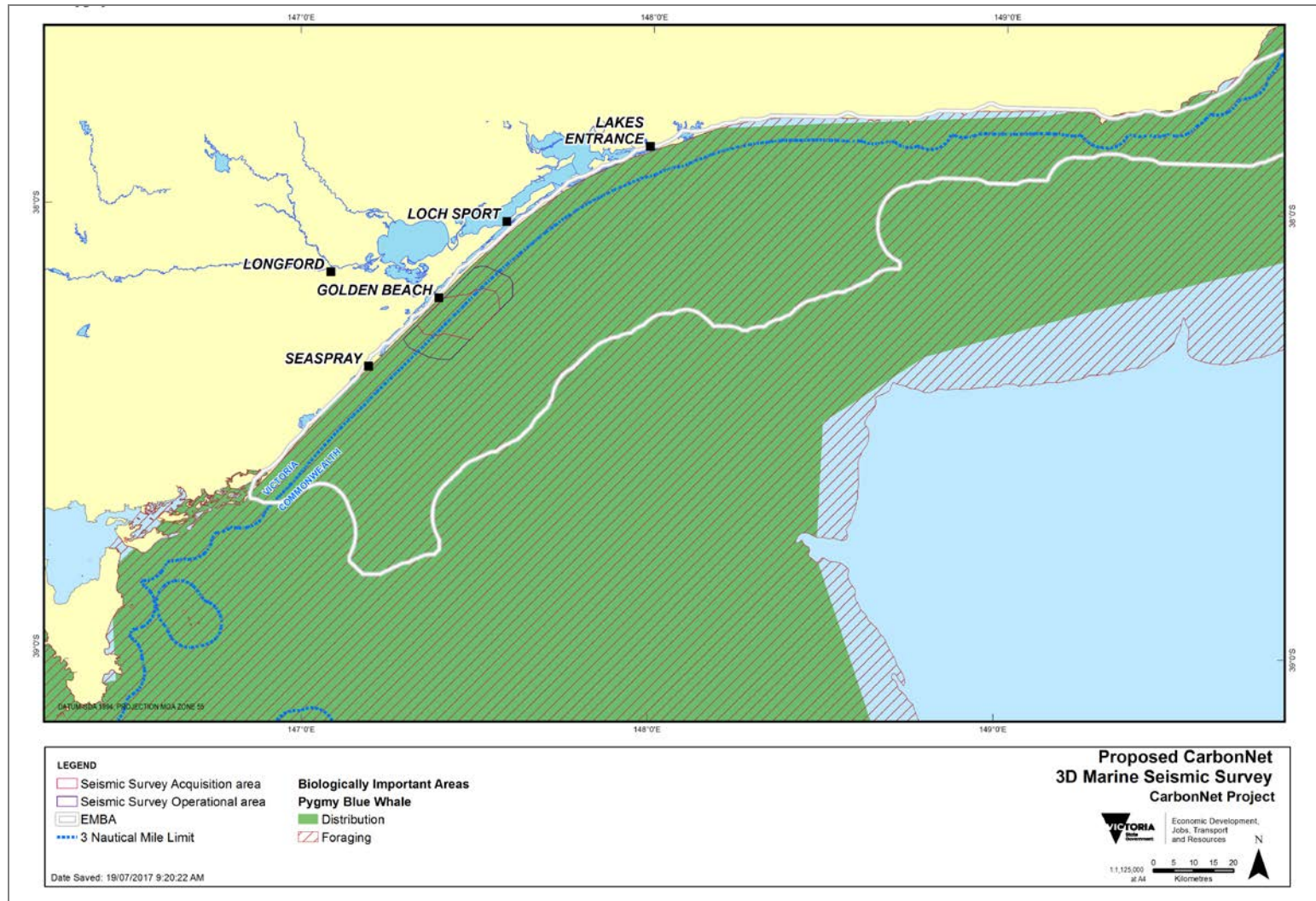
The time and location of the appearance of blue whales in the South-east Marine Region generally coincides with the upwelling of cold water in summer and autumn along the southeast South Australian and southwest Victoria coast (the Bonney



Upwelling) and the associated aggregations of krill that they feed on (DoE, 2015b; Gill and Morrice, 2003). This is a key feeding area for the species. The Bonney Upwelling generally starts in the eastern part of the Great Australian Bight in November or December and spreads eastwards to the Otway Basin around February as southward migration of the sub-tropical high-pressure cell creates upwelling favourable winds. Pygmy blue whales predominately occupy the western area of the Bonney Upwelling from November to December, and then move southeast during January to April, though the within-season distribution trends in Bass Strait are unknown (DoE, 2015b).

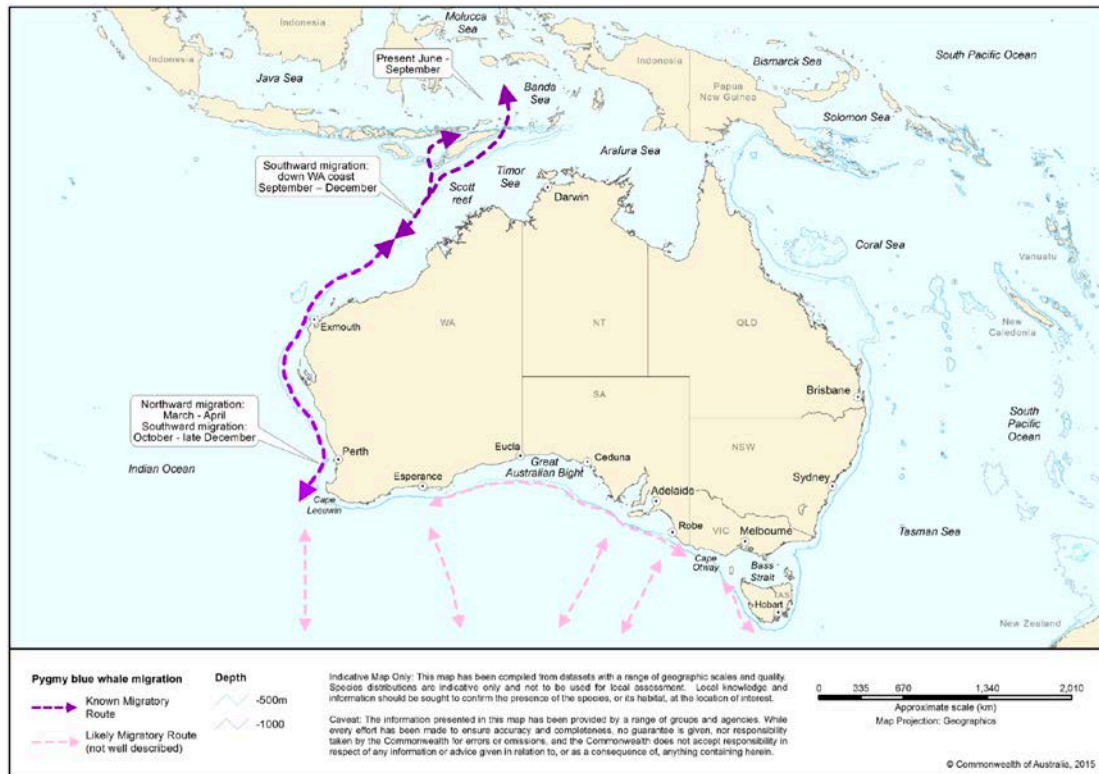
Esso has advised CarbonNet that there have been no sightings of blue whales from their facilities in the last five years (Bok, pers. comm., March 2017).

The DoE (2015b) states that migratory routes for pygmy blue whales off the east coast of Australia are unknown (as seen by the absence of migratory routes in Figure 5.14). However, blue whale migration patterns are thought to be similar to those of the humpback whale, with the species feeding in mid-to high-latitudes (south of Australia) during the summer months and moving to temperate/tropical waters in the winter for breeding and calving. Pygmy blue whale migration is oceanic and no specific migration routes have been identified in the Australasian region (DoE, 2015b).



Source: National Conservation Atlas (DoEE, 2017a).

Figure 5.13. Pygmy blue whale BIA



Source: DoE (2015).

Figure 5.14. Pygmy blue whale migration routes

The Conservation Management Plan for the Blue Whale (DoE, 2015b) identifies vessel strike and anthropogenic noise as threats to the species, the latter important as it may mask vocalisations or cause injury or death.

Given the intersection of the foraging BIA with the survey area, it is possible that pygmy blue whales may occur in the proposed acquisition area and the EMBA, though this possibility is low, and sightings would be most likely to occur during autumn.

Fin whale (*Balaenoptera physalus*) (EPBC Act: Vulnerable, listed migratory, FFG Act: Not listed)

The fin whale is the second-largest whale species after the blue whale, growing up to 27 m long and weighing up to 70 tonnes (TSSC, 2015d). It is a cosmopolitan species and is found from polar to tropical waters (more commonly in temperate waters) (TSSC, 2015d).

There are stranding records of this species from most Australian states, but they are considered rare in Australian waters (Bannister *et al.*, 1996), with available information suggesting they are more common in deeper water (TSSC, 2015d).

The total abundance and population trends of fin whales in Australian waters is unknown (TSSC, 2015d). They show well-defined long annual migrations between higher latitude feeding grounds in summer to lower latitude breeding ground in winter (TSSC, 2015d). Migratory movements are essentially north–south with little longitudinal dispersion.

The Conservation Advice (TSSC, 2015d) identifies vessel strike and anthropogenic noise as threats to the species, the latter important as it may mask vocalisations or cause injury or death.

Based upon the species preference for offshore waters, the absence of a BIA in Australian waters and the nearshore location of the survey area, it is considered unlikely that this species occurs within the proposed acquisition area or the EMBA survey.

Pygmy right whale (*Caperea marginata*) (EPBC Act: Listed migratory, FFG Act: Not listed)

Pygmy right whales are a little-studied baleen whale species found in temperate and sub-Antarctic waters in oceanic and inshore locations. The species, which has never been hunted commercially, is thought to have a circumpolar distribution in the Southern Hemisphere between about 30°S and 55°S. Distribution appears limited by the surface water temperature as they are almost always found in waters with temperatures ranging from 5° to 20°C (Baker, 1985).

There are few confirmed sightings of pygmy right whales at sea (Reilly *et al.*, 2008), with few or no records from eastern Victoria and no population estimates available for Australian waters (DoEE, 2017i). The largest reported group sighted (100+) occurred near Portland in June 2007 (Gill *et al.*, 2008).

Based upon the lack of sightings off eastern Victoria, the absence of a BIA in Australian waters and the nearshore location of the survey area, it is considered unlikely that this species occurs within the proposed acquisition area or the EMBA survey.

Southern right whale (*Eubalaena australis*) (EPBC Act: Endangered, listed migratory, FFG Act: Threatened)

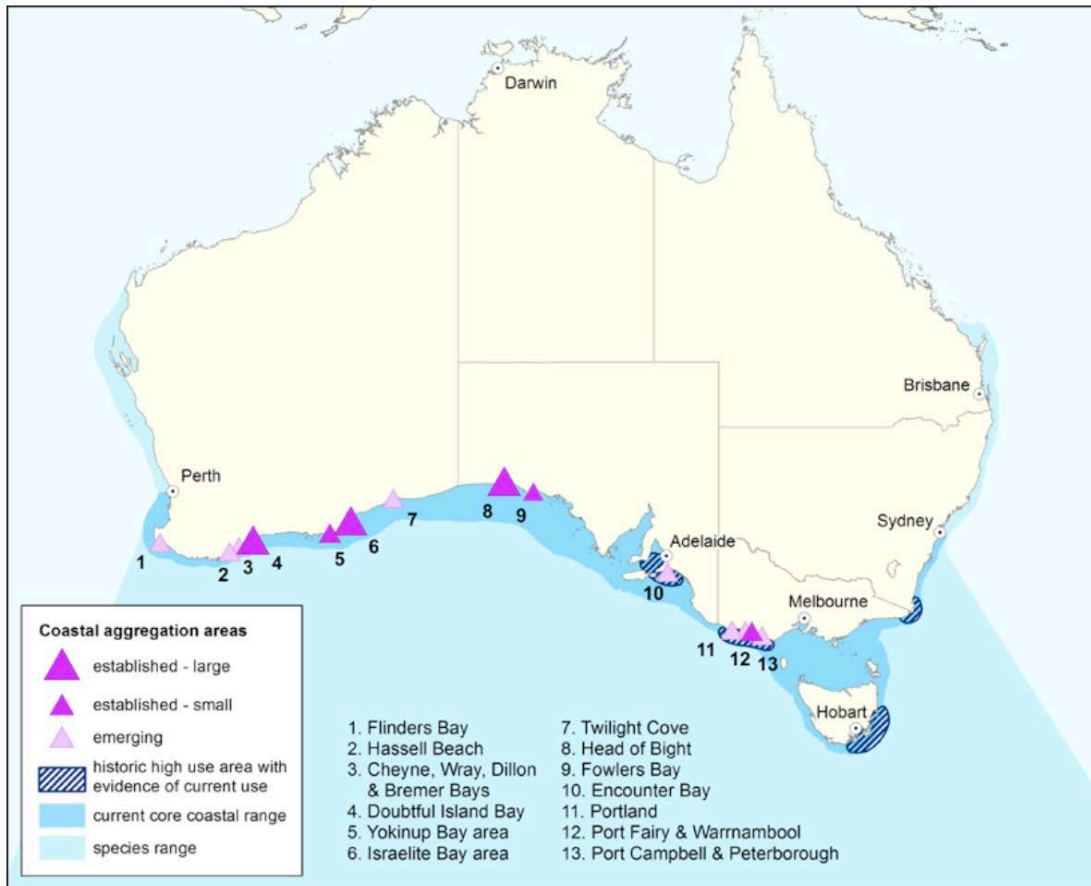
Southern right whales are medium to large black (or less commonly grey-brown) baleen whales (DSEWPC, 2012b). They are recognizable by the lack of a dorsal fin, rotund body shape, and whitish callosities (patches of keratinised skin colonised by cyamids - small crustaceans) on the head. They reach a maximum length of approximately 17.5 m and a weight of around 80 tonnes, with mature females slightly larger than males (DSEWPC, 2012b).

Nineteenth century whaling drastically reduced southern right whale numbers. An estimated 55,000 to 70,000 whales were present in the southern hemisphere in the late 1700s (DSEWPC, 2012b). However, by the 1920s there may have been fewer than 300 individuals remaining throughout the southern hemisphere (DSEWPC, 2012b). Other reports suggest the number of individuals in Australia was reduced to 1,500 (Charlton *et al.*, 2014). The Australian population is estimated at 3,500 individuals (Charlton *et al.*, 2014).

The southern right whale is typically distributed between 16°S and 65°S in the southern hemisphere and is present off the Australian coast between May and October (sometimes as early as April and as late as November) (DSEWPC, 2012b) (Figure 5.15).

Southern right whales tend to be distinctly clumped in aggregation areas (DSEWPC, 2012b). Aggregation areas are well known, with the only one in Victoria being at Warrnambool. A number of additional areas for southern right whales are emerging that might be of importance, particularly to the south-eastern population. In these areas, small but growing numbers of non-calving whales regularly aggregate for short periods of time. These areas include coastal waters off Peterborough, Port Campbell, Port Fairy and Portland in Victoria, located more than 400 km west of the proposed acquisition area, with waters less than 10 m deep preferred (DSEWPC, 2012b).

Esso has advised CarbonNet that there have been no sightings of blue whales from their facilities in the last five years (Bok, pers. comm., March 2017).

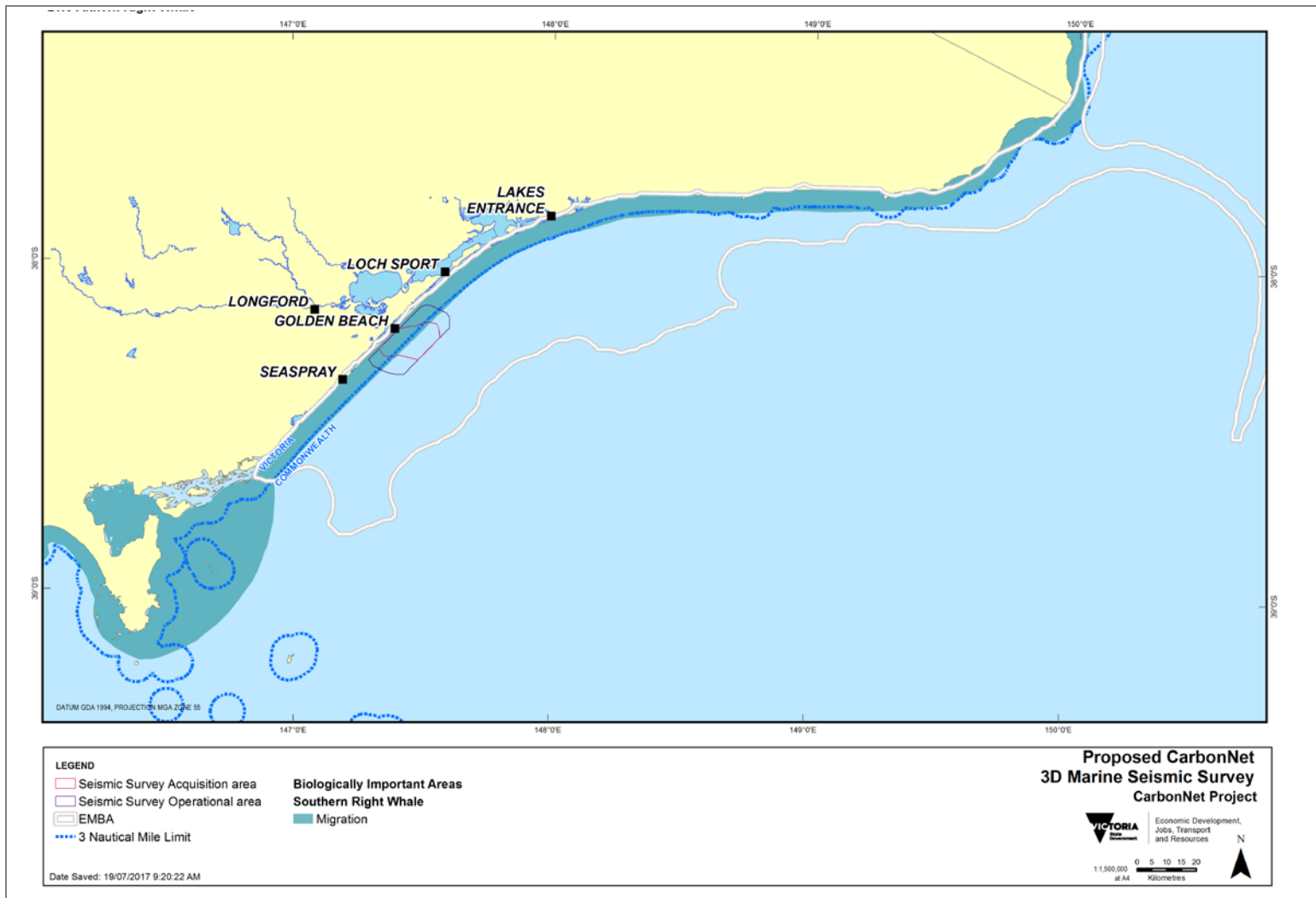


Source: DSEWPC (2012).

Figure 5.15. Southern right whale aggregation areas

The closest known calving/nursery grounds to the proposed acquisition area occurs at Logan’s Beach off the coast of Warrnambool in southwest Victoria (approximately 430 km west of the survey area) and intermittently at Portland (520 km northwest of the survey area) (DSEWPAC, 2012).

The National Conservation Values Atlas recognises a BIA for migration/resting on migration for the southern right whale through all Victorian state waters, including those around the proposed acquisition area (Figure 5.16), as they are known to generally occur within 2 km of shorelines (DSEWPC, 2012b).



Source: National Conservation Atlas (DoEE, 2017a).

Figure 5.16. Southern right whale BIA

However, a defined near-shore coastal migration corridor is considered unlikely given the absence of any predictable directional movement for the species (DSEWPC, 2012b).

Critical habitat for the southern right whale is not defined under the EPBC Act (DSEWPC, 2012b), though the BIA (aggregation area) illustrated in Figure 5.15 (around Warrnambool) may be considered critical habitat given that female southern right whales show calving site fidelity, which combined with their low and slow reproductive rate, make calving sites of critical importance to the species recovery (DSEWPC, 2012b).

Due to the uncertainties associated with the exact migratory paths in eastern Bass Strait, there is a low potential that southern right whales may be encountered through the survey area and EMBA between May and October (outside of the proposed survey period).

Humpback whale (*Megaptera novaeangliae*) (EPBC Act: Vulnerable, listed migratory, FFG Act: Threatened)

The humpback whale is a moderately large (15-18 m long) baleen whale that has a worldwide distribution but geographic segregation. In the 19th and 20th centuries, humpback whales were hunted extensively throughout the world's oceans and as a result it is estimated that 95% of the population was eliminated. In Australia, commercial whaling of humpback whales ceased in 1963 and until this time, it is estimated that humpback whales were reduced to between 3.5 and 5% of pre-whaling abundance (TSSC, 2015e).

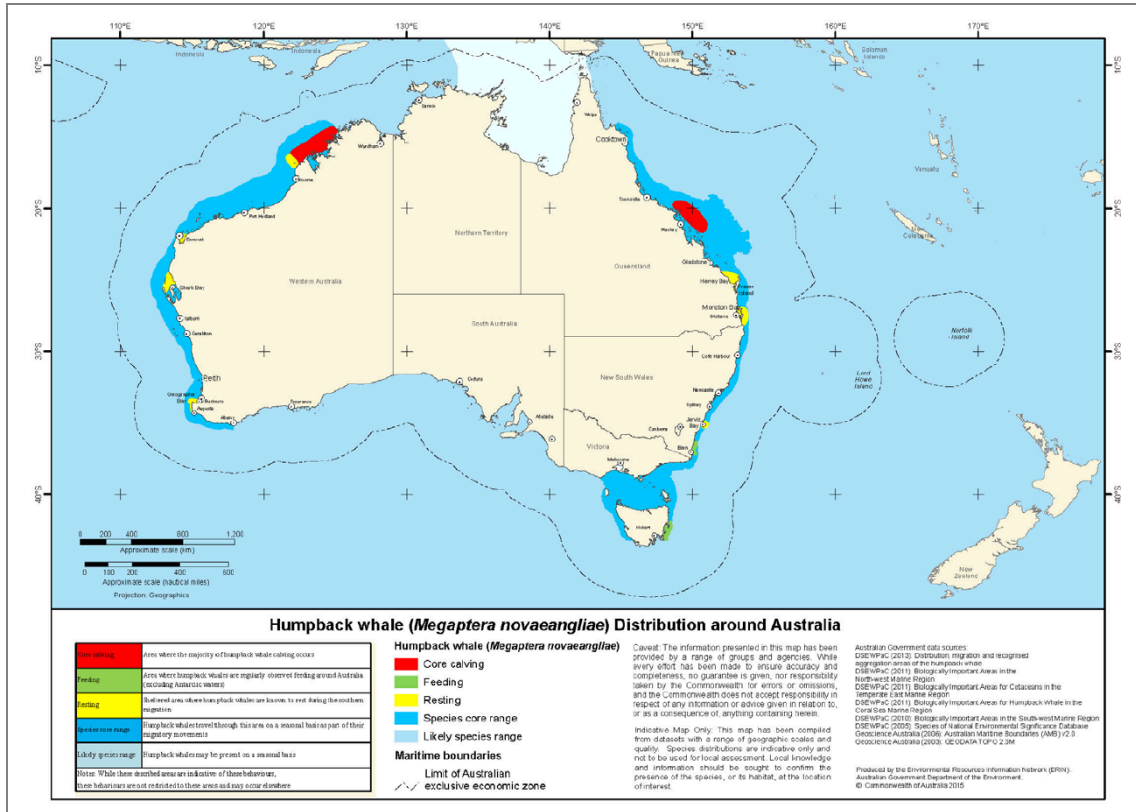
The TSSC (2015e) states that a 2012 and 2014 review of the conservation status of the species considered that it no longer meets any criteria for listing as threatened under the EPBC Act, though it remains listed as vulnerable.

Humpback whales are found in Australian offshore and Antarctic waters. They primarily feed on krill in Antarctic waters south of 55°S. The eastern Australian population of humpback whales is referred to as Group E1 by the International Whaling Commission, one of seven distinct breeding stocks in the southern hemisphere (TSSC, 2015e).

Bass Strait represents part of the core range of the E1 Group, but feeding, resting or calving is not known to occur in Bass Strait (TSSC, 2015e), though migration through Bass Strait may occur (Figure 5.17). The nearest area that humpback whales are known to congregate (forage) is at the southern-most part of NSW (near the eastern border of Victoria), approximately 225 km east of the proposed acquisition area (Figure 5.18). Twofold Bay (Eden) off the NSW south coast is the nearest known feeding area (a BIA) for humpback whales, located 240 km northeast of the proposed acquisition area.

Humpback whales undertake annual migrations between their summer feeding grounds in Antarctic waters to their breeding and calving grounds in sub-tropical and tropical inshore waters, migrating up the Australian east coast (TSSC, 2015e). The northern migration off the southeast coast starts in April and May, with the southern migration occurring from November to December. This migration tends to occur close to the coast, along the continental shelf boundary in waters about 200 m deep (TSSC, 2015e) (Figure 5.19).

The Conservation Advice for the humpback whale (TSSC, 2015e) identifies vessel strike and anthropogenic noise as threats to the species, the latter important as it may mask vocalisations or cause injury or death.

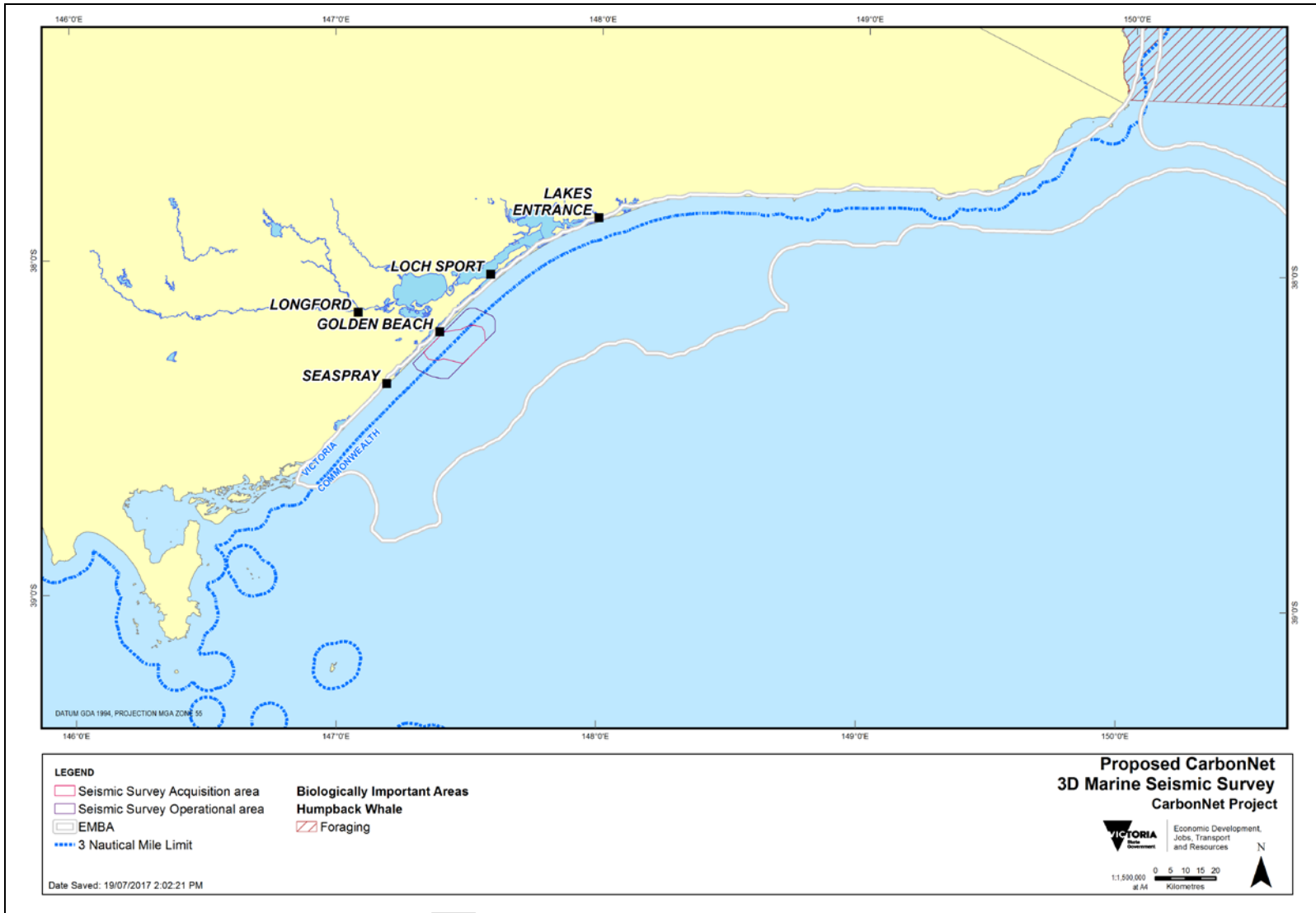


Source: TSSC (2015).

Figure 5.17. Distribution of the humpback whale around Australia

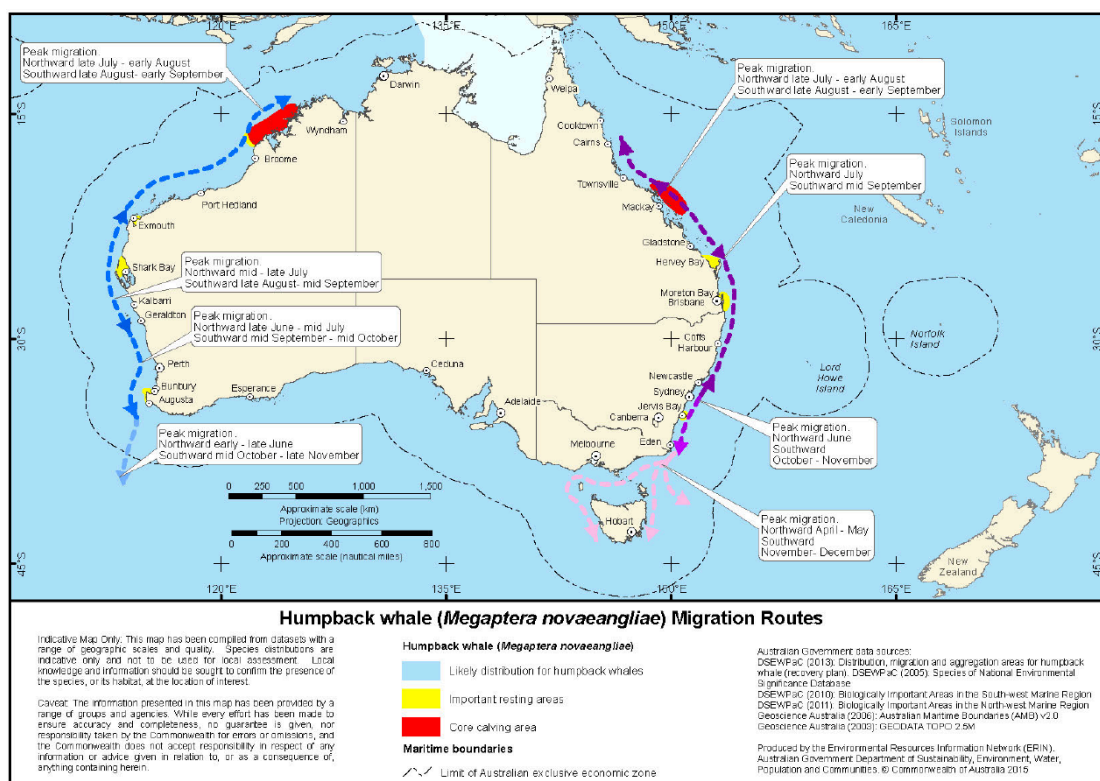
As the proposed survey acquisition area and the EMBA represent a core range for humpback whales, there is a likelihood that they may be encountered, particularly during April, May, November and December, though this likelihood is considered low due to their preference for migrating along the edge of the continental shelf.

Esso has advised CarbonNet that many humpback whales have been sighted from their facilities in the last two seasons, with the period between September and November having the most sightings (Bok, pers. comm., March 2017).



Source: National Conservation Atlas (DoEE, 2017a).

Figure 5.18. Humpback whale BIA



Source: TSSC (2015).

Figure 5.19. Migration routes of humpback whales around Australia

Sperm whale (*Physeter macrocephalus*) (EPBC Act: Listed migratory, FFG Act: not listed)

The sperm whale has a worldwide distribution and has been recorded in waters off all Australian states. Sperm whales tend to inhabit offshore areas with a water depth of 600 m or greater, and are uncommon in waters less than 300 m deep (DoEE, 2017i). Key locations for the species include:

- The area between Cape Leeuwin to Esperance (WA);
- Southwest of Kangaroo Island (SA);
- Deep waters of the Tasmanian west and south coasts;
- Areas off southern NSW (e.g., Wollongong); and
- Stradbroke Island (Qld) (DoEE, 2017i).

Concentrations of sperm whales are generally found where seabeds rise steeply from a great depth (i.e., submarine canyons at the edge of the continental shelf) associated with concentrations of food such as cephalopods (DoEE, 2017i).

Females and young males are restricted to warmer waters (i.e., north of 45°S) and are likely to be resident in tropical and sub-tropical waters year-round. Adult males are found in colder waters and to the edge of the Antarctic pack ice. In southern Western Australian waters sperm whales move westward during the year. For species in oceanic waters, there is a more generalised movement of sperm whales southwards in summer and northwards in winter (DoEE, 2017i).

Sperm whales are prolonged and deep divers often diving for over 60 minutes (Bannister *et al.*, 1996), however studies have observed sperm whales do rest at, or

just below the sea surface for extended periods (>1 hr) (Gannier *et al.*, 2002). In addition, female and juvenile sperm whales in temperate waters have been observed to spend several hours a day at surface resting or socialising (Hastie *et al.*, 2003).

The nearest BIA to the proposed acquisition area for sperm whales is a foraging area in the Great Australian Bight. Given their preference for deep-water in tropical and sub-tropical regions, there is a low likelihood that sperm whales occur within the proposed acquisition area or the EMBA.

Beaked whales (EPBC Act: Listed marine species, FFG Act: Not listed)

Several beaked whales are listed in the PMST as having the potential to occur within the EMBA (see Table 5.8). In Australia, these species have not been well studied, and key localities are not known to occur in Australia. Most beaked whales are deep-water species.

The most common and widespread species known to occur in Australian waters is the strap-toothed beaked whale (*Mesoplodon layardii*), which occurs in waters deeper than 200 m. Their population size is unknown, and oceanic (deep-water) squid form the bulk of their diet (DoEE, 2017i). Due to their preference for deep water, this species is unlikely to occur within the proposed survey area or EMBA.

Dolphins (EPBC Act: Listed marine species)

None of the seven dolphin species listed in the PMST are listed as threatened under the EPBC Act or FFG Act. Many dolphins are cosmopolitan species that are generally restricted to continental shelf environments. A brief description of these dolphin species is provided below.

- The **common dolphin** (*Delphinus delphis*) is an abundant species, widely distributed from tropical to cool temperate waters, and generally further offshore than the bottlenose, although small groups may venture close to the coast and enter bays and inlets. They have been recorded in waters off all Australian states and territories. Stranding statistics indicate that common dolphins are active in Bass Strait at all times of the year, though less so in winter (DoEE, 2017i).
- **Risso's dolphin** (*Grampus griseus*) is a widely distributed species found in deep waters of the continental slope and outer shelf from the tropics to temperate regions. This species prefers warm temperate to tropical waters with depths greater than 1,000 m, although they do sometimes extend their range into cooler latitudes in summer (Bannister *et al.*, 1996). In Australia, the species has been recorded from all states except Tasmania and the Northern Territory. Fraser Island (off the southern Queensland coast) has the only suspected 'resident' population in Australia (Bannister *et al.*, 1996). There are no known calving areas in Australian waters. The lack of resident populations in or near Bass Strait, and the lack of calving areas in Australia indicates there are no critical areas (and no BIA) for the species within the proposed acquisition area or the EMBA.
- The **dusky dolphin** (*Lagenorhynchus obscurus*) is primarily found from approximately 55°S to 26°S, though sometimes further north associated with cold currents. They are considered to be primarily an inshore species, but can also be oceanic when cold currents are present (Gill *et al.*, 2000; Ross, 2006). Only 13 reports of the dusky dolphin have been made in Australia since 1828, and key locations are yet to be identified (Bannister *et al.*, 1996). They occur across southern Australia from WA to Tasmania, confirmed sightings near Kangaroo Island and off Tasmania. No key localities or critical habitats in Australian waters have been identified (Bannister *et al.*, 1996). Given the lack

of sightings in Australian waters, it is unlikely that significant numbers of dusky dolphins would be present in the survey area and EMBA.

- The **killer whale** (*Orcinus orca*) (the largest member of the dolphin family) are thought to be the most cosmopolitan of all cetaceans and appear to be more common in cold, deep waters, though they have often been observed along the continental slope and shelf particularly near seal colonies (Bannister *et al.*, 1996). The killer whale is widely distributed from polar to equatorial regions and has been recorded in all Australian waters with concentrations around Tasmania. The only recognised key locality in Australia is Macquarie Island and Heard Island in the Southern Ocean (Bannister *et al.*, 1996). The habitat of killer whales includes oceanic, pelagic and neritic (relatively shallow waters over the continental shelf) regions, in both warm and cold waters (DoEE, 2017i). In Victoria, sightings peak in June/July, where they have been observed feeding on sharks, sunfish, and Australian fur seals (Mustoe, 2008). The breeding season is variable and the species moves seasonally to areas of food supply (Bannister *et al.*, 1996; Morrice *et al.*, 2004). It is possible that killer whales may occur in the EMBA, however given the distance to the nearest seal colonies (see Section 5.4.6), the proposed survey acquisition area is unlikely to represent an important habitat for this species and significant numbers of this species are not expected during the survey period.
- The **southern right whale dolphin** (*Tursiops aduncas*) are found off southern continental Australia, with no key localities in and no population estimates known for Australian waters (DoEE, 2017i). It is a pelagic species generally occurring between the sub-tropical and sub-Antarctic convergences, and usually found well offshore past the continental shelf in water temperatures of 2-20°C (DoEE, 2017i). Given their habitat preferences, it is unlikely that southern right whale dolphins occur within the proposed acquisition area.
- The **Indian Ocean bottlenose dolphin** (*Tursiops aduncus*) is distributed around the entire Australian mainland, but as the common name suggests, occur mainly in tropical and sub-tropical waters, usually coastal and shallow offshore areas. The species is thought to be common in discreet areas of eastern, northern and western Australia, though the total population size is not known (DoEE, 2017i). No critical habitats are known to occur within the proposed acquisition area or EMBA.
- The **bottlenose dolphin** (*Tursiops truncatus*) has a worldwide distribution from tropical to temperate waters. While the species is primarily coastal, they are found inshore and on the shelf and open oceans as well. There are two forms of bottlenose dolphin, a nearshore form and an offshore form. The nearshore form occurs in southern Australia (DoEE, 2017i). Most populations are relatively discrete and reside in particular areas, such as individual resident populations in Port Phillip Bay (180 km west of the proposed acquisition area) and Westernport Bay (235 km west of the proposed acquisition area). There may be some migration and exchange between the populations, but it is likely that most are local residents.

Though not listed in the EPBC PMST or the VBA for the EMBA, the Burrunan dolphin (*Tursiops australis*) is a species of bottlenose dolphin (only recognised as a separate species in 2011) that is present in the Gippsland Lakes. This species is listed as threatened under the FFG Act. Only two resident populations of Burrunan dolphin are known to occur, comprising about 50 individuals in the Gippsland Lakes and 100 individuals in Port Phillip Bay (Charlton-Robb *et al.*, 2011). It is unclear whether migration occurs between these sites, though researchers from the Marine Mammal

Foundation released information in mid-2017 indicating that there are genetic similarities between the dolphins in the Gippsland Lakes and around Tasmania’s Freycinet Peninsula (ABC, 2017). The Marine Mammal Foundation believes a transient group of male dolphins swim between Gippsland and eastern Tasmania to breed with two different populations of female dolphins. The taxonomic validity of this new species has been questioned by the Committee for Taxonomy for the International Society for Marine Mammology (DRI, 2016).

5.4.6. Pinnipeds

There are two pinniped species recorded under the EPBC Act PMST as potentially occurring within the EMBA (Table 5.9). These species are not listed as threatened under the FFG Act.

A search of the VBA database indicates that four seal species have been recorded in the EMBA. In addition to those listed in Table 5.9, there are nine records of leopard seal (*Hydrurga leptonyx*) and one record of a crabeater seal (*Lobodon carcinophagus*). These species are not listed as threatened under the EPBC Act or the FFG Act. The key habitat for both species is Antarctica, and they may be present along the southern Australian coastline as occasional vagrants only during the winter.

Table 5.9. EPBC Act-listed pinnipeds that may occur in the EMBA

Scientific name	Common name	EPBC Act status			FFG Act status	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
<i>Arctocephalus forsteri</i>	New Zealand fur-seal	-	-	Yes	-	-	-
<i>Arctocephalus pusillus</i>	Australian fur-seal	-	-	Yes	-	-	-

New Zealand fur-seal (*Arctocephalus forsteri*) (EPBC Act: Listed marine, FFG Act: Not listed)

New Zealand fur-seals (also known as long-nosed fur-seals) are mostly found in central South Australian waters (Kangaroo Island to South Eyre Peninsula); 77% of their population is found here (Shaughnessy, 1999).

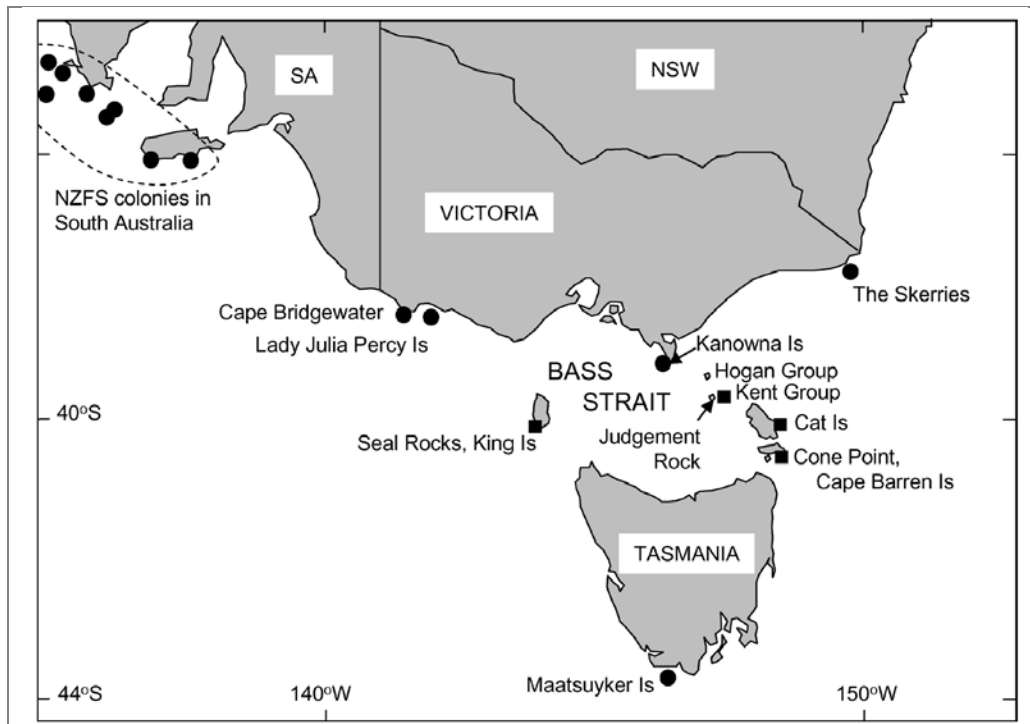
There are 51 known breeding sites for New Zealand fur-seals in Australia, with most of these outside of Victoria (47 in SA and WA) (DEHWA, 2007) (Figure 5.20). Lower density breeding areas occur in Victoria (Shaughnessy, 1999). Breeding locations in Victoria occur at Kanowna Island (located 132 km southwest of the survey area) and the Skerries (located approximately 175 km east of the survey area) (Kirkwood *et al.*, 2009) (the latter being within the EMBA).

During the non-breeding season (November to January) the breeding sites are occupied by pups/young juveniles, whilst adult females alternate between the breeding sites and foraging at sea (Shaughnessy, 1999).

Haul-out sites in Bass Strait, as reported by Barton *et al* (2012) and OSRA mapping, include:

- Beware Reef (110 km east of the survey area, and within the EMBA);
- Kanowna Island (132 km southwest of the survey area) - ~300 individuals;

- The Hogan Islands Group (102 km southwest of the survey area); and
- West Moncoeur Island (near Wilson’s Promontory, 128 km southwest of the survey area).



Filled circles = early 1800s distribution. Filled squares = current distribution.
 Source: Kirkwood *et al* (2009).

Figure 5.20. New Zealand fur-seal colonies

The species prefers the rocky parts of islands with jumbled terrain and boulders and prefers smoother igneous rocks to rough limestone. Shaughnessy (1999) and OSRA mapping report that breeding colonies in Bass Strait include:

- Rag Island (1,000 fur seal & 235 pups in 2006, 90 km southwest of the survey area);
- Kanowna Island (10,700 adults and 2,700 pups, 132 km southwest of the survey area);
- Anser Group of Islands (all more than 120 km southwest of the survey area);
- The Skerries (175 km east of the survey area, and within the EMBA) – 300 individuals and 78 pups (in 2002); and
- Judgment Rock in the Kent Island Group (~2,500 pups per year, 132 km south-southwest of the survey area) (Kirkwood *et al.*, 2009)

New Zealand fur-seals feed on small pelagic fish, squid and seabirds, including little penguins (Shaughnessy, 1999). Juvenile seals feed primarily in oceanic waters beyond the continental shelf, lactating females feed in mid-outer shelf waters (50-100 km from the colony) and adult males forage in deeper waters (DoEE, 2017i).

There is no BIA for the New Zealand fur-seal in Bass Strait. Given the close proximity of the proposed acquisition area to breeding colonies and haul-out sites, it is likely that the species feeds within the proposed acquisition. However, there are no islands or rock outcrops within the proposed acquisition area, so a resident population is unlikely to occur. These waters are unlikely to represent important critical feeding or

breeding habitat. Some of the breeding colonies known to occur in Bass Strait occur within the EMBA.

Australian fur-seal (*Arctocephalus pusillus*) (EPBC Act: Listed marine, FFG Act: Not listed)

The Australian fur-seal has a relatively restricted distribution around the islands of Bass Strait, parts of Tasmania and southern Victoria.

There are 10 established breeding colonies of the Australian fur-seal that are restricted to islands in the Bass Strait; six occurring off the coast of Victoria and four off the coast of Tasmania (DoEE, 2017i). The largest of the established colonies occur at Lady Julia Percy Island (26% of the breeding population and 467 km west of the survey area) and at Seal Rocks (25% of the breeding population and 196 km west of the proposed acquisition area), in Victoria (DoEE, 2017i). These areas are not located within the EMBA.

Other breeding colonies in Bass Strait include:

- Rag Island (1,000 fur seal & 270 pups in 2007, 90 km southwest of the survey area);
- Kanowna Island (15,000 adults and 3,000 pups, 132 km southwest of the survey area);
- Anser Group of Islands (all more than 120 km southwest of the survey area);
- The Skerries (175 km east of the survey area) – 11,500 individuals and 3,000 pups (in 2002); and
- Judgment Rock in the Kent Island Group (~2,500 pups per year, 132 km south-southwest of the survey area) (Kirkwood *et al.*, 2009, Shaughnessy, 1999; OSRA) (Figure 5.21).

All of the above-listed sites are located outside the EMBA, except for The Skerries (offshore from the mouth of the Wingan River, see Section 5.3). Historically, Australian fur-seal breeding colonies were more widespread, but several islands have not been occupied since their populations were removed by early commercial sealing (DoEE, 2017i).

Their preferred habitat, especially for breeding, is a rocky island with boulder or pebble beaches and gradually sloping rocky ledges. Australian fur-seals are present in the region all year. Pups begin to forage in June/July and are generally weaned by September/October (Shaughnessy, 1999).

Australian fur-seals are also regularly seen resting and foraging on and around the petroleum production platforms off the Gippsland coast. Barton *et al* (2012), Carlyon *et al* (2011) and OSRA (2015) report that haul-out sites in Bass Strait include:

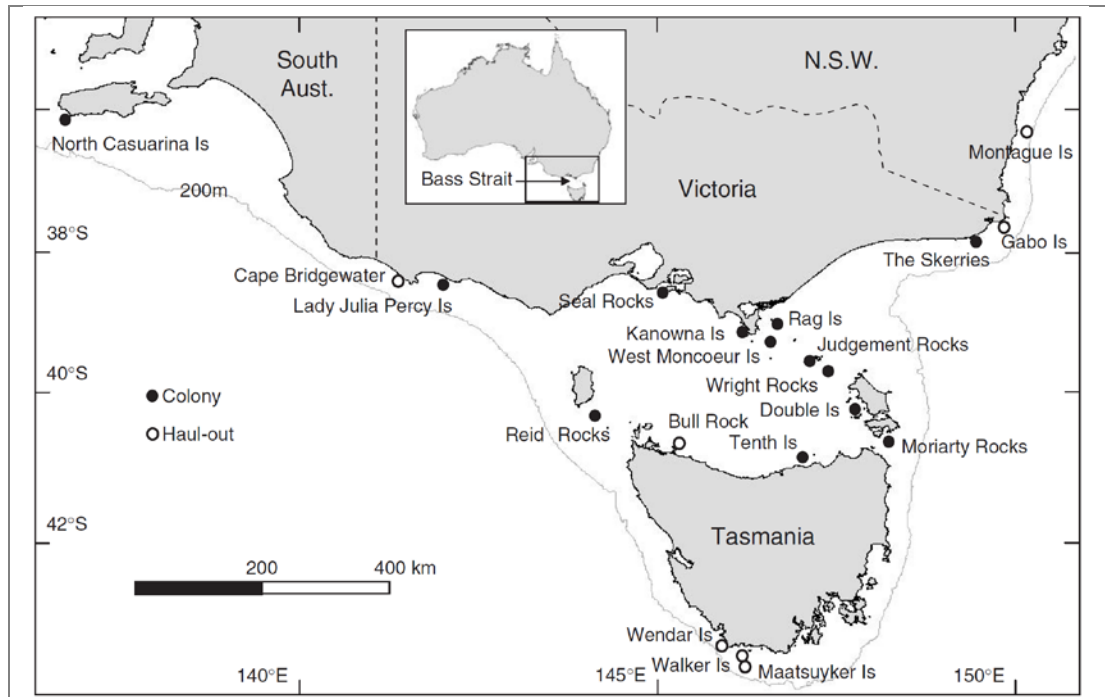
- Beware Reef (110 km east of the proposed acquisition area and within the EMBA) – a haul-out site where the seals are present most of year;
- Gabo Island (215 km northeast of the proposed acquisition area and within the EMBA) – 30-50 individuals; and
- The Hogan Island group (102 km southwest of the proposed acquisition area) – ~300 animals.

During the summer months, Australian fur-seals travel between northern Bass Strait islands and southern Tasmania waters following the Tasmanian east coast, however, lactating female fur-seals and some territorial males are restricted to foraging ranges within Bass Strait waters. Lactating female Australian fur-seals forage primarily within the shallow continental shelf of Bass Strait and Otway on the benthos at depths of

between 60 - 80 m and generally within 100 - 200 km of the breeding colony for up to five days at a time. The diet of Australian fur-seals is principally fish, including red-bait, leatherjackets and jack mackerel in winter and mostly cephalopods in summer (Shaughnessy, 1999).

Male Australian fur-seals are bound to colonies during the breeding season from late October to late December, and outside of this time forage further afield (up to several hundred kilometres) and are away for long periods, even up to nine days (Kirkwood *et al.*, 2009; Hume *et al.*, 2004).

There is no BIA for the Australian fur-seal in Bass Strait.



Filled circles = breeding colonies. Empty circles = haul-out sites.
Source: Kirkwood *et al.* (2009).

Figure 5.21. Australian fur-seal colonies and haul-out sites where pups were born in 2007

5.4.7. Reptiles

Five species of marine turtle are listed under the EPBC Act as potentially occurring in the survey area and EMBA, as listed in Table 5.10. No BIAs for turtles occur within Bass Strait. EA (2003) reports that the turtles known to occur in Victorian waters are considered to be rare vagrants outside their usual range. No turtles are listed as threatened under the FFG Act 1988 (Vic), except for the leatherback turtle.

A search of the VBA database indicates that three turtle species have been recorded in the EMBA (all of which are listed in Table 5.10). In addition to these, the freshwater eastern snake-necked turtle (*Chelodina longicollis*) has also been recorded. Given its freshwater habitat, it is not described in this section.

Additionally, Wilson and Swan (2005) report that 31 species of sea snake and two species of sea kraits occur in Australian waters, though none of these occurs in waters of the southern coast of Australia, with the exception of the yellow-bellied sea snake (*Pelamis platurus*) that extends into waters off the WA and Victorian coast. This species is the world's most widespread sea snake and feeds on fish at the sea surface (Wilson and Swan, 2005).

Table 5.10. EPBC Act-listed marine reptiles that may occur in the EMBA

Scientific Name	Common Name	EPBC Act status			FFG Act status	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
<i>Caretta caretta</i>	Loggerhead turtle	Endangered	Yes	Yes	-	-	Generic RP in place for all marine turtle species, + AS for leatherback turtle
<i>Chelonia mydas</i>	Green turtle	Vulnerable	Yes	Yes	-	-	
<i>Dermochelys coriacea</i>	Leatherback turtle	Endangered	Yes	Yes	T	-	
<i>Eretmochelya imbricata</i>	Hawksbill turtle	Vulnerable	Yes	Yes	-	-	
<i>Natador depressus</i>	Flatback turtle	Vulnerable	Yes	Yes	-	-	

Loggerhead turtle (EPBC Act: Endangered, listed migratory, FFG Act: Not listed)

The loggerhead turtle (*Caretta caretta*) is globally distributed in sub-tropical waters (Limpus, 2008a), including those of eastern, northern and western Australia (DoEE, 2017k), and is rarely sighted off the Victorian coast.

The main Australian breeding areas for loggerhead turtles are generally confined to southern Queensland and Western Australia (Cogger *et al.*, 1993). Loggerhead turtles will migrate over distances in excess of 1,000 km, but show a strong fidelity to their feeding and breeding areas (Limpus, 2008a).

Loggerhead turtles are carnivorous, feeding primarily on benthic invertebrates such as molluscs and crabs in depths ranging from nearshore to 55 m (DoEE, 2017k) in tidal and sub-tidal habitats, reefs, seagrass beds and bays (DoEE, 2017k). No known loggerhead foraging areas have been identified in Victoria waters although foraging areas have been infrequently identified in waters off SA (DoEE, 2017k).

The DoEE (2016) maps the loggerhead turtle as having a known or likely range within Bass Strait, but given this species preference for sub-tropical waters, it is unlikely to be encountered in the EMBA.

Green turtle (EPBC Act: Vulnerable, listed migratory, FFG Act: Not listed)

The green turtle (*Chelonia mydas*) is distributed in sub-tropical and tropical waters around the world (Limpus, 2008b; DoEE, 2017k). In Australia, they nest, forage and migrate across tropical northern Australia. Mature turtles settle in tidal and sub-tidal habitat such as reefs, bays and seagrass beds where they feed on seagrass and algae (Limpus, 2008b; DoEE, 2017k).

There are no known nesting or foraging grounds for green turtles in Victoria, and they occur only as rare vagrants (DoEE, 2017k). The DoEE (2017k) maps the green turtle as having a known or likely range within Bass Strait, and due to the presence of suitable foraging sites, it may be encountered in the EMBA.

Leatherback turtle (EPBC Act; Endangered, listed migratory, FFG Act: Threatened)

The leatherback turtle (*Dermochelys coriacea*) is widely distributed throughout tropical, sub-tropical and temperate waters of Australia (DoEE, 2017k), including in oceanic waters and continental shelf waters along the coast of southern Australia (Limpus, 2009). Unlike other marine turtles, the leatherback turtle utilises cold water foraging areas, with the species most commonly reported foraging along the coastal waters of central Australia (southern Queensland to central NSW), southeast Australia (Tasmania, Victoria and eastern SA), and southern WA (Limpus, 2009).

This species feeds on soft-bodied invertebrates, including jellyfish (Limpus, 2009).

No major nesting has been recorded in Australia, with isolated nesting recorded in the Northern Territory, Queensland and northern NSW (DoEE, 2017k). This species nests only in the tropics. The DoEE (2017k) maps the leatherback turtles as having a known or likely range within Bass Strait, and a migration pathway in southern waters. The waters of the EMBA do not represent critical habitat for the species, though it may occur in low numbers during migration.

Hawksbill turtle (EPBC Act: Vulnerable, listed migratory, FFG Act: Not listed)

The hawksbill turtle (*Eretmochelya imbricata*) is distributed in nearshore and offshore rocky and coral reef habitats in northern Australian waters, feeding mostly on sponges, seagrass and algae. Nesting occurs only in these tropical waters (DoEE, 2017k).

The DoEE (2017k) maps the hawksbill turtle as having a known or likely range in the eastern-most part of Bass Strait, and due to the presence of suitable foraging sites (e.g., seagrass beds at Mallacoota Inlet), it may be encountered in the EMBA.

Flatback turtle (EPBC Act: Vulnerable, listed migratory, FFG Act: Not listed)

In Australia, the flatback turtle (*Natador depressus*) is found only in the tropical waters of northern Australia, where it feeds on soft-bodied prey. Nesting occurs only in these tropical waters.

The DoEE (2017k) maps the flatback turtle as having a known or likely range north of the Victorian/NSW border, and as such this species is not likely to be encountered in the EMBA.

5.4.8. Avifauna

Seventy-one (71) avifauna species (seabirds and shorebirds) are listed under the EPBC Act as potentially occurring in the EMBA, as listed in Table 5.11. The majority of these are listed as migratory and marine species, with 37 being threatened species.

A search of the VBA database indicates that 31 seabird species have been recorded in the EMBA (mostly albatross, petrels, prions, shearwaters and jaegers).

The focus of this section is true seabirds (i.e., birds of the order *Procellariiformes*) and true shorebirds (i.e., birds of the order *Charadriiformes*). Seabirds are those species of bird whose normal habitat and food source is derived from the sea, whether that be coastal or offshore (DEWR, 2006), while shorebirds spend most of their time (nesting, feeding and breeding) on the shoreline.

Terrestrial, wetland and coastal species listed in the PMST that do not use marine resources within the EMBA are described only where part of their habitat may overlap the EMBA (i.e., resources within tidal areas).

Table 5.11. EPBC Act-listed bird species that may occur in the EMBA

Scientific Name	Common Name	EPBC Act status			FFG Act status	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Seabirds (28 species)							
<i>Albatross</i>							
<i>Diomedea antipodensis</i>	Antipodean albatross	V	Yes	Yes	-	Foraging	Generic RP in place for all albatross in Australia, + AS for all albatross
<i>Diomedea antipodensis gibsoni</i>	Gibson's albatross	V	Yes	Yes	-	-	
<i>Diomedea epomophora</i> (sensu stricto)	Southern royal albatross	V	Yes	Yes	T	-	
<i>Diomedea exulans</i> (sensu lato)	Wandering albatross	V	Yes	Yes	T	Foraging	
<i>Diomedea sanfordi</i>	Northern royal albatross	E	Yes	Yes	-	-	
<i>Phoebastria fusca</i>	Sooty albatross	V	Yes	Yes	T	-	
<i>Thalassarche bulleri</i>	Buller's albatross	V	Yes	Yes	T	Foraging	
<i>Thalassarche bulleri platei</i>	Northern Buller's albatross	V	-	-	-	Foraging	
<i>Thalassarche cauta cauta</i>	Shy albatross	V	Yes	Yes	T	Foraging	
<i>Thalassarche cauta steari</i>	White-capped albatross	V	Yes	Yes	-	-	
<i>Thalassarche chrysostoma</i>	Grey-headed albatross	E	Yes	Yes	T	-	
<i>Thalassarche eremita</i>	Chatham albatross	E	Yes	Yes	-	-	
<i>Thalassarche impavida</i>	Campbell albatross	V	Yes	Yes	-	Foraging	
<i>Thalassarche melanophris</i>	Black-browed albatross	V	Yes	Yes	-	Foraging	
<i>Thalassarche salvini</i>	Salvin's albatross	V	Yes	Yes	-	-	
<i>Thalassarche</i> sp. nov.	Pacific albatross	V	Yes	Yes	-	-	

Scientific Name	Common Name	EPBC Act status			FFG Act status	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
<i>Thalassarche steadi</i>	White-capped albatross	V	Yes	Yes	-	-	
Petrels							
<i>Fregetta grallaria grallaria</i>	White-bellied storm-petrel	V	-	-	-	-	-
<i>Halobaena caerulea</i>	Blue petrel	V	-	Yes	-	-	-
<i>Macronectes giganteus</i>	Southern giant petrel	E	Yes	Yes	T	-	Generic RP and AS for giant petrels
<i>Macronectes halli</i>	Northern giant petrel	V	Yes	Yes	T	-	
<i>Pterodroma leucoptera leucoptera</i>	Gould's petrel	E	-	-	-	-	RP
Other seabirds							
<i>Apus pacificus</i>	Fork-tailed swift	-	Yes	Yes	-	-	-
<i>Catharacta skua</i>	Great skua	-	-	Yes	-	-	-
<i>Haliaeetus leucogaster</i>	White-bellied sea-eagle	-	-	Yes	T	-	-
<i>Pachyptila turtur subantarctica</i>	Fairy prion (southern)	V	-	-	-	-	CA
<i>Pandion haliaetus</i>	Osprey	-	Yes	Yes	-	-	-
<i>Puffinus carneipes</i>	Flesh-footed shearwater	-	Yes	Yes	-	-	-
Shorebirds/wetlands species (43 species)							
<i>Actitis hypoleucos</i>	Common sandpiper	-	Yes	Yes	-	-	-
<i>Ardea alba</i>	Great egret	-	-	Yes	-	-	-
<i>Ardea ibis</i>	Cattle egret	-	-	Yes	-	-	AS
<i>Arenaria interpres</i>	Ruddy turnstone	-	Yes	Yes	-	-	-
<i>Botaurus poiciloptilus</i>	Australian bittern	E	-	-	T	-	CA
<i>Calidris acuminata</i>	Sharp-tailed sandpiper	-	Yes	Yes	-	-	-
<i>Calidris alba</i>	Sanderling	-	Yes	Yes	-	-	-

Scientific Name	Common Name	EPBC Act status			FFG Act status	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
<i>Calidris canutus</i>	Red knot	E	Yes	Yes	-	-	
<i>Calidris ferruginea</i>	Curlew sandpiper	CE	Yes	Yes	T	-	-
<i>Calidris ruficollis</i>	Red-necked stint	-	Yes	Yes	-	-	-
<i>Calidris tenuirostris</i>	Great knot	CE	Yes	Yes	-	-	CA
<i>Charadrius bicinctus</i>	Double-banded plover	-	-	Yes	-	-	
<i>Charadrius leschenaultii</i>	Greater sand plover	V	Yes	Yes	-	-	CA
<i>Charadrius mongolus</i>	Lesser sand plover	E	Yes	Yes	-	-	CA
<i>Charadrius ruficapillus</i>	Red-capped plover	-	-	Yes	-	-	-
<i>Gallinago hardwickii</i>	Latham's snipe	-	Yes	Yes	-	-	-
<i>Gallinago megala</i>	Swinhoe's snipe	-	Yes	Yes	-	-	-
<i>Gallinago stenura</i>	Pin-tailed snipe	-	Yes	Yes	-	-	-
<i>Heteroscelus brevipes</i>	Grey-tattler	-	Yes	Yes	T	-	-
<i>Himantopus himantopus</i>	Black-winged stilt	-	-	Yes	-	-	-
<i>Hirundapus caudacutus</i>	White-throated needletail	-	Yes	Yes	T	-	-
<i>Lathamus discolor</i>	Swift parrot	CE	-	Yes	-	-	AS
<i>Limosa lapponica baueri</i>	Bar-tailed godwit	V	Yes	Yes	-	-	-
<i>Limosa lapponica menzbieri</i>	Northern Siberian bar-tailed godwit	CE	Yes	Yes	-	-	-
<i>Limosa limosa</i>	Black-tailed godwit	-	Yes	Yes	-	-	-
<i>Merops ornatus</i>	Rainbow bee-eater	-	-	Yes	-	-	-
<i>Neophema chrysogaster</i>	Orange-bellied parrot	CE	-	Yes	T	-	RP, AS
<i>Numenius</i>	Eastern	CE	Yes	Yes	T	-	CA

Scientific Name	Common Name	EPBC Act status			FFG Act status	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
<i>madagascariensis</i>	curlew						
<i>Numenius minutus</i>	Little curlew	-	Yes	Yes	-	-	-
<i>Numenius phaeopus</i>	Whimbrel	-	Yes	Yes	-	-	-
<i>Philomachus pugnax</i>	Ruff (Reeve)	-	Yes	Yes	-	-	-
<i>Pluvialis fulva</i>	Pacific golden plover	-	Yes	Yes	-	-	-
<i>Pluvialis squatarola</i>	Grey plover	-	Yes	Yes	-	-	-
<i>Recurvirostra novaehollandiae</i>	Red-necked avocet	-	-	Yes	-	-	-
<i>Rostratula australis</i>	Australian painted snipe	E	-	Yes	T	-	CA
<i>Sterna albifrons</i>	Little tern	-	Yes	Yes	T	-	AS
<i>Sterna fuscata</i>	Sooty tern	-	-	Yes	-	-	-
<i>Sternula nereis nereis</i>	Australian fairy tern	V	-	-	T	-	CA
<i>Thinornis rubricollis rubricollis</i>	Hooded plover (eastern)	V	-	Yes	T	-	AS
<i>Tringa glareola</i>	Wood sandpiper	-	Yes	Yes	-	-	-
<i>Tringa nebularia</i>	Common greenshank	-	Yes	Yes	-	-	-
<i>Tringa stagnatilis</i>	Marsh sandpiper	-	Yes	Yes	-	-	-
<i>Xenus cinereus</i>	Terek sandpiper	-	Yes	Yes	T	-	-

Exclusively Seabirds

Albatross (EPBC Act: Endangered & vulnerable, listed migratory, FFG Act: many listed as threatened)

Albatrosses (and giant-petrels) are among the most dispersive and oceanic of all birds, spending more than 95% of their time foraging at sea in search of prey and usually only returning to land (remote islands) to breed (EA, 2001). Only five species of albatross and the southern and northern giant petrel are known to breed within Australia. Breeding within Australian territory occurs on the isolated islands of Antarctica (Giganteus Island, Hawker Island and Frazier islands) and the Southern Ocean (Heard Island, McDonald Island, Macquarie Island, Bishop and Clerk Islands), as well as islands off the south coast of Tasmania and Albatross Island off the north-west coast of Tasmania in Bass Strait (DSEWPC, 2011).

Albatross Island, supporting a breeding population of approximately 5,000 shy albatross (*Thalassarche cauta*), is the closest breeding colony of threatened seabird to the proposed survey acquisition area, located approximately 165 km to the southeast.

All Australian waters can be considered foraging habitat for albatross and petrels, with the most important habitat considered to be south of 25°S (DSEWPC, 2011), which includes the survey area. Given these species' ability to cover vast ocean distances while foraging, it is possible they may overfly and forage in the vicinity of the survey area. Key threats to albatross and petrels are incidental catch from fishing, competition with fisheries for prey, dependence on fishing discards, marine pollution and loss of nesting habitat (DSEWPC, 2011).

The 17 albatross species listed in Table 5.11 have a widespread distribution throughout the southern hemisphere. There is one additional species, the sooty albatross (*Phoebastria fusca*) listed under the VBA (with one record in the EMBA). This is listed as threatened under the FFG Act.

Albatrosses nest on isolated islands and forage across the ocean for food, usually in offshore areas during winter, and particularly along the continental shelf edge and open waters (DSEWPC, 2011). All the albatross species listed in Table 5.12 are known to forage in Australian waters, with cephalopods, fish and crustaceans forming the basis of their diet, caught by diving (DSEWPC, 2011). They undertake no annual migration, but disperse widely after breeding. No breeding colonies or nesting areas for the listed albatross species are located near the proposed acquisition area or EMBA (DSEWPC, 2011).

Four of the albatross species (wandering, black-browed, shy and grey-headed albatross) breed in or adjacent to the South-east marine Region on Macquarie Island (2,000 km southeast), Albatross Island (325 km southwest), Pedra Branca (620 km southwest) and Mewstone Island (618 km south of the survey area) (DoE, 2015a). These constitute critical habitat to the survival of albatross (DSEWPC, 2011) and represent a small portion of the global population for each species (DoE, 2015a). These critical habitat areas are remote from the survey area and EMBA.

The National Conservation Values Atlas (DoEE, 2016) indicates that BIAs for foraging exist within various parts of the EMBA for seven albatross species (see Table 5.11), with foraging taking place throughout all of Bass Strait.

Petrels (EPBC Act: Vulnerable and endangered, some listed migratory, FFG Act: two listed as threatened)

The five petrel species listed in Table 5.11 as potentially occurring within the EMBA are widely distributed throughout the southern hemisphere. They nest on isolated islands and breed on sub-Antarctic and Antarctic islands. The northern giant-petrel and southern giant-petrel share the same breeding areas listed for the albatross (DSEWPaC, 2011a). Outside the breeding season (October to February), petrels disperse widely and move north into sub-tropical waters (DoEE, 2017i). Most petrel species feed on krill, squid, fish, other small seabirds and marine mammals (DoEE, 2017i). No breeding colonies or nesting areas for the listed petrel species are located in or near the survey area or EMBA.

The DoE (2015) states that the blue petrel occurs in Australian waters between July and September, the northern giant petrel occurs from May to October, and the southern giant petrel occurs during all months (except February).

The National Conservation Values Atlas (DoEE, 2016) indicates that there are no BIAs for the listed petrel species in or around Bass Strait, with the nearest being that of a foraging BIA for the southern giant petrel (*Macronectes giganteus*), which occurs off the southern NSW coast (outside the EMBA).

Other seabirds

Other seabirds that may occur within the survey area and EMBA are described here.

- The **fork-tailed swift** (*Apus pacificus*) is a medium-sized bird has a large global distribution and population, and occurs throughout much of Australia. In Victoria, it is widespread but sparsely scattered, and occurs over cliffs, beaches and sometimes well out to sea (DoEE, 2017i). This species is almost exclusively aerial, feeding on insects in flight (DoEE, 2017i). AS a migratory species, it arrives in Australia from September to October, leaving southern Australia from mid-April (DoEE, 2017i). As a common species, the fork-tailed swift may occur in the survey area and EMBA from September to April.
- The **great skua** (*Catharacta skua*) is a large migratory seabird distributed throughout all southern Australian waters (though not listed as migratory under the EPBC Act). This species breeds in summer on nested elevated grasslands or sheltered rocky areas on sub-Antartic islands, with most adult birds leaving their colonies in winter. Great skuas feed on other seabirds, fish, molluscs and crustaceans, and may be present in the EMBA (though scarce) during winter (Flegg, 2002).
- The **southern fairy prion** (*Pachyptila turtur subantarctica*) is mainly found offshore. The species diet is comprised mostly of crustaceans (especially krill), but occasionally includes some fish and squid. It feeds mainly by surface-seizing and dipping, but can also catch prey by surface-plunging or pattering (DoEE, 2017i). In Australia, it is known to breed only on Macquarie Island (2,000 km southeast of the proposed acquisition area), and on the nearby Bishop and Clerk islands (DoEE, 2017i). The three other prion species listed in the VBA for the EMBA are not listed as threatened.
- The **white-bellied sea eagle** (*Haliaeetus leucogaster*) is distributed along the coastline in coastal lowlands with breeding from Queensland to Victoria in coastal habitats and terrestrial wetlands in temperate regions. The breeding season is from June to January with nests built in tall trees, bushes, cliffs or rock outcrops. Breeding pairs are generally widely dispersed (DoEE, 2017i). The species forages over open water (coastal and terrestrial) and feeds on fish, birds, reptiles, mammals and crustaceans and normally launches into a glide to snatch its prey, usually with one foot, from the ground or water surface. The species is widespread and makes long-distance movements (DoEE, 2017i). This species may be present along the coastline during the survey period.
- The **osprey** (*Pandion haliaetus*) is a common, medium-sized raptor that is present around the entire Australian coastline, with the breeding range restricted to the north coast of Australia (including many offshore islands) and an isolated breeding population in South Australia (DoEE, 2017i). Breeding occurs from April to February. Ospreys occur mostly in coastal areas but occasionally travel inland along waterways, where they feed on fish, molluscs, crustaceans, reptiles, birds and mammals. They are mostly resident or sedentary around breeding territories, and forage more widely and make intermittent visits to their breeding grounds in the non-breeding season (DoEE, 2017i). Due to their broad habitat, osprey may be present in the EMBA.

The **flesh-footed shearwater** (*Puffinus carneipes*) is a trans-equatorial migrant widely distributed across the south-western Pacific during breeding season (early September to early May) and is a common visitor to the waters of the continental shelf/slope and occasionally inshore waters. The species breeds in burrows on

sloping ground in coastal forest, scrubland, shrubland or grassland. Thirty-nine of the 41 islands on which the species breeds lie off the coast of southern Western Australia, with the remaining two islands being Smith Island (SA) and Lord Howe Island (off NSW). This shearwater feeds on small fish, cephalopod molluscs (squid, cuttlefish, nautilus and argonauts), crustaceans (barnacles and shrimp), other soft-bodied invertebrates and offal. The species forages almost entirely at sea and very rarely on land. It obtains most of its food by surface plunging or pursuit plunging. It also regularly forages by settling on the surface of the ocean and snatching prey from the surface ('surface seizing'), momentarily submerging onto prey beneath the surface ('surface diving') or diving and pursuing prey beneath the surface by swimming ('pursuit diving'). It is possible this species may overfly the EMBA.

Shorebirds and Coastal Species

Plovers

The seven EPBC Act-listed plovers that may occur within the EMBA (**double-banded, greater sand, lesser sand, red-capped, Pacific golden, grey and hooded**) are medium to large sized migratory wading birds that have wide-ranging coastal habitats comprising estuaries, bays, mangroves, damp grasslands, sandy beaches, sand dunes, mudflats and lagoons (Flegg, 2002), with roosting also taking place on sand bars and spits. Plovers feed on a range of molluscs, worms, crustaceans and insects. Plovers (with the exception of the hooded and red-capped plovers) breed in Asia and the Arctic region and are present in Australia throughout the year, depending on the species. The hooded plover (*Thinornis rubricollis rubricollis*) and red-capped plover (*Charadrius ruficapillus*) breed in Australia, building their nests in sandy oceanic beaches. The location of these nests presents the greatest threat to this species' population, as nests, eggs and chicks are vulnerable to predation and trampling (DoE, 2014; Birdlife Australia, 2016). The sandy beaches of the Ninety Mile Beach are recognised habitat for the hooded plovers. The Pacific Golden plover and grey plover are also listed under the VBA as occurring within the EMBA and are not listed as threatened under the FFG Act.

Terns

There are three EPBC Act-listed tern species that may occur within the EMBA (**fairy, little and sooty**). Many of the tern species present along the southern Australian coastline are widespread and occupy beach, wetland, grassland and beach habitats. Terns rarely swim; they hunt for prey in flight, dipping to the water surface or plunging for prey (Flegg, 2002) usually within sight of land for fish, squid, jellyfish and sometimes crustaceans (DEHWA, 2007). Fairy terns feed by plunge diving on small baitfish in coastal waters, usually close to land (DoEE, 2017i).

The National Conservation Values Atlas (DoEE, 2016) indicates that the foraging BIA for the fairy tern (*Sterna nereis nereis*) (listed as vulnerable under the EPBC Act and threatened under the FFG Act) occur in and offshore of the gulfs of South Australia. They are also known to breed on the offshore islands and coast of Spencer Gulf (Edyvane, 1999). Flegg (2002) reports that the species is widespread on southern and western Australian coasts, and breeds on coastal beaches and islands.

There are two distinct populations of little tern (*S. albigrons*) in Australia, with the south-eastern population being that which occurs within the EMBA. The little tern (listed as migratory and marine under the EPBC Act and threatened under the FFG Act) has an estimated population of 3,000 breeding pairs in eastern Australia (DoEE, 2017i). It is a migratory species that breeds in eastern Australia during spring and summer, leaving the colonies in late summer-autumn and vacating southern Australia (DoEE, 2017i). In eastern Australia, breeding normally occurs within wetland areas. Little terns inhabit sheltered coastal environments, including lagoons, estuaries, river mouths, lakes and exposed ocean beaches (DoEE, 2017i). Near the survey area,

habitat for this species occurs at the Gippsland Lakes, Corner Inlet and Western Port Bay (DoEE, 2017i). Little terns feed on small fish, crustaceans, insects and molluscs by plunging in shallow water or gleaning from the water surface (DoEE, 2017i). Depending on the final timing of the survey, the little tern may occur within the EMBA.

The sooty tern (*S. fuscata*), listed as a marine species under the EPBC Act, is widely distributed along the west coast of Western Australia, South Australia and eastern Victoria (DoEE, 2017i). There is a paucity of publicly available information on this species, though Flegg (2002) reports that it breeds colonally on remote rocky or sandy island beaches, dispersing to tropical oceanic waters. It is not clear whether this species may occur within the EMBA, though the presence of suitable breeding habitats in the EMBA suggests it may be present.

Sandpipers (EPBC Act: Listed migratory, marine)

There are six EPBC Act-listed sandpiper species that may occur within the survey area and EMBA (**wood, marsh, terek, curlew, common, sharp-tailed**). They breed in Europe and Asia and migrate to Australia during the southern summer. Sandpipers are small wader species found in coastal and inland wetlands, particularly in muddy estuaries, feeding on small marine invertebrates. Up to 3,000 sharp-tailed sandpiper and up to 1,800 curlew sandpiper are known to congregate to feed at the Gippsland Lakes. Sandpipers may be present within the EMBA at the time of the survey.

Knots (EPBC Act: threatened, listed migratory and marine)

There are two EPBC Act-listed species of knots that may occur within the survey area and EMBA (**red** and **great**). Both species are also recorded from the EMBA in the VBA, with the great knot also listed as threatened under the FFG Act. Both these species have a coastal distribution around the entire Australian coastline when they are present during the southern hemisphere summer (they breed in eastern Siberia in the northern hemisphere summer). They are medium-sized waders that prefer sandy beach, tidal mudflats and estuary habitats, where they feed on bivalve molluscs, snails, worms and crustaceans. Lake Reeve has supported the largest concentration (5,000) of red knot (*Calidris canutus*) recorded in Victoria. Knots may be present within the EMBA at the time of the survey.

Snipes (EPBC Act: listed as mostly migratory, marine)

There are four EPBC-Act listed snipe species that may occur within the EMBA (**Latham's, Swinhoe's, pin-tailed and Australian painted**). Latham's snip is also recorded from the EMBA in the VBA, and is not listed as threatened under the FFG Act. These snipe species (other than the Australian painted snipe, which is endemic to Australia) are present during the southern hemisphere summer (breeding in Asia and Russia in the northern hemisphere summer). They are medium-sized waders that roost among dense vegetation around the edge of wetlands during the day and feed at dusk, dawn and during the night on seeds, plants, worms, insects and molluscs. There are few if no confirmed records of the pin-tailed and Swinhoe's snipe in Victoria (DoEE, 2017i), while the Australian painted snipe is known to occur at Mallacoota Inlet. Snipes may be present within the EMBA at the time of the survey.

Godwits (EPBC Act: threatened, listed marine and migratory)

There are three EPBC Act-listed godwit species that may occur within the EMBA (**bar-tailed, Northern Siberian and black-tailed**), with the bar-tailed godwit also recorded in the VBA (though not listed as threatened under the FFG Act). Godwits are large waders that are found around all coastal regions of Australia during the southern hemisphere summer (breeding in Europe during the northern hemisphere summer), though the largest numbers remain in northern Australia. Godwits are commonly found in sheltered bays, estuaries and lagoons with large intertidal

mudflats or sandflats, or spits and banks of mud, sand or shell-grit where they forage on intertidal mudflats or sandflats, in soft mud or shallow water and occasionally in shallow estuaries (DoEE, 2017i). They have been recorded eating annelids, crustaceans, arachnids, fish eggs and spawn and tadpoles of frogs, and occasionally seeds. The Nooramunga Marine and Coastal Park (see Section 5.2.9) has recorded the largest concentrations of bar tailed godwit (*Limosa lapponica*) in south-eastern Australia. Godwits may be present within the EMBA at the time of the survey.

Orange-bellied parrot (EPBC Act: Critically endangered, FFG Act: Threatened)

The orange-bellied parrot (*Neophema chrysogaster*) breeds in Tasmania during summer, migrates north across Bass Strait in autumn and over-winters on the mainland. Birds depart the mainland for Tasmania from September to November (Green, 1969). The southward migration is rapid (Stephenson, 1991), so there are few migration records. The northward migration across western Bass Strait is more prolonged (Higgins, 1999).

The parrot's breeding habitat is restricted to southwest Tasmania, where breeding occurs from November to mid-January mainly within 30 km of the coast (Brown and Wilson, 1984). The species forage on the ground or in low vegetation (Brown and Wilson, 1980; 1984, Loyn *et al.*, 1986).

During winter, on mainland Australia, orange-bellied parrots are found mostly within 3 km of the coast (DoEE, 2017i). In Victoria, they mostly occur in sheltered coastal habitats, such as bays, lagoons and estuaries, or, rarely, saltworks. They are also found in low samphire herbland dominated by beaded glasswort (*Sarcocornia quinqueflora*), sea heath (*Frankenia pauciflora*) or sea-blite (*Suaeda australis*), and in taller shrubland dominated by shrubby glasswort (*Sclerostegia arbuscula*) (DoE, 2016i). This habitat may occur around the Gippsland Lakes area, and therefore the species may occur in the EMBA during winter.

Swift parrot (EPBC Act: Critically endangered)

The swift parrot (*Lathamus discolor*) is a small parrot that has rapid, agile flight. During summer, it breeds in colonies in blue gum forest of south-east Tasmania. Infrequent breeding also occurs in north-west Tasmania. The entire population migrates to the mainland for winter. On the mainland it disperses widely and forages on flowers and psyllid lerps in eucalypts. The birds mostly occur on inland slopes, but occasionally occur on the coast (DoEE, 2017i). Given its habitat preferences, this species is unlikely to occur within the EMBA, though there are 10 records for this species in the VBA for the EMBA (the last being 30 years ago).

Rainbow bee-eater (EPBC Act: listed marine)

The **rainbow bee-eater** (*Merops ornatus*) is a medium-sized bird distributed across much of mainland Australia and some nearshore islands. Its main habitat is open forests, woodlands and shrublands, but has also been recorded on coastal sand dunes and beaches (DoEE, 2017i). It feeds on insects (mainly bees and wasps), worms and spiders. The southern populations of the rainbow bee-eater migrate northward from February to April, and return to their breeding grounds in September and October. Nesting occurs in burrows at the end of long chambers in a variety of habitats. The broad distribution of the species means it may occur within the EMBA, and there are 3 records for this species in the VBA for the EMBA (the last being in 1981).

Exclusively VBA-listed seabirds

Little penguins

Little penguins (*Eudyptula minor*) are seabirds that don't fly, and are the smallest of the 17 penguin species in the world. They are permanent residents of the coastal and offshore islands of parts of the Victorian and Tasmanian coast and Bass Strait islands, with the South-east Marine Region representing about 60% of the species known breeding population (DoE, 2015a).

Individuals exhibit strong site fidelity, returning to the same breeding colony each year to breed in the winter and spring months. While on land, penguins remain in burrows to rest, nest and moult (PFPI, 2017). Nest building (in sand dunes or in rock crevices) occurs from June to December, breeding occurs from August to October, egg laying occurs from August to December, chick raising occurs from August to March and moulting occurs between February and April (during which time they must remain on land). During winter, penguins spend most of their time at sea, returning to the burrows to rest and attend to their burrows (PFPI, 2017).

Little penguins dive on average between 5 and 20 m in depth, with their preferred food sources being pilchards, anchovies, warehou, red cod, barracouta and squid (PFPI, 2017). They forage mostly from dawn to an hour before dusk, returning to their burrows at dusk (BirdLife, 2016).

During the breeding season, little penguins forage within 5-25 km of the coast, and at other times, foraging can occur up to 75 km from the coast (SARDI, 2011). Based on OSRA mapping, little penguin colonies in the Gippsland region occur at:

- Wilsons Promontory (139 km west of the proposed acquisition area, outside the EMBA) – 400 breeding pairs on Shellback Island, 1,000 breeding pairs at Norman Island, 3,400 breeding pairs at the Glennie Group Islands, 500 breeding pairs at the Anser Group of Islands, 400 breeding pairs at Wattle Island, 1,000 breeding pairs on Seal Island, 1,000 breeding pairs on Notch Island, 400 breeding pairs at Rag Island, 8,000 breeding pairs on Rabbit Island and 200 breeding pairs at Rabbit Rock;
- Phillip Island (175 km west of the proposed acquisition area, outside the EMBA) – 32,000 individuals;
- Tullaberga Island (210 km northeast of the proposed acquisition area) – 900 breeding pairs; and
- Gabo Island (215 km northeast of the proposed acquisition area) – 35,000 breeding pairs (50% of Victorian population).

Bass Strait islands with known populations of little penguins include:

- Babel Island – 20,000 pairs;
- Betsy Island – 15,000 pairs;
- Curtis Island group – 2,000 individuals;
- Hogan Island group – 10,000 individuals
- Furneaux Island group (over 40,000 pairs); and
- Forsyth, Passage and Gull islands – 80,000 pairs.

The nearest BIA for little penguins occurs at Curtis Island (south of Wilson's Promontory, 139 km southwest of the proposed acquisition area), around Flinders Island (156 km south) and at Phillip Island (175 km west) (all located outside the EMBA), and thus may forage within the operational area. Little penguins are recorded in the VBA as being present throughout the EMBA.

Terns

In addition to the three tern species listed under the EPBC Act, several other tern species are recorded as occurring in the EMBA under the VBA. These are the whiskered tern (*Chlidonias hybridus javanicus*), white-winged black-tern (*C. leucopterus*), gull-billed tern (*Gelochelidon nilotica macrotarsa*), Caspian tern (*Hydroprogne caspia*), common tern (*Sterna hirundo*), Arctic tern (*S. paradisaea*), white-fronted tern (*S. striata*) and crested tern (*Thalasseus bergii*). The crested, little and Caspian terns have the most sightings within the VBA. Most terns favour shoreline habitats, feeding on invertebrates and fish in marine waters and intertidal areas. Terns may overfly and forage in and around the proposed acquisition area.

Of these, the Caspian tern is listed as threatened under the FFG Act (as well as marine and migratory under the EPBC Act). It has regular breeding colonies at Corner Inlet (47 km southwest of the proposed acquisition area) and forages on fish and aquatic invertebrates in open wetlands, lakes and rivers, and is therefore unlikely to forage within the proposed acquisition area.

Shearwaters

In addition to the EPBC Act-listed shearwaters previously described, there are five other shearwater species listed under the VBA as occurring with the EMBA (none of which are listed as threatened under the FFG Act), these being the:

- Fluttering shearwater (*P. gavia*) – 48 recorded observations within the EMBA, this species is endemic to New Zealand and may forage within the EMBA during its annual migration to Australia.
- Sooty shearwater (*P. grisea*) – six recorded observations, this species may overfly and forage within the EMBA as they known to breed on islands off the southern Tasmanian and southern NSW coasts.
- Hutton's shearwater (*P. huttoni*) – one recorded observation, with this species known only to occur off the Western Australian coast.
- Wedge-tailed shearwater (*P. pacifica*) – one recorded observation, this species may overfly and forage within the EMBA as they known to breed on islands off the WA west coast and Queensland and NSW coasts. It is widespread across the Indian and Pacific oceans.
- Short-tailed shearwater (*P. tenuirostris*) – 92 recorded observations within the EMBA, this species may overfly and forage within the EMBA as they known to breed on islands off the Victorian, SA, southern WA, Tasmanian and NSW coasts.

Petrels

In addition to the EPBC Act-listed petrels previously described, there are five additional petrel species listed under the VBA (none of which are listed as threatened under the FFG Act), these being the Wilson's storm petrel (*Oceanites oceanicus*), white-faced storm-petrel (*Pelagodroma marina*), common diving-petrel (*Pelecanoides urinatrix*), white-headed petrel (*Pterodroma lessonii*) and great-winged petrel (*Pterodroma macroptera*). They share the same broad habitat requirements as the previously described petrel species and may overfly and forage in and around the proposed acquisition area.

5.4.9. Other EPBC Act-listed species

The PMST identifies several terrestrial species as occurring within the EMBA (likely due to the 1 km buffer on the search area). This includes:

- Eight terrestrial mammals;
- Four frogs; and
- Five plants.

Given that the onshore area of the EMBA only includes shorelines up to the high water mark, these species are not found in the marine environment and are therefore not described in the EP.

5.4.10. Marine Pests

In the South-east Marine Region, 115 marine pest species have been introduced and an additional 84 have been identified as possible introductions, or 'cryptogenic' species (NOO, 2002). Several introduced species have become pests either by displacing native species, dominating habitats or causing algal blooms.

Marine pests known to occur in South Gippsland, according to ParksVic (2015) and Butler et al (2012) include:

- Pacific oyster (*Crassostrea gigas*) – small number of this oyster species are reported to occur in Western Port Bay and at Tidal River in the Wilsons Promontory National Park (DELWP, 2015).
- Northern pacific seastar (*Asterias amurensis*) – prefer soft sediment habitat, but also use artificial structures and rocky reefs, living in water depths usually less than 25 m (but up to 200 m water depths). It is thought to have been introduced in 1995 through ballast water from Japan.
- New Zealand screw shell (*Maoricolpus roseus*) – lies on or partially buried in sand, mud or gravel in waters up to 130 m deep. It can densely blanket the sea floor with live and dead shells and compete with native scallops and other shellfish for food. This species is present in eastern Bass Strait, forming extensive and dense beds on sandy seabeds (Patil *et al.*, 2004). It is known to occur in the Point Hicks Marine National Park.
- European shore crab (*Carcinus maenas*) – prefers intertidal areas, bays, estuaries, mudflats and subtidal seagrass beds, but occurs in waters up to 60 m deep. It is presumed to occur on the intertidal reefs of all the marine national parks in Gippsland, except the Ninety Mile Beach MNP (which has no intertidal reef).

The Marine Pests Interactive Map (DAFF, 2017) indicates that the ports likely to be used for the survey (either Portland, Geelong, Melbourne or Eden) are known to harbour the following species:

- Northern pacific seastar – as above.
- European shore crab – as above.
- New Zealand screw shell – as above.
- European fan worms (*Sabella spallanzanii* and *Euchone* sp) – attaches to hard surfaces, artificial structures and soft sediments, preferring sheltered waters up to 30 m deep. It reached Port Phillip Bay in the mid 1980s and is a nuisance fouler (ParksVic, 2017).

- Japanese kelp (*Undaria pinnatifida*) – occupies cold temperate oceanic waters up to 20 m deep, growing on rock, reef, stones and artificial structures. It rapidly forms dense forests and overgrows native species. It first established in Port Phillip Bay in the 1980s (ParksVic, 2017).
- Asian date mussel (*Musculista senhousia*) – prefers soft sediments in waters up to 20 m deep, forming mats and altering food availability for marine fauna.
- European shell clam (*Varicorbula gibba*) – burrows into soft-bottomed habitats in waters up to 150 m deep in temperate waters, forming mats and altering food availability for marine fauna.

These species have the potential to be picked up in the ballast water and transferred to the proposed acquisition area. Two of these species (Pacific oyster and European green crab) are also known to occur in the Gippsland Lakes (Hirst & Bott, 2016).

5.5. Cultural Heritage Values

Cultural heritage can be broadly defined as the legacy of physical science artefacts and intangible attributes of a group or society that are inherited from past generations, maintained in the present and bestowed for the benefit of future generations. Cultural heritage includes tangible culture (such as buildings, monuments, landscapes, books, works of art, and artefacts), intangible culture (such as folklore, traditions, language, and knowledge) and natural heritage (including culturally significant landscapes).

This section describes the cultural heritage values of the EMBA (which includes the coastline up to the high-water mark), which are broadly categorised as Aboriginal and non-Aboriginal (maritime archaeology).

5.5.1. Aboriginal Heritage

Aboriginal people have occupied Gippsland for at least 18,000 years and probably for over 40,000 years (OMV, 2003). The coastline adjacent to the proposed acquisition area is occupied by the *Gunaikurnai* language group, which comprises five distinct clans; the Brataualung, the Brayalaulung, the Tatungalung, the Brabalung and the Krautungalung (Basslink, 2001). Estimates of the number of clanspeople in the *Gunaikurnai* are between 3,000 and 5,000 prior to European contact (Basslink, 2001).

The Gippsland coastline is of significant Aboriginal cultural heritage significance. Coastal fishing is an important part of Aboriginal culture, with fishing methods including hand gathering, lines, rods and reels, nets, traps and spears (DoE, 2015a). The Victorian Aboriginal Heritage Register contains details of Aboriginal cultural heritage places and objects areas along the coastline, however this is not publically accessible as it contains culturally sensitive information.

Crustaceans (e.g., rock lobster, crab) and shellfish formed an important part of the diet of Aboriginals living along the coast. There are numerous areas containing Aboriginal shell middens (i.e., the remains of shellfish eaten by Aboriginal people) along the sand dunes of the Gippsland coast. Coastal shell middens are found as layers of shell exposed in the side of dunes, banks or cliff tops or as scatters of shell exposed on eroded surfaces. These areas may also contain charcoal and hearth stones from fires, and items such as bone and stone artefacts, and are often located within sheltered positions in the dunes, coastal scrub and woodlands. Other archaeological sites present along the Gippsland coast include scar trees and assorted artefact scatters (Basslink, 2001).

5.5.2. Maritime Archaeological Heritage

Shipwrecks (together with their associated relics) over 75 years old are protected within Commonwealth waters under the Historic *Shipwrecks Act 1976* (Cth) and in Victorian waters under the *Victorian Heritage Act 1995* (Vic).

Shipwrecks

There are no shipwrecks mapped as occurring in the proposed operational area, and there are 37 shipwrecks mapped within the EMBA (Figure 5.22). The nearest shipwreck to the proposed acquisition area is the *SS Trinculo*, an iron sailing barque that was wrecked in 1879. It is located on the beach to the east of Flamingo Beach.

Shipwrecks listed in the Australian National Shipwreck and Relic Database (DoEE, 2017j) closest to, but not within the EMBA, are:

- *PS Thistle* – an iron paddle steamer (measuring 45 m long and 6 m wide) wrecked in 1859 just outside Corner Inlet. It ran ashore through navigational error and all crew reached the shore safely.
- *PS Clonmel* – a paddle steamer (measuring 47 m long and 8 m wide) wrecked in 1841 at the Port Albert entrance ('Clonmel Island') just outside Corner Inlet. The wreck of the *Clonmel* was instrumental in the settlement of Gippsland and the establishment of the towns of Port Albert, Tarraville and Alberton. In 2015, the wreck was completely covered with sand. It lies within a protected zone.
- *SS Blackbird* – a screw steamer (measuring 60 m long and 8 m wide) wrecked in June 1878 at Clonmel Island, Port Albert, due to reckless navigation, while on the way from Newcastle to Melbourne. All crew made it shore alive. The steamer was constructed of iron and remains well preserved on the seabed.
- *SS Glenelg* – a twin screw steamer (measuring 41 m long and 6 m wide) constructed of iron wrecked in March 1900 soon after leaving Lakes Entrance, with 38 people dying and 3 making it ashore. It lies 30 km southwest of the proposed acquisition area in a protected zone.

Shipwreck Protection Zones

Of the 650 shipwrecks in Victoria, nine have been placed within protected zones (a no-entry zone of 500-m radius [78.5 ha] around a particularly significant and/or fragile shipwreck) (DELWP, 2017). Five of these are located within Port Phillip Bay, and two along the west Gippsland coast, these being the *PS Clonmel* (just outside Corner Inlet) and the *SS Glenelg* (see previous subsection).

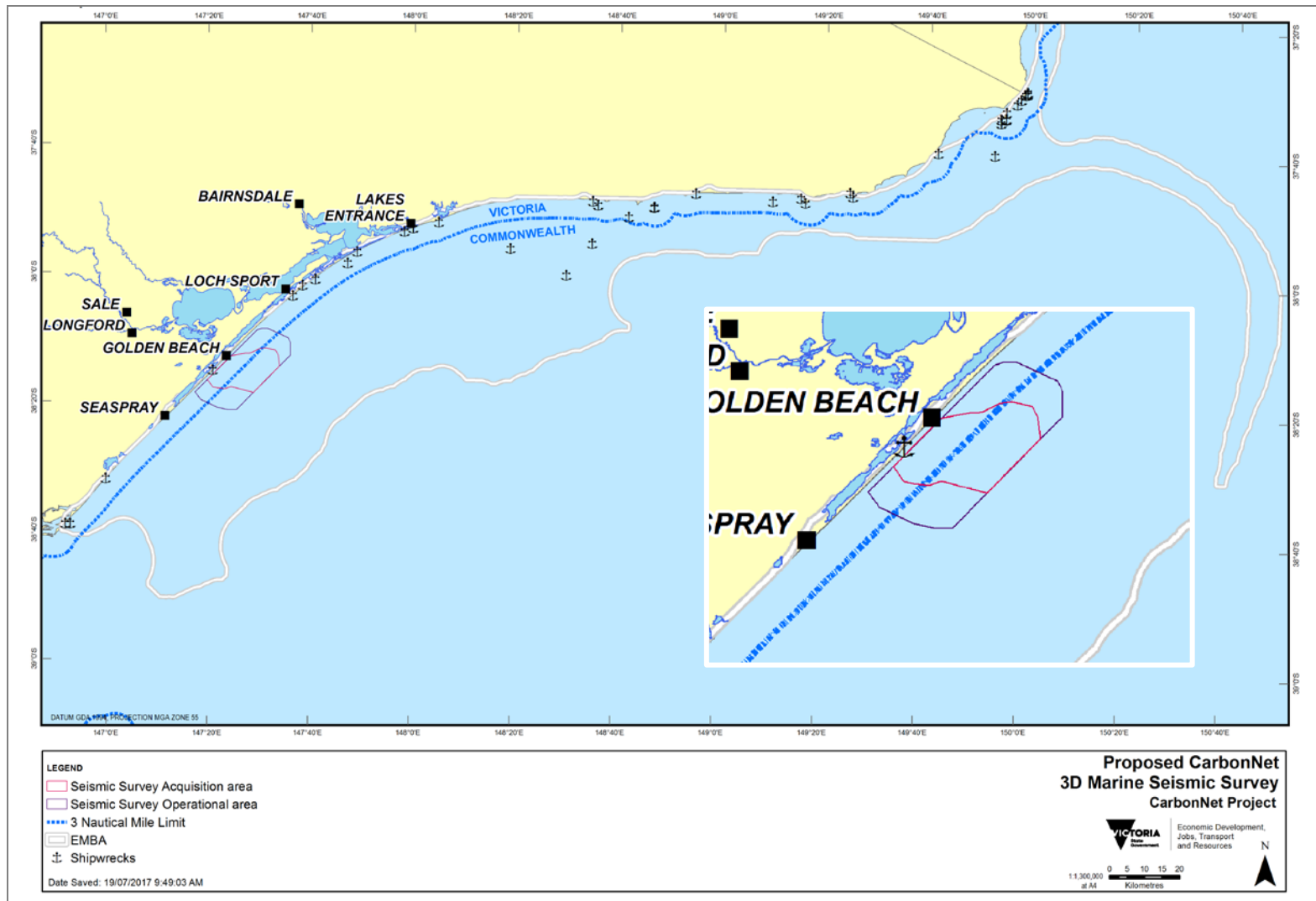


Figure 5.22. Shipwrecks known to occur within the EMBA

5.6. Socio-economic Environment

This section describes the social and economic environment of the proposed Pelican 3DMSS area and the EMBA.

5.6.1. Coastal Settlements

The coastline adjacent to the proposed Pelican 3DMSS area is sparsely populated, with the adjoining townships of Golden Beach and Paradise Beach being the closest. These towns are located within the Shire of Wellington.

Wellington Shire

Australian Bureau of Statistics (ABS) data for the Wellington Shire indicates that it has a population of 42,220 in 2014, with a median age of 42.6 years, with Aboriginal people comprising 1.4% of the population in 2011. Managers and professionals comprise 33% of the workforces, technicians and trade works occupy 16% and community works 10.4% (ABS, 2017).

In 2014, the total number of businesses in the Shire of Wellington numbered 2,450, with most of these employing 1-4 people, and the median personal income in 2013 was \$44,056. The largest industries in 2011 were healthcare and social assistance (12.5%), agriculture, forestry and fishing (11.8%) and accommodation and food services (11.3%) (ABS, 2017).

Many residents from the hinterland town of Sale (and surrounding townships) work at the Longford Gas Plant, which processes oil and gas from the offshore Gippsland oil and gas fields (see Section 5.6.6).

Towns

There are no ABS statistics available for Golden Beach and Paradise Beach. These towns have very small resident populations, with housing catering primarily to the holiday market, with shacks used by holidaymakers, along with the many vacant blocks used for camping. Camping among the sand dunes is also available along this section of coastline. Golden Beach has a small group of retail shops, a church, caravan park, football oval, bowling green and 9-hole golf course.

The area between The Honeysuckles and Paradise Beach Ninety Mile was subdivided into about 11,800 small urban sized lots from 1955 to 1969 without planning controls. The developer only provided a main sealed road along the coast (Shoreline Drive) and very little of the promised facilities or services were ever built. Only the main settlements of Golden and Paradise Beaches and The Honeysuckles are now serviced with electricity and no reticulated water or sewerage was provided. Some dwellings were built without services on the primary sand dunes and on flood-prone land (Wellington Shire, 2017). As such, the Victorian government has been in the process of buying out these properties.

The towns of Seaspray and The Honeysuckles are located further west on the coastline adjacent to the proposed Pelican 3DMSS. Similar to Golden Beach and Paradise Beach, these are essentially tourism-focused towns.

5.6.2. Native Title

The National Native Title Tribunal (NNTT) database identifies that there is Native Title Determination registered over much of the coastline adjacent to the proposed survey acquisition area, this being for the Gunai/Kurnai People (VCD2010/001)

(Figure 5.23). This was also confirmed during the stakeholder consultation process (see Section 4.5).

There are no Native Title Claims over the proposed acquisition area or adjacent coastline (NNTT, 2017).

There are no Indigenous Land Use Agreements (ILUA) registered by the NNTT along the coastline adjacent to the proposed survey acquisition area (NNTT, 2017).

5.6.3. Commercial Fishing

Several Commonwealth and Victorian commercial fisheries are licensed to operate in and around the Pelican 3DMSS area and the diesel spill EMBA (as defined at the start of Chapter 5). These are described in the following sections.

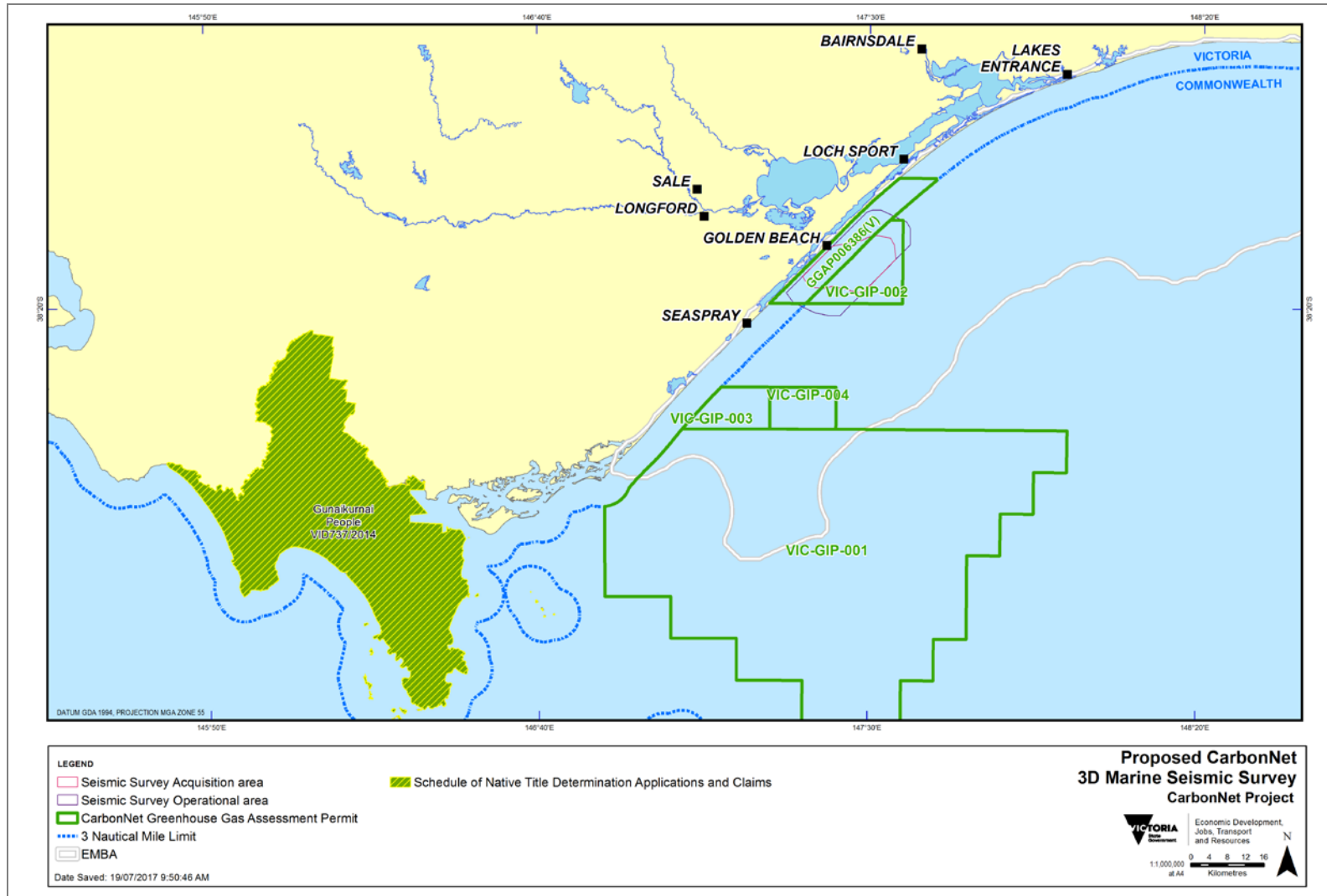
Commonwealth-managed Fisheries

Commonwealth fisheries are managed by the AFMA under the *Fisheries Management Act 1991* (Cth). Their jurisdiction covers the area of ocean from 3 nm from the coast out to the 200 nm limit (the extent of the AFZ). Commonwealth commercial fisheries with jurisdictions to fish the EMBA are the:

- Bass Strait Central Zone Scallop Fishery;
- Eastern Tuna and Billfish Fishery;
- Eastern Skipjack Tuna Fishery;
- Southern Bluefin Tuna Fishery;
- Small Pelagic Fishery (eastern sub-area);
- Southern Squid Jig Fishery; and
- Southern and Eastern Scalefish and Shark (SESS), incorporating;
 - Gillnet and Shark Hook sector.
 - South East Trawl sector.
 - Scalefish Hook sector.

Table 5.12 summarises the key facts and figures of each of these fisheries, and indicates that only the Southern Squid Jig Fishery and the SESS are likely to fish within the acquisition area or EMBA.

Consultation with fisheries groups and research commissioned by CarbonNet and undertaken by SETFIA & Fishwell (2017) indicates that the only Commonwealth-managed fisheries currently operating in the operational area is the SESS Fishery.



Source: (NNTT (2017)).

Figure 5.23. The Gunai/Kurnai Native Title Determination

Table 5.12. Commonwealth-managed commercial fisheries with jurisdictions to fish in or around the survey area and EMBA

Fishery	Target species	Geographic extent of fishery	Does fishing activity intersect acquisition area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Bass Strait Central Zone Scallop Fishery	Commercial scallop (<i>Pecten fumatus</i>)	The central Bass Strait area that lies within 20 nm of the Victorian and Tasmanian coasts. Fishery does not operate in state waters. Fishing effort is normally concentrated around King Island.	Acquisition area – No based on 2015 fishing intensity data. Diesel spill EMBA – No based on 2015 fishing intensity data. <i>Acquisition area intersects 0% of the fishery.</i> <i>Operational area intersects 0% of the fishery.</i> <i>EMBA intersects 0.6% of the fishery.</i>	1 st April to 31 st December.	Towed scallop dredges that target dense aggregations ('beds') of scallop. 65 fishing permits are in place. Eleven vessels were active in the fishery in 2015, a decrease from 26 active vessels in 2009, reflecting the 'boom or bust' nature of the fishery.	2,260 tonnes in 2015, worth \$2.8 million. 1,418 tonnes in 2014, worth \$0.5 million. Scallop spawning occurs from winter to spring (June to November), with timing dependent on environmental conditions such as wind and water temperature.
Eastern Tuna and Billfish Fishery	Albacore tuna (<i>Thunnus alulunga</i>), bigeye tuna (<i>T. obesus</i>), yellowfin tuna (<i>T. albacares</i>), broadbill swordfish (<i>Xiphias gladius</i>), striped marlin (<i>Tetrapturus audux</i>)	South Australia/Victoria border, around east coast of Australia to Cape York, including waters around Tasmania. Fishing effort is concentrated along the NSW coast and southern Queensland coast around the 200 m depth contour.	Acquisition area – No based on 2015 fishing intensity data. Diesel spill EMBA – No based on 2015 fishing intensity data. <i>Acquisition area intersects 0.004% of the fishery.</i> <i>Operational area intersects 0.009% of the fishery.</i> <i>EMBA intersects 0.28% of the fishery.</i>	12-month season, beginning 1 st of March.	Pelagic longline is the key fishing method, with small quantities taken using minor line methods (such as handline, troll, rod and reel). Active vessel numbers were 39 in 2015 (down from about 150 in 2002). No Victorian ports are used to land catches.	5,408 tonnes in 2015 with a value of \$35 million. In 2014, the catch was 4,368 tonnes worth \$30.7 million. Spawning occurs through most of the year in water temperatures greater than 26°C (Wild Fisheries Research Program, 2012). No recent fishing effort in the proposed acquisition area. Consultation with Tuna Australia confirms the proposed acquisition area does not impact on this fishery.

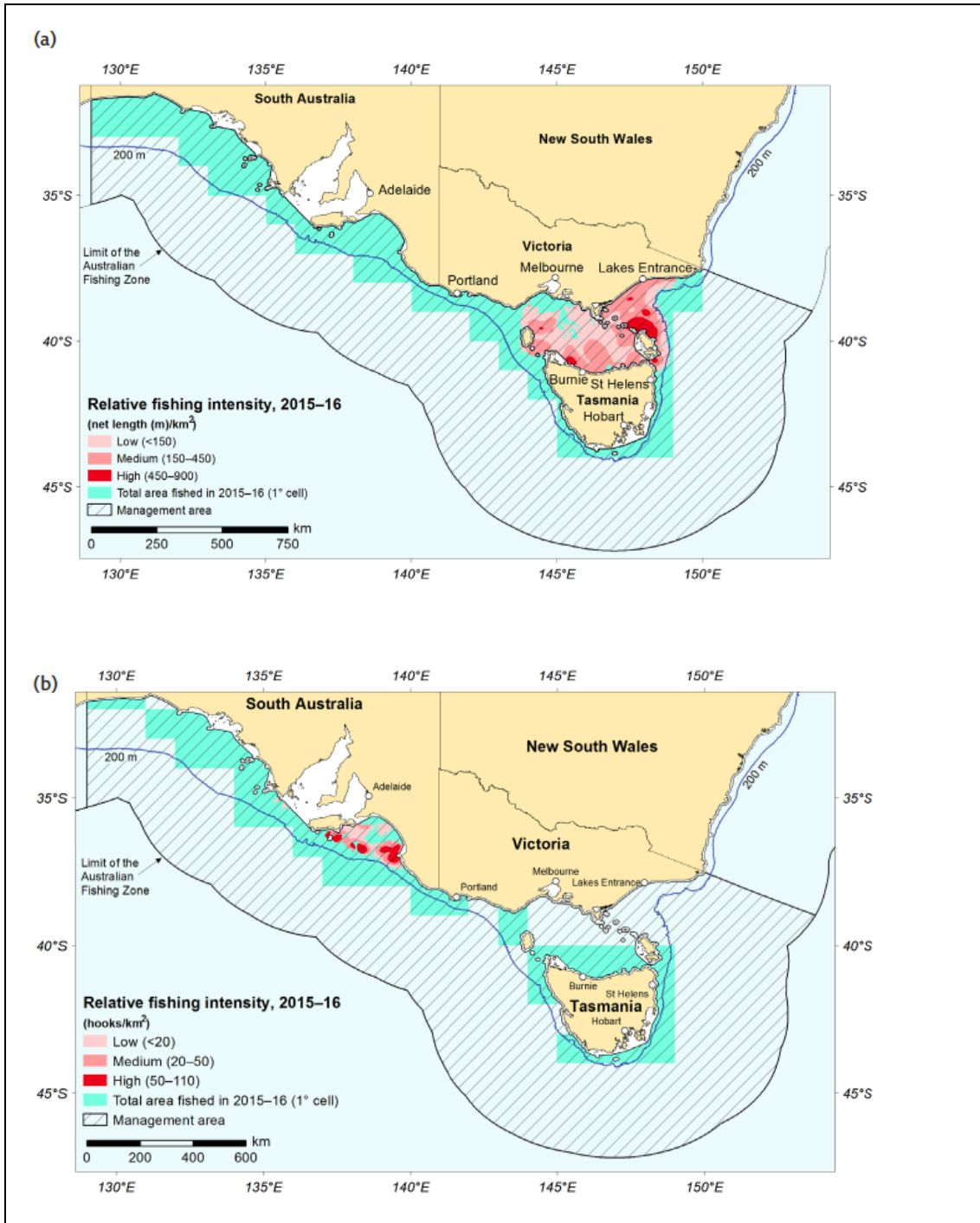
Fishery	Target species	Geographic extent of fishery	Does fishing activity intersect acquisition area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Eastern Skipjack Tuna Fishery	Skipjack tuna (<i>Katsuwonus pelamis</i>)	Extends from the border of Victoria and South Australia to Cape York, Queensland.	<p>Acquisition area – No. Eastern seaboard not currently fished.</p> <p>Diesel spill EMBA – No. Eastern seaboard not currently fished.</p> <p><i>Acquisition area intersects 0.004% of the fishery.</i></p> <p><i>Operational area intersects 0.009% of the fishery.</i></p> <p><i>EMBA intersects 0.28% of the fishery.</i></p>	Not currently active.	<p>There are 19 permits in the eastern zone, though no vessels currently work the fishery.</p> <p>Port Lincoln was the main landing port until the tuna cannery in the town closed down.</p>	No recent fishing effort in the proposed acquisition area.
Southern Bluefin Tuna	Southern bluefin tuna (<i>Thunnus maccoyii</i>)	<p>The fishery extends throughout all waters in the AFZ.</p> <p>AFMA manages Southern Bluefin Tuna stocks in Victorian State waters under agreements set up within the OCS (DEH, 2004).</p> <p>The nearest fishing effort to the proposed acquisition area is concentrated along the NSW south coast around the 200 m depth contour (. </p>	<p>Acquisition area – No based on longline catch in 2015.</p> <p>Diesel spill EMBA – No based on longline catch in 2015.</p> <p><i>Acquisition area intersects 0.02% of the fishery.</i></p> <p><i>Operational area intersects 0.004% of the fishery.</i></p> <p><i>EMBA intersects 0.11% of the fishery.</i></p>	12-month season, beginning 1 st of December.	<p>Purse sein catch in the Great Australian Bight for transfer to aquaculture farms off Port Lincoln in South Australia (five to eight vessels consistently fish this area).</p> <p>On the east coast, pelagic longline fishing is the key fishing method, with 18 vessels working the fishery in 2014-15 (15 vessels in 2013-14).</p> <p>Port Lincoln is the primary landing port.</p>	<p>572 tonnes worth \$36.8 million in 2014-15 (east coast pelagic longline).</p> <p>381 tonnes worth \$2 million in 2013-14 (east coast pelagic longline).</p> <p>No recent fishing effort in the proposed acquisition area.</p> <p>Consultation with the ASBTIA confirms the proposed acquisition area does not impact on this fishery.</p>

Fishery	Target species	Geographic extent of fishery	Does fishing activity intersect acquisition area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Small Pelagic Fishery (eastern sub-area)	Australian sardine (<i>Sardinops sagax</i>), Jack mackerel (<i>Trachurus declivis</i>), blue Mackerel (<i>Scomber australasicus</i>), redbait (<i>Emmelichthys nitidus</i>)	Operates in Commonwealth waters (3-200 nm) extending from southern Queensland around southern Western Australia. There is no fishing near the proposed acquisition area.	Acquisition area – No (based on total area fished in 2015-16). Diesel spill EMBA – No (based on total area fished in 2015-16). <i>Acquisition area intersects 0.003% of the fishery.</i> <i>Operational area intersects 0.006% of the fishery.</i> <i>EMBA intersects 0.28% of the fishery.</i>	12-month season, beginning 1 st of May.	Purse seine and mid-water trawl, with the latter being the main method. A 'factory trawler' operating the fishery in 2014-15 and 2015-16 has increased recent catch efforts. 32 entities held in 2015-16 using three active vessels. The main landing ports are in Tasmania, South Australia and New South Wales, along with Geelong in Victoria.	A total allowable catch of 39,170 tonnes in 2015-16, with the value being confidential due to the small number of fishers. In 2014-15, the Total Allowable Commercial Catch (TACC) was 34,920 tonnes, with a confidential value. No recent fishing effort in the proposed acquisition area.
Southern Squid Jig Fishery	Arrow squid (<i>Nototodarus gouldi</i>)	The fishery extends from the SA/WA border east to southern Queensland. AFMA does not control squid fishing in Victorian state waters. There is no fishing near the proposed acquisition area, with most fishing takes place off Portland, southwest Victoria.	Acquisition area – Yes , based on 2015 catch data (but 'no' based on fishing intensity data). Diesel spill EMBA – No (based on fishing intensity data). <i>Acquisition area intersects 0.004% of the fishery.</i> <i>Operational area intersects 0.008% of the fishery.</i> <i>EMBA intersects 0.35% of the fishery.</i>	Starts in February and ends in June. The season starts off the Port Phillip Bay heads and slowly moves westwards to Portland as the season progresses, following the natural migration of the squid (SIV, 2016).	Squid jigging is the fishing method used, mainly at night time and in water depths of 60 to 120 m. High-powered lamps are used to attract squid. In 2015, there were seven active vessels, compared to one vessel in 2014. Portland and Queenscliff are the primary landing ports.	The species' short life span, fast growth and sensitivity to environmental conditions result in strongly fluctuating stock sizes. Fishery value in 2015 was \$890,000 based on a catch of 330 tonnes (compared with 2 tonnes worth \$250,000 in 2014). No recent fishing effort in the proposed acquisition area.
Southern and Eastern Scafish and Shark Fishery						

Fishery	Target species	Geographic extent of fishery	Does fishing activity intersect acquisition area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Shark Gillnet and Shark Hook Sector (Figure 5.24)	Gummy shark (<i>Mustelus antarcticus</i>) is the key target species, with bycatch of elephant fish (<i>Callorhynchus milii</i>), sawshark (<i>Pristiophorus cirratus</i> , <i>P. nudipinnis</i>), and school shark (<i>Galeorhinus galeus</i>).	Waters from the NSW/Victorian border westward to the SAWA border, including the waters around Tasmania, from the low water mark to the extent of the AFZ. Most fishing occurs in waters adjacent to the coastline in Bass Strait, with a low to medium fishing intensity over the proposed acquisition area (Figure 5.27).	Acquisition area – Yes based on 2015-16 fishing intensity data (gillnet only, not hook). Diesel spill EMBA – Yes based on 2015-16 fishing intensity data (gillnet only, not hook). <i>Acquisition area intersects 0.008% of the fishery.</i> <i>Operational area intersects 0.014% of the fishery.</i> <i>EMBA intersects 0.6% of the fishery.</i>	12-month season, beginning 1 st May.	Demersal gillnet and a variety of line methods. 61 gillnet permits and 13 hook permits in 2015-16 (same as 2014-15).	In 2015-16, the SESS Fishery is the largest Commonwealth fishery in terms of volume produced. 1,960 tonnes in 2015-16 with an unknown dollar value. 1,710 tonnes in 2014-15 with a value of \$15.6 million.
Commonwealth Trawl Sector (CTS) (Figure 5.25)	Key species targeted are eastern school whiting (<i>Sillago flindersi</i>), flathead (<i>Platycephalus richardsoni</i>) and gummy shark (<i>Mustelus antarcticus</i>).	Covers the area of the AFZ extending southward from Barrenjoey Point (north of Sydney) around the New South Wales, Victorian and Tasmanian coastlines to Cape Jervis in South Australia. Effort increasingly concentrated on the continental shelf, rather than historical areas of the slope (Figure 5.28).	Acquisition area – No based on 2015-16 fishing intensity data (but 'yes' based on total area fished). Diesel spill EMBA – Yes based on 2015-16 fishing intensity data. <i>Acquisition area intersects 0.009% of the fishery.</i> <i>Operational area intersects 0.017% of the fishery.</i> <i>EMBA intersects 0.76% of the fishery.</i>	12-month season, beginning 1 st May. Highest catches from September to April.	Multi-gear fishery, but predominantly demersal otter trawl and Danish-seine methods. In the proposed acquisition area, between 7 and 13 vessels have operated since 2007. Catches have ranged from 9 t in 2013 to 62 t in 2016. Total catch value from the proposed acquisition area since 2007 is estimated at \$810,000. Primary landing ports in NSW, and Lakes Entrance and Portland in Victoria.	Logbook catches have been gradually declining since 2001. 9,026 tonnes in 2015-16 (of which 8,057 tonnes was flathead, blue grenadier, pink ling, eastern school whiting and orange roughy, accounting for 79% of the catch). No values are assigned to the 2015-16 catch, but the 2014-15 catch of 8,264 tonnes was valued at \$37.7 million. Little fishing effort in the vicinity of the proposed acquisition area.

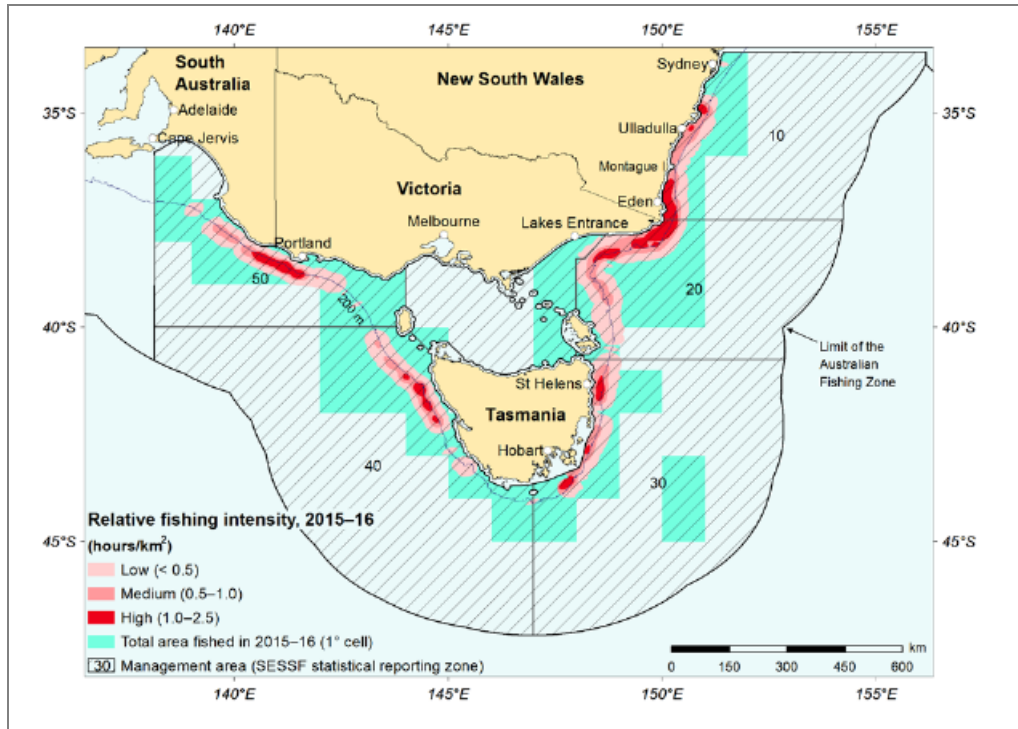
Fishery	Target species	Geographic extent of fishery	Does fishing activity intersect acquisition area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Scalefish Hook Sector (Figure 5.26)	Key species targeted are gummy shark (<i>Mustelus antarcticus</i>), elephantfish (<i>Callorhinchus milii</i>) and draughtboard shark (<i>Cephaloscyllium laticeps</i>).	Includes all waters off South Australia, Victoria and Tasmania from 3 nm to the extent of the AFZ. Effort increasingly concentrated on the continental shelf, rather than historical areas of the slope. There is no fishing near the proposed acquisition area (Figure 5.29).	Acquisition area – No based on 2015-16 area fished data. Diesel spill EMBA – Yes based on 2015-16 area fished data. <i>Acquisition area intersects 0.004% of the fishery.</i> <i>Operational area intersects 0.009% of the fishery.</i> <i>EMBA intersects 0.36% of the fishery.</i>	12-month season, beginning 1 st May. Effort highest from January to July.	Multi-gear fishery, using different gear types in different areas or depth ranges. Predominantly demersal longline fishing methods, some of which are automated, and demersal gillnets. Sixteen scalefish hook vessels operated in 2015-16 (15 vessels in 2014-15). Primary landing ports in NSW, and Lakes Entrance and Portland in Victoria.	Logbook catches have been gradually declining since 2006 and are now less than 2,000 t/yr. In the proposed acquisition area, the catch has fluctuated below 20 t/yr since 2011. Value of the catch in the proposed acquisition area is reported as highest in 2007 at \$150,000, to as low as \$31,500 in 2015. No recent fishing effort in the proposed acquisition area.

Sources: Patterson et al (2016), AFMA (2017a), Status of Australian Fish Stocks reports (2017), SETFIA & Fishwell (2017).



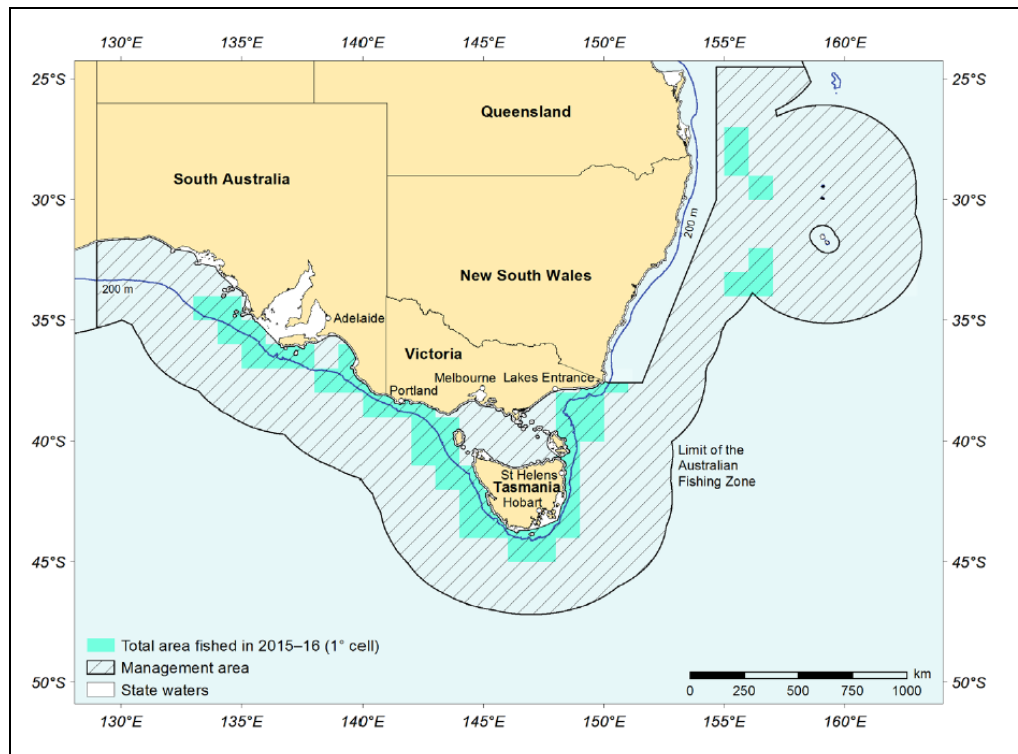
Source: Patterson et al (2016).

Figure 5.24. Jurisdiction of and fishing intensity in the Commonwealth SESS fishery - (a) shark gillnet & (b) shark hook (Cth)



Source: Patterson et al (2016).

Figure 5.25. Jurisdiction of and fishing intensity in the Commonwealth SESS fishery (Commonwealth trawl sector)



Source: Patterson et al (2016).

Figure 5.26. Jurisdiction of and fishing intensity in the Commonwealth SESS fishery (scalefish hook sector)

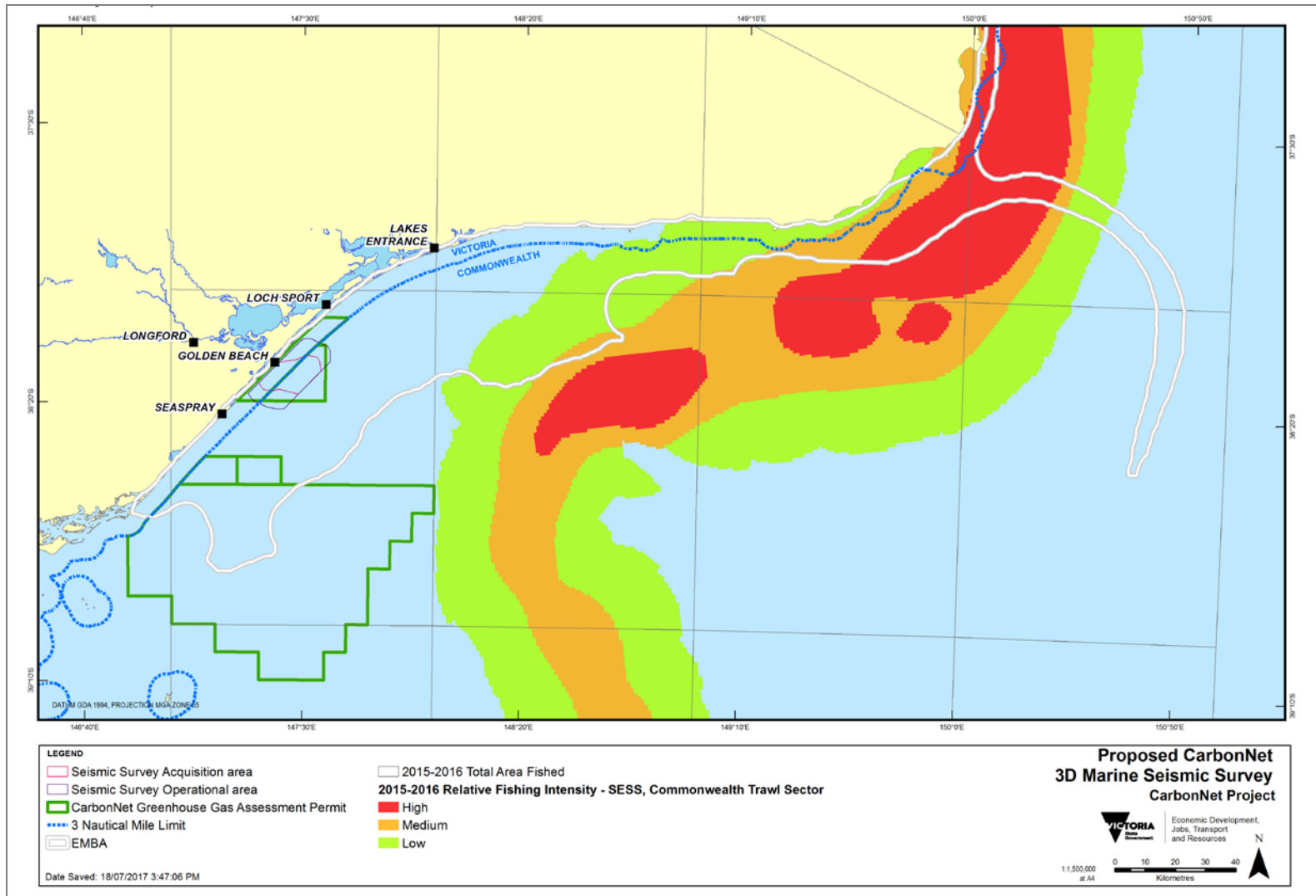


Figure 5.27. Relative fishing intensity of the SESS (Commonwealth Trawl Sector) in relation to the EMBA

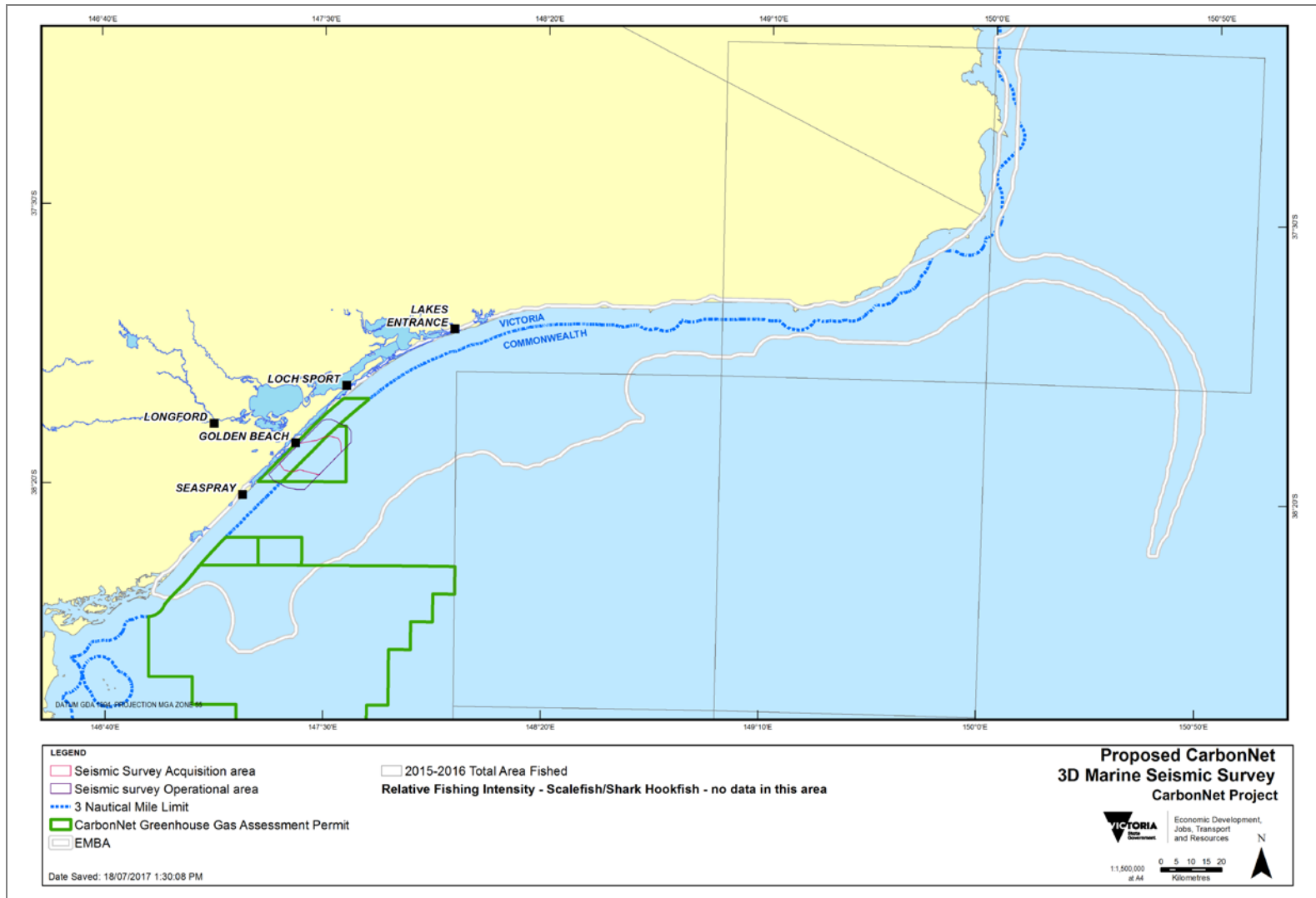


Figure 5.28. Relative fishing intensity of the SESS (Scalefish Hook Sector) in relation to the EMBA

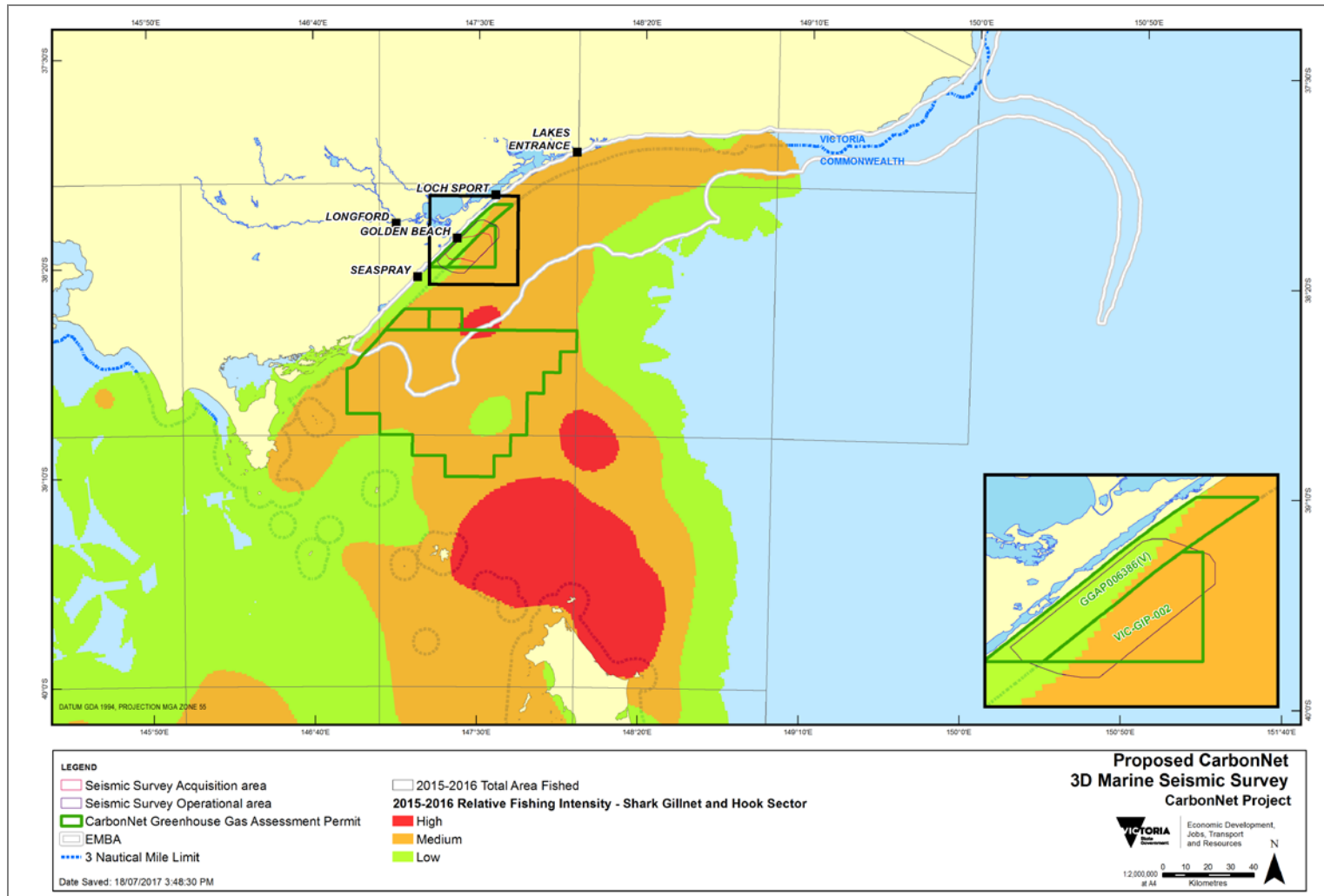


Figure 5.29. Relative fishing intensity of the SESS (Shark Gillnet and Hook Sector) in relation to the EMBA

Victorian-managed Fisheries

Victorian-managed commercial fisheries with access licences that authorise harvest in the waters of the proposed acquisition area and/or the EMBA include the following (noting that not all actually operate in the area):

- Ocean Scallop;
- Abalone (central zone) (does not operate in the proposed acquisition area);
- Rock Lobster (Eastern zone);
- Trawl (inshore);
- Ocean Purse Seine (noted by VFA as being the most active fishery in the region);
- Ocean Access (General);
- Wrasse (does not operate in the proposed acquisition area); and
- Banded Morwong (by permit) (does not operate in the proposed acquisition area).

The proposed acquisition area intersects the VFA catch and effort grid cells E39 and E40, with a miniscule intersection with E38. The proposed operational area intersects VFA catch and effort grid cells D39, D40, E38, E39, E40, F38 and F39 (Figure 5.30). These grid cells are based on divisions of 10' latitude (approximately 10 nm) and 12.1' longitude (approximately 12.1 nm).

Table 5.13 provides a presence/absence of fishing activity and catch data (where available) for the grid cells overlapped by the proposed acquisition area for the period 2006/07 to 2015/16 (inclusive).

Table 5.13 Fisheries catch data from the proposed acquisition area

Year	Catch (tonnes)	Fisheries fished				
		Ocean scallop	Rock lobster	Ocean access	Ocean purse seine	Inshore trawl
2006/07	333.4					
2007/08	235.5					
2008/09	466.3					
2009/10	ID					
2010/11	ID	Zero quota				
2011/12	ID	Zero quota				
2012/13	ID	Zero quota				
2013/14	ID					
2014/15	ID					
2015/16	ID					

ID = Insufficient data to report (where there are fewer than 5 licence holders, VFA policy is that data is not publicly released in order to protect confidentiality).

Green cells = catch recorded, red cells = no catch recorded.

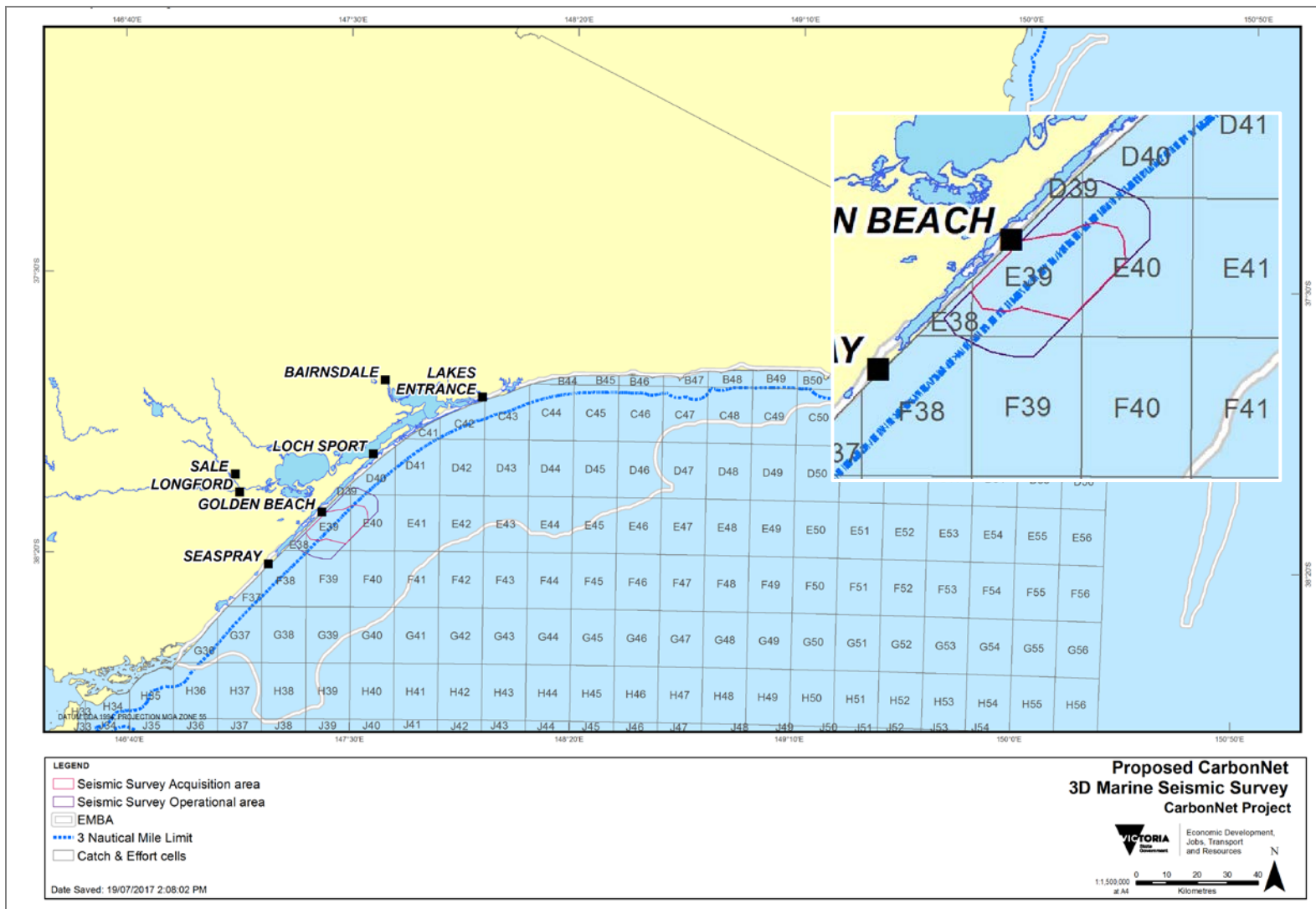


Figure 5.30. VFA catch and effort grid cells overlapped by the proposed operational area and EMBA

The EMBA intersects the following VFA catch and effort grid cells: A53-54, B44-56, C41-53, D39-47, E38-46, F37-41, G36-40 and H37-39 (see Figure 5.30). Table 5.14 provides a presence/absence of fishing activity and catch data (where available) for these grid cells for the period 2006/07 to 2015/16 (inclusive).

Table 5.14 Fisheries catch data from the EMBA

Year	Catch (tonnes)	Fisheries fished					
		Ocean scallop	Rock lobster	Ocean access	Ocean purse seine	Wrasse	Inshore trawl
2006/07	2,031						
2007/08	2,849						
2008/09	2,427						
2009/10	ID						
2010/11	ID	Zero quota					
2011/12	ID	Zero quota					
2012/13	ID	Zero quota					
2013/14	ID						
2014/15	ID						
2015/16	ID						

ID = Insufficient data to report (where there are fewer than 5 licence holders, VFA policy is that data is not publicly released in order to protect confidentiality).

Green cells = catch recorded, red cells = no catch recorded.

Table 5.15 summarises the key facts and figures for each for the Victorian fisheries licensed to fish within the EMBA.

Table 5.15. Victorian-managed commercial fisheries with jurisdictions to fish within the EMBA

Fishery	Target species	Geographic extent of fishery	Does fishing activity intersect acquisition area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Bass Strait Scallop Fishery (Victorian zone) (Figure 5.31)	Commercial scallop (<i>Pecten fumatus</i>).	Extends 20 nm from the high tide water mark of the entire Victorian coastline (excluding bays and inlets where commercial scallop fishing is prohibited). Management of the Bass Strait Scallop fishery was split between the Commonwealth, Victoria and Tasmania in 1986 under an Offshore Constitutional Settlement, whereby Commonwealth central, Victorian and Tasmanian zones were created.	<p>Acquisition area – Yes, based on VFA 2012-2016 catch data.</p> <p>Diesel spill EMBA – Yes, based on VFA 2012-2016 catch data.</p> <p>The same survey found no scallops within the acquisition area in commercial quantities.</p> <p><i>Acquisition area intersects 0.11% of the fishery.</i></p> <p><i>Operational area intersects 0.21% of the fishery.</i></p> <p><i>EMBA intersects 6.02% of the fishery.</i></p> <p>Based on historical catch data (1998-2003), the catch from the area overlapping the proposed acquisition area represents <1.85% of the fishery.</p>	<p>12-month season, beginning 1st of April.</p> <p>Fishing usually occurs during the winter months, but can occur from May to the end of November.</p> <p>While scallops are still present in the region, they are believed to be present in much lower numbers than historically. Scallops have highly variable levels of natural mortality, with an historical 'boom' or 'bust' nature.</p> <p>Fishing activity in the area is currently low, although the VFA is implementing management arrangements designed to increase fishing activity in the area.</p>	<p>Towed scallop dredges (typically 4.5 m wide) that target dense aggregations ('beds') of scallop. A tooth-bar on the bottom of the mouth of the dredge lifts scallops from the seabed and into the dredge basket.</p> <p>There are a maximum of 90 licences available. Only a few vessels fishing these licenses operate in any one year (generally between 12 and 20).</p> <p>Vessels are typically based out of Lakes Entrance or Port Welshpool, although licence holders may fish the entire coastline.</p> <p>Some licence holders also have entitlements to fish the Commonwealth scallop fishery, inshore trawl, Commonwealth SESS fishery and the southern squid jig fishery (see Table 5.15).</p> <p>The VSFA has advised that the fishery operates to its own Scallop Management Plan (i.e., not one developed by the VFA).</p>	<p>VFA has advised that in the proposed acquisition area, about 1-1.5 tonnes have been caught in the last five years (2011-2016) (value unknown).</p> <p>For the fishery as a whole, 7.6 tonnes was landed in 2015-16 (value unknown).</p> <p>Zero quotas were in place for the 2010-11, 2011-12 and 2012-13 seasons due to a lack of commercial scallop quantities.</p> <p>The TACC has been set at 135 tonnes for the 2013-14, 2014-15 and 2015-16 fishing seasons, and is likely to remain at this level for the foreseeable future.</p> <p>Scallop spawning normally occurs from late winter to early spring, with larvae drifting as plankton for up to six weeks before first settlement. Juvenile scallops reach marketable size within 18 months.</p>

Fishery	Target species	Geographic extent of fishery	Does fishing activity intersect acquisition area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Abalone Fishery (central zone) (Figure 5.32)	Blacklip abalone (<i>Haliotis rubra</i>) is the primary target, with greenlip abalone (<i>H. laevigata</i>) taken as a bycatch.	Victorian Central Abalone Zone is located between Lakes Entrance and the mouth of the Hopkins River. Most abalone live on rocky reefs from the shore out to depths of 30 m.	Acquisition area – No , based on VFA 2012-2016 catch data. Diesel spill EMBA – Yes , small abalone aquaculture leases exist at Tullaberga Island and Gabo Island near the Victorian/NSW border. <i>Acquisition area intersects 0.26% of the fishery (eastern zone).</i> <i>Operational area intersects 0.52% of the fishery (eastern zone).</i> <i>EMBA intersects 14.66% of the fishery (eastern zone).</i>	12-month season, beginning 1 st of April.	Abalone diving activity occurs close to shoreline (generally no greater than 30 m) using hookah gear (breathing air supplied via hose connected to an air compressor on the vessel). Commercial divers do not use SCUBA gear. Divers use an iron bar to prise abalone from rocks. The fishery consists of 71 fishery access licences, of which 34 operate in the central zone.	In the central zone, catches for the last five seasons were: <ul style="list-style-type: none"> • 2016/17 – 280 t. • 2015/16 – 306 t. • 2014/15 – 310 t. • 2013/14 – 282 t. • 2012/13 – 311 t. Across all zones, the catches were: <ul style="list-style-type: none"> • 2015/16 – 725 t valued at \$19.8 million. • 2014/15 – 736 t valued at \$20.1 million. • 2013/14 – 731 t valued at \$21.3 million. • 2012/13 – 825 t valued at \$26.2 million. • 2011/12 – 746 t valued at \$23.2 million.

Fishery	Target species	Geographic extent of fishery	Does fishing activity intersect acquisition area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Rock Lobster Fishery (eastern zone; Lakes Entrance region) (Figure 5.33)	<p>Southern rock lobster (<i>Jasus edwardsii</i>).</p> <p>Very small bycatch of species including southern rock cod (<i>Lotella</i> and <i>Pseudophycis</i> spp), hermit crab (family Paguroidea), leatherjacket (<i>Monacanthidae</i> spp) and octopus (<i>Octopus</i> spp).</p> <p>SETFIA has stated that octopus is now being sighted in the area for the first time since the 1990s and that Moreton Bay bugs (<i>Thenus orientalis</i>) are spawning near the Ninety Mile Beach MNP, though it is not clear whether these are fished.</p>	<p>The eastern zone stretches from Apollo Bay in southwest Victoria to the Victorian/NSW border. Rock lobster abundance decreases moving from western Victoria to eastern Victoria.</p> <p>Larval release occurs across the southern continental shelf, which is a high-current area, facilitating dispersal. The pelagic phyllosoma larval phase lasts around 12–18 months.</p>	<p>Acquisition area – Yes, based on VFA 2012-2016 catch data. Rocky reef is sparse and patchy in the acquisition area.</p> <p>Diesel spill EMBA – Likely, though no data is available.</p> <p><i>Acquisition area intersects 0.26% of the fishery (eastern zone).</i></p> <p><i>Operational area intersects 0.52% of the fishery (eastern zone).</i></p> <p><i>EMBA intersects 14.66% of the fishery (eastern zone).</i></p>	<p>Closed season for:</p> <ul style="list-style-type: none"> Female lobsters – 1 June to 15 November to protect females in berry during spawning period. Male lobsters – 15 September to 15 November to protect males during their moulting period when soft shells increase their vulnerability. <p>Catches generally highest from August to January.</p>	<p>Fished from coastal rocky reefs in waters up to 150 m depth, with most of the catch coming from inshore waters less than 100 m deep.</p> <p>Baited pots are generally set and retrieved each day, marked with a surface buoy.</p> <p>In 2014/15, there were 25 active licences and 23 fishing vessels in the eastern zone.</p> <p>Anecdotal information from a fisher working in the region indicates that only one lobster fisher operates in the proposed acquisition area, fishing a small section of mapped reef between the marine environmental assessment sampling sites 51 and 52 (water depths between 15-20 m).</p>	<p>In the eastern zone, catches for the last five seasons were:</p> <ul style="list-style-type: none"> 2015/16 – 58 t valued at \$5.1 million. 2014/15 – 59 t valued at \$5 million. 2013/14 – 51 t valued at \$3.6 million. 2012/13 – 48 t valued at \$2.7 million. 2011/12 – 65 t valued at \$3.9 million.

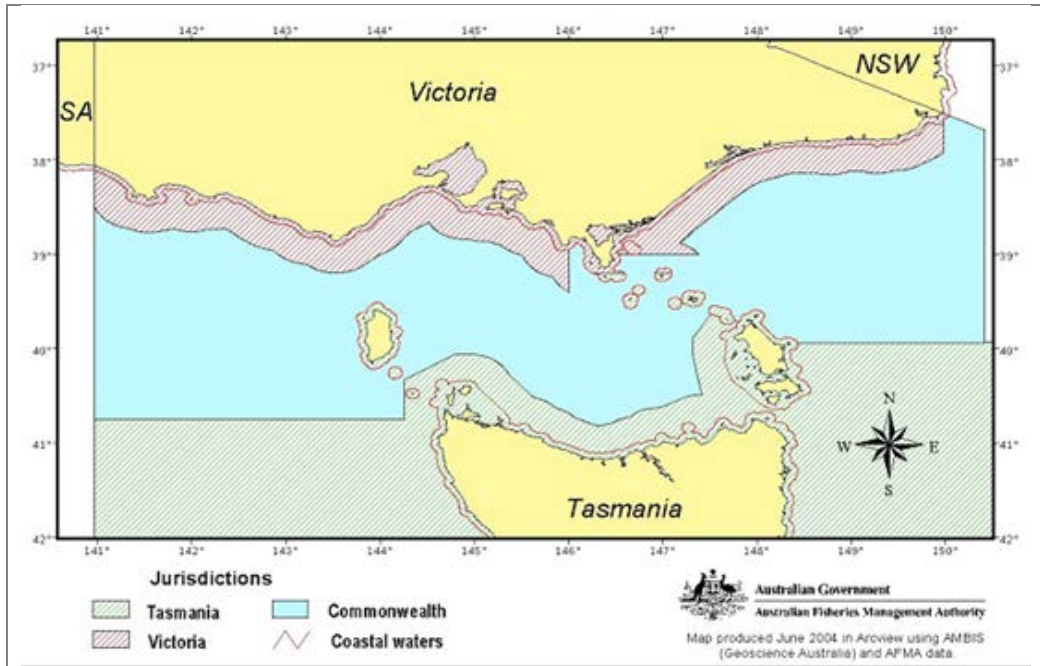
Fishery	Target species	Geographic extent of fishery	Does fishing activity intersect acquisition area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Wrasse Fishery (Lakes Entrance region)	Blue-throat wrasse (<i>Notolabrus tetricus</i>), saddled wrasse (<i>N. fucicola</i>), orange-spotted wrasse (<i>N. parilus</i>).	Entire Victorian coastline out to 20 nm (excluding marine reserves, bays and inlets). In recent years, catches have been highest off the central coast (Port Phillip Heads, Western Port and Wilson's Promontory) and west coast (Portland).	Acquisition area – No , based on VFA 2012-2016 catch data. Diesel spill EMBA – Unknown , as licences will be made transferrable from 1 st April 2017, so fishing effort could be activated in the area. <i>Acquisition area intersects 0.4% of the fishery.</i> <i>Operational area intersects 0.79% of the fishery.</i> <i>EMBA intersects 20.9% of the fishery.</i>	Year-round.	Handline fishing (excluding longline), rock lobster pots (if in possession of a rock lobster access fishing licence). Preferred water depths for blue-throat wrasse is 20-40 m, while saddled wrasse prefer depths of 10-30 m. Maximum of 23 fishing licences.	Catches of blue-throat wrasse for the last five seasons were: <ul style="list-style-type: none"> • 2015/16 – 24 t valued at \$512,000. • 2014/15 – 26 t valued at \$444,000. • 2013/14 – 15 t valued at \$243,000. • 2012/13 – 10 t valued at \$169,000. • 2011/12 – 11 t valued at \$185,000. Prior to this time, catches varied from 30-40 tonnes per annum from 2005-09, and 40-50 tonnes per annum from 2000-04.
Multi-species Ocean Fishery						

Fishery	Target species	Geographic extent of fishery	Does fishing activity intersect acquisition area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Ocean Access (or Ocean General) Fishery	Gummy shark (<i>Mustelus antarcticus</i>), school shark (<i>Galeorhinus galeus</i>), Australian salmon (<i>Arripis trutta</i>), snapper (<i>Pagrus auratus</i>). Small bycatch of flathead (<i>Platycephalidae</i> spp).	Entire Victorian coastline, excluding marine reserves, bays and inlets.	Acquisition area – Yes , based on VFA 2012-2016 catch data. Diesel spill EMBA – Unknown, but likely.	Year-round. Most fishing undertaken off Lakes Entrance occurs between April and July.	Utilises mainly longlines (200 hook limit), but also haul seine nets (maximum length of 460 m) and mesh nets (maximum length of 2,500 m per licence). There are 182 Ocean Access Licences. Fishing usually conducted as day trips from small vessels (<10 m).	VFA indicates there is insufficient catch data.
Ocean Purse Seine Fishery	Australian sardine (<i>Sardinops sagax</i>), Australian salmon (<i>Arripis trutta</i>) and sandy sprat (<i>Hyperlophus vittatus</i>) are the main species. Southern anchovy (<i>Engraulis australis</i>) caught in some years.	Entire Victorian coastline, excluding marine reserves, bays and inlets.	Acquisition area – Yes , based on VFA 2012-2016 catch data Diesel spill EMBA – Unknown, but likely.	Year-round.	Purse seine, which is generally a highly selective method that targets one species at a time, thereby minimising bycatch. Purse seines do not touch the seabed. A lampara net may also be used. Only one licence is active in Victorian waters (based out of Lakes Entrance), with fishing focused close to shore and during the day. This licence is held by Mitchelson Fisheries Pty Ltd, a family business that catches primarily sardines, salmon, mackerel, sandy sprat, anchovy and white bait using the <i>Maasbanker</i> purse seine vessel.	

Fishery	Target species	Geographic extent of fishery	Does fishing activity intersect acquisition area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Inshore Trawl Fishery	Key species are eastern king prawn (<i>Penaeus plebejus</i>), school prawn (<i>Metapenaeus macleayi</i>) and shovelnose lobster/Balmain bug (<i>Ibacus peronii</i>). Minor bycatch of sand flathead (<i>Platcephalus bassensis</i>), school whiting (<i>Sillago bassensis</i>) and gummy shark (<i>Mustelus antarcticus</i>).	Entire Victorian coastline, excluding marine reserves, bays and inlets. Most operators are based at Lakes Entrance.	Acquisition area – Yes , based on VFA 2012-2016 catch data. Diesel spill EMBA – Yes , based on VFA advice.	Year-round, although the majority of prawn fishing occurs in the warmer months up until Easter.	Otter-board trawls with no more than a maximum head-line length of 33 m, or single mesh nets are used. There are 54 trawl licences (with only about 15 active to various degrees).	Catch in the EMBA has been between 43 and 223 tonnes over the last 10 years.

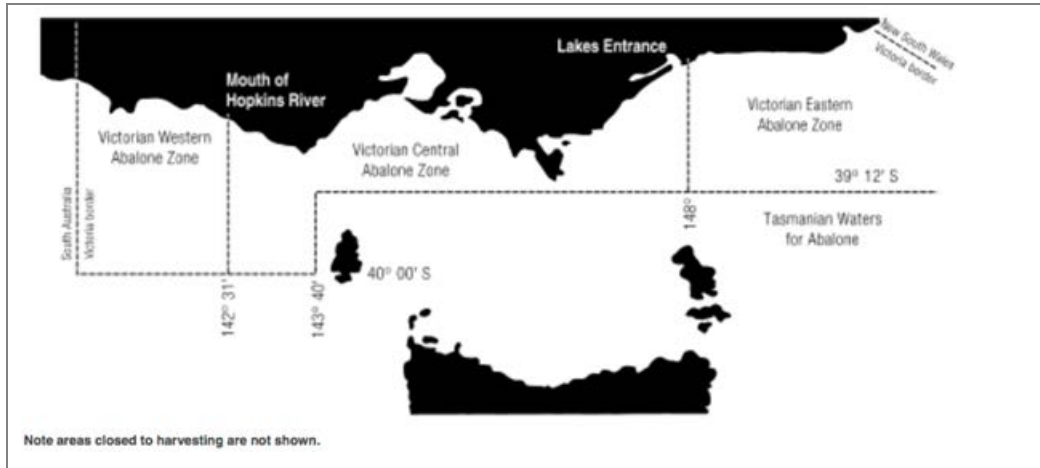
Fishery	Target species	Geographic extent of fishery	Does fishing activity intersect acquisition area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Banded Morwong Fishery	<p>Banded morwong (<i>Cheilodactylus spectabilis</i>).</p> <p>Some fish are also landed as byproduct from the Ocean Access Fishery.</p>	Extent is uncertain. The banded morwong is a temperate reef species. The sparse and patchy nature of reef in and around the proposed acquisition area suggests there may be limited or non-existent.	<p>Acquisition area – Unlikely, based on limited reef habitat and based on distribution of reported catch (south of Wilsons Promontory).</p> <p>Diesel spill EMBA – Unlikely, based on distribution of reported catch (south of Wilsons Promontory).</p>	Unknown.	Uses large-mesh gillnets.	<p>The most recent stock assessment (undertaken in 2012) has not been published because of the limited number of operators and concerns about confidentiality. Catch data examined from 2002–12 concluded that there was a clear downward trend in biomass since the mid-2000s (catch per unit effort may have fallen by up to 48% from the peak).</p> <p>The total catch is currently less than 2.5 tonnes per year (catches are now limited to 625 fish per operator).</p>

Sources: Agriculture Victoria (Fisheries) (2017); FRDC (2017), SETFIA and Fishwell Consulting (2017), VFA (2017), Sen (2011) and consultation with VFA.



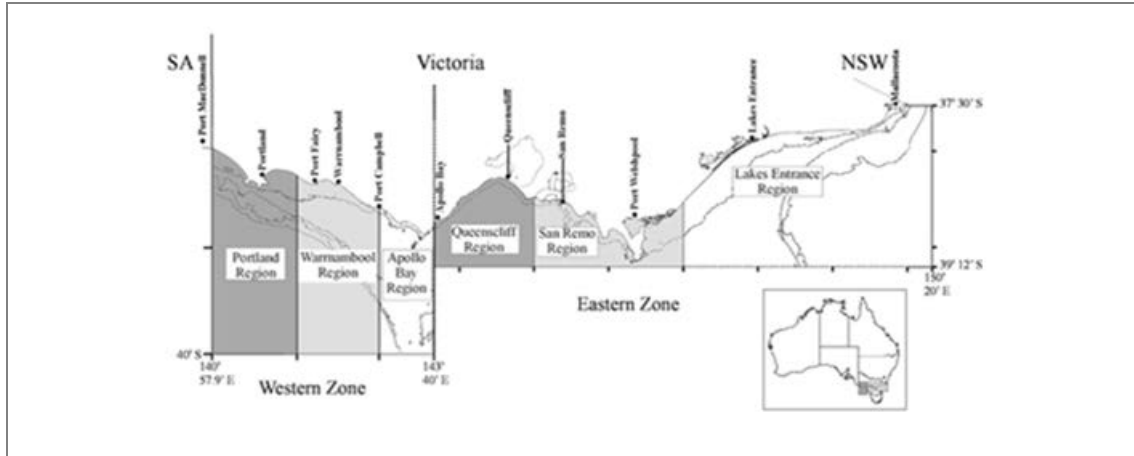
Source: Agriculture Victoria (Fisheries) (2017).

Figure 5.31. Jurisdiction of the Victorian scallop fishery



Source: Agriculture Victoria (Fisheries) (2017).

Figure 5.32. Jurisdiction of the Victorian abalone fishery



Source: Agriculture Victoria (Fisheries) (2017).

Figure 5.33. Jurisdiction of the Victorian southern rock lobster fishery

As a result of extensive stakeholder consultation undertaken for the project, significant interest has been raised regarding potential impacts of the Pelican 3DMSS on the Victorian scallop fishery. As such, further detail about this fishery is provided here.

Victorian scallop fishery

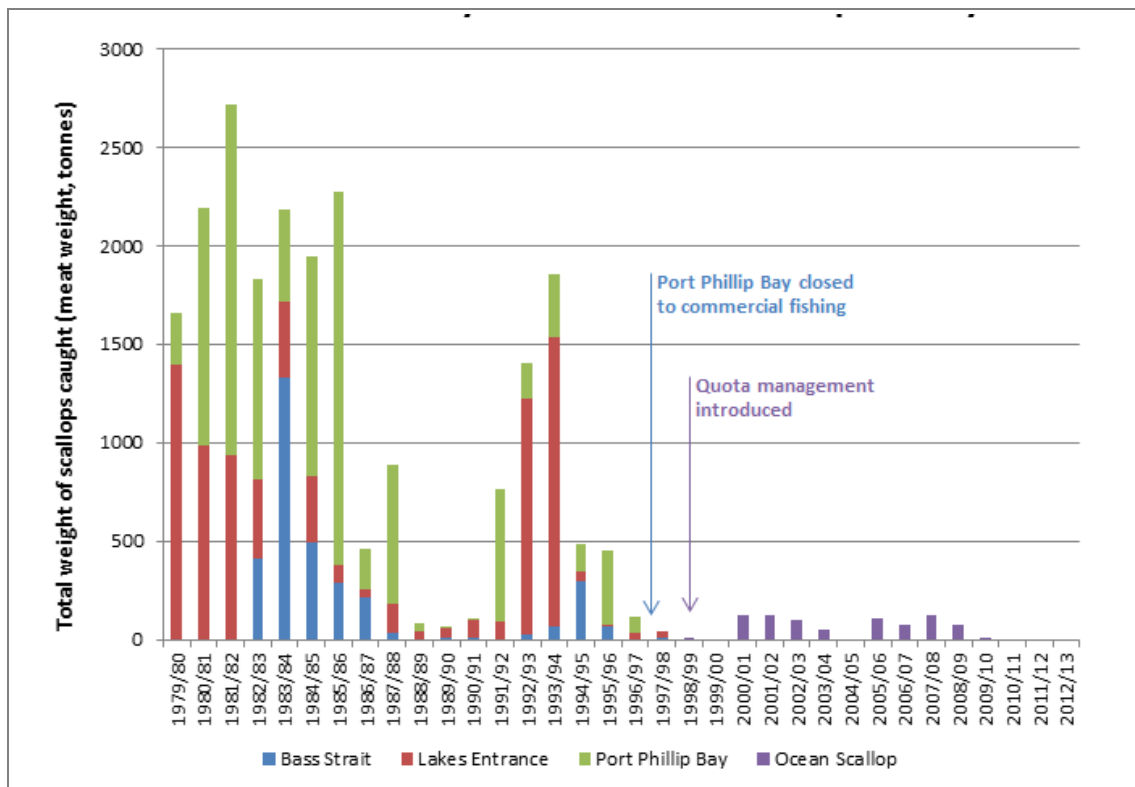
In order to understand the Victorian scallop fishery, CarbonNet considered:

- Existing data about the presence of commercial scallops in the proposed acquisition area;
- Consultation with the custodians of fishing data;
- The results of the Advisian marine habitat assessment commissioned by CarbonNet;
- The results of the SETFIA fisheries report commissioned by CarbonNet;
- Feedback received through stakeholder consultation; and
- A review of recent published scientific research.

Scallop abundance is naturally highly variable causing catches to fluctuate widely from season to season. Since the beginning of the commercial fishery in the 1970s, catches have varied from tens of tonnes to thousands of tonnes. Catch rates, and therefore stock abundance, declined in the mid- to late 2000s (Figure 5.34), and surveys of scallop grounds conducted in 2009 and 2012 revealed a lack of commercial quantities of scallops. In response to these findings, quotas of zero were put in place for the 2010/11, 2011/12 and 2012/13 seasons.

While there is very little publicly available information regarding commercial scallop catches and values over the last 10 years, there is some historic information that provides insight into the areas previously fished. As shown in Figure 5.35, DPI (2006) confirms that scallop fishing did take place along much of the Gippsland coast, with the area to the immediate northeast of the proposed acquisition area having the highest catches between 1998 and 2003. Based on Figure 5.35, and taking the upper estimate of catch, the two fishing grid cells intersected by the proposed acquisition area had catches of 133 tonnes (E39) and 265 tonnes (E40) for the 6 years between 1998 and 2003. As the proposed acquisition area overlaps grid cell E39 by ~50% and grid cell E40 by ~25%, this equates to 66.25 tonnes from each of these two cells

over six years (or 11.1 tonnes per year for those six years). This equates to an approximate catch of 22.2 tonnes from the proposed acquisition year for the 6 years from 1998 to 2003 (noting this is an upper estimate based on the coarse data provided in the map). Of the total catch for these years, again based on the upper estimate provided in Figure 5.35, this 22.2 tonnes represents 1.85% of the total average annual catch calculated upon the same basis for those six years. This demonstrates that although the area to the immediate northeast of the proposed acquisition area was an important scallop fishing ground, the proposed acquisition area represented only a small portion of the total fishery's catch. By extension, if fishing was currently taking place within the proposed acquisition area, it may continue to represent a small percentage of the fishery's catch.



Source: VFA (2017).

Figure 5.34. Production history in the Victorian scallop fishery

In the VSFA-prepared Victorian Scallop Fishery Industry Management Plan (undated), it is stated that despite some scallop stocks being of a commercially viable size in the fishery, fishermen have agreed to rest the known beds until the end of 2018 to allow for another spawning cycle to contribute to biomass prior to harvesting. The VSFA claims that these stocks of commercial significance are located within and adjacent to the proposed acquisition area.

CarbonNet's marine habitat assessment via towed video undertaken in early April 2017 (with an even coverage through the proposed acquisition area; spacing of 1,600 m between sample points) did not encounter any commercial scallop beds. The VSFA has stated that this may be due to a lack of specific fishing expertise, knowledge in locating scallop stocks in the marine environment and the reliance on one survey methodology (towed video) rather than a scallop dredge, which can result in erroneous and false negative results. CarbonNet and its marine consultants do not share this conclusion, given that:

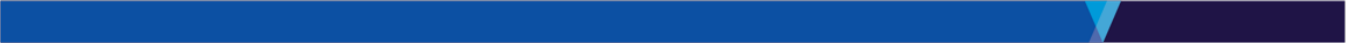
- Smith et al (2016) recommend that underwater camera surveys should be considered for fisheries stock assessment as they can provide information on scallop densities and habitat structure at a finer scale and with more accuracy and higher coverage than dredge gear;
- Footage from the CarbonNet habitat assessment clearly detected partially buried commercial and doughboy scallops, along with dead scallops in the form of empty shells;
- The consultants engaged in the marine habitat assessment are highly experienced marine biologists with considerable experience working in Bass Strait and are familiar with the partial burial patterns of scallops;
- Towed video has been used by the consultants to assess for scallop presence/abundance for TasPorts;
- The Bass Strait Central Zone Scallop Fishery Resource Assessment Group noted in June 2017 that video assessments for scallops were being utilised in Tasmania at Great Oyster Bay (AFMA, 2017b); and
- The sampling was statistically robust in terms of optimising the maximum number of sites possible over a large area.

Additional information supplied by SIV in July 2017 indicated that dredging for scallops had been undertaken throughout the proposed acquisition area by a fisherman and that significant quantities of scallops were caught (and returned to the seabed due to being under the legal catch size limit). Further interrogation of GPS data by the VFA (undertaken at CarbonNet's request) for the fishing vessel involved in this exercise found that the dredging in fact took place outside the proposed acquisition area, with the nearest areas being immediately adjacent to and 840 m to 10,000 m northeast of the proposed acquisition and operational areas.

In late September 2017, the VSFA provided a short video file to CarbonNet in support of their claims that there are abundant scallops present within the proposed acquisition area. This video footage showed scallops on the back of a vessel and then moved to the bridge with geographic coordinates located within the proposed acquisition area. However, there is no footage or data showing those scallops being recovered within the proposed acquisition area. CarbonNet has requested the VSFA provide the location of scallop beds known to them on many occasions (see Table 4.3 in the consultation chapter). The VSFA has not provided any specific information to CarbonNet on the location of scallop beds.

In May 2017, the VSFA presented CarbonNet a proposal for a pre- and post-MSS scallop stock assessment 70% funded by CarbonNet to be conducted by three dedicated scallop vessels using the scallop box dredging technique. According to their proposal, each vessel would undertake 20-40 exploratory sampling tows (of between 600 and 1,200 m) per 12-hour day over a combined survey time of 144 hours. CarbonNet has not been able to progress this particular collaboration opportunity on a number of grounds, including the view that a towed video survey methodology is both appropriate and superior, and the potential environmental detriment of VSFA's invasive approach is unnecessary. As CarbonNet is under an obligation to minimise the environmental impacts of its activities to the extent reasonably necessary to perform the MSS, it would be contrary to CarbonNet's obligations to perform invasive investigations where these are not reasonably required.

In any event, CarbonNet is constrained by its current approvals that were granted on the basis that there would be no disturbance of the seabed or sub-soil associated



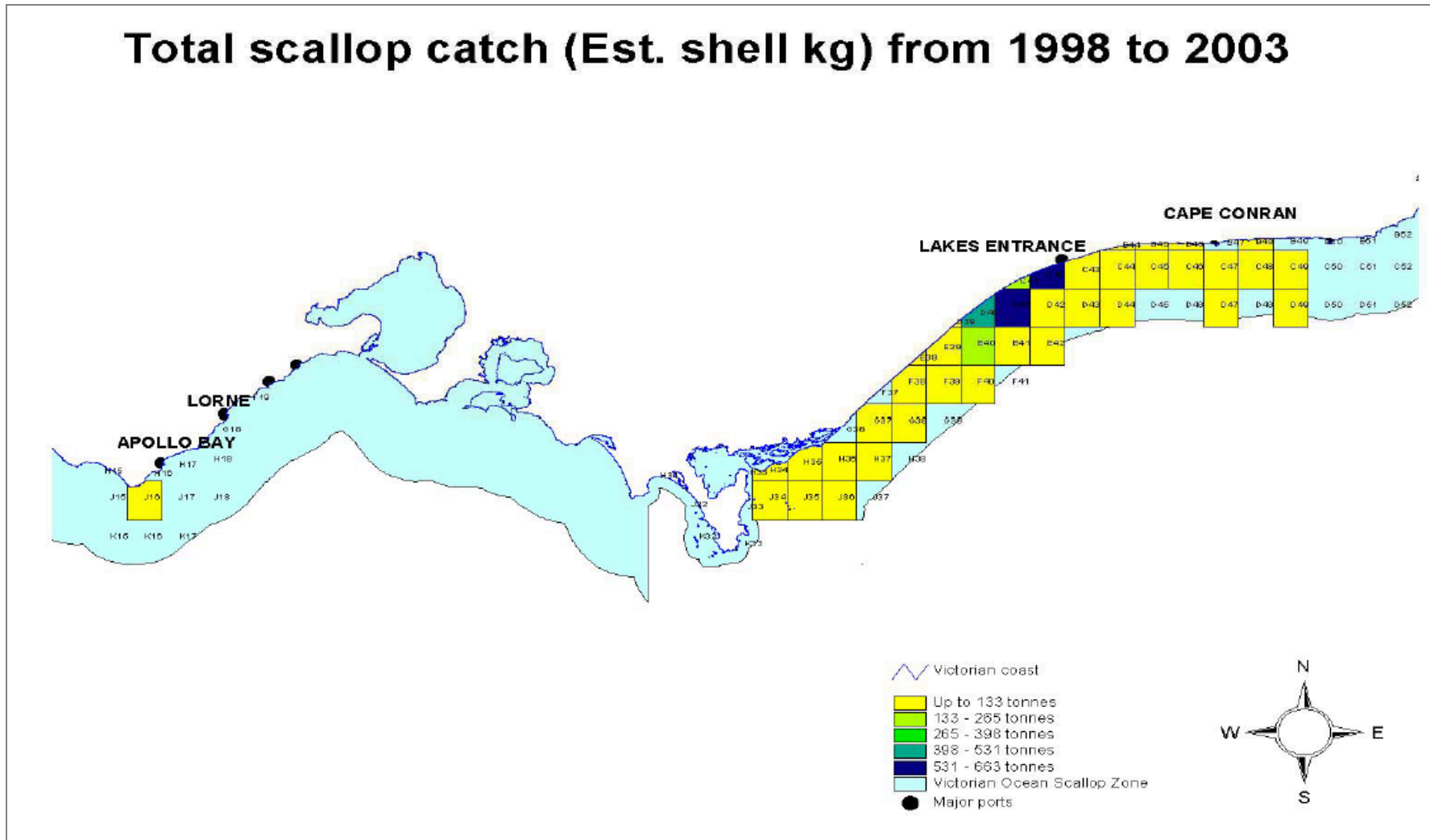
with the MSS. For this reason, the proposal is fundamentally inconsistent with CarbonNet's current approvals (and the titleholder consultations underpinning them). By way of an alternative, CarbonNet will undertake pre- and post-MSS habitat assessments, which will include further, non-invasive video surveys to monitor the effects of the MSS on various species, including scallops. CarbonNet is collaborating with the fishing industry in the design and implementation of this assessment.

In summary, CarbonNet does not consider the VSFA's proposal for a scallop stock assessment using scallop box dredging to be suitable for adoption because:

- It is inconsistent with CarbonNet's approvals;
- It is unnecessarily invasive relative to towed video monitoring;
- In the expert opinion of CarbonNet's marine consultants, the presence of commercially viable scallop populations in the area is unlikely, making the resort to invasive investigations disproportionately damaging;
- 'Before and after' monitoring using towed video has been the accepted methodology for monitoring scallops elsewhere; and
- Whilst a fisheries stock assessment might be an appropriate activity for the VSFA to undertake as a separate matter, it is not something that CarbonNet should be required to undertake with regard to a particular species or as part of the EP.

As noted in Chapter 4, CarbonNet is contributing to a whole of Victorian Eastern Ocean Scallop Fishery stock assessment to be managed by the VFA.

Total scallop catch (Est. shell kg) from 1998 to 2003



Source: DPI (2006).

Figure 5.35. Total scallop catch (estimated shell kilograms) from 1998 to 2003

5.6.4. Recreational Fishing

Recreational fishing along the Gippsland coast typically targets snapper, King George whiting, flathead, bream, sharks, tuna, calamari, and Australian salmon.

Recreational fishing and boating is largely confined to the Gippsland Lakes and nearshore coastal waters. As Bass Strait is relatively shallow, the water currents through the Bass Strait can create unpredictable seas, reducing the numbers of recreational boats from venturing long distances into the Bass Strait from shore. VRFish has stated that small boats are likely to fish around the nearshore reef area, while larger game fishing boats are likely to fish further out to sea and use nearby ports and boat ramps for launching.

There are no boat ramps adjacent to the operational area, though stakeholder consultation indicates that recreational fishers often carry small 'tinnies' (aluminium-hulled boats) over the sand dunes in order to access the beach, with the sand dune clearing for the ROS at Delray Beach providing one of the more suitable access points.

The GPBRA has advised CarbonNet that the Golden Beach Surf Fishing Competition takes place over the weekend nearest Australia Day and during the Easter long weekend (midnight Good Friday to midnight Easter Sunday) each year (starting 30th March 2018) between Seaspray and Loch Sport. They estimate that up to 1,000 extra people are in the region during these competitions, which provides an important economic contribution to local towns. VRFish also stated that the period of time between Christmas and Australia Day weekend are generally the busiest for recreational fishing.

The Gippsland Lakes Fishing Club Inc. and Lakes Entrance Game & Sport Fishing Club Inc. (formed in 2015) are active recreational fishing clubs in the region. These clubs host regular club competitions, with flathead being a key fishing target.

5.6.5. Tourism

Marine-based tourism and recreation in the Bass Strait is primarily associated with recreational fishing and boating (see previous section).

The Gippsland Lakes (comprising Lake Victoria, Lake King, and Lake Wellington, together with other smaller lakes, marshes and lagoons) are the primary tourist attraction in the region. The communities adjacent to this network of lakes are popular tourist towns for their boating and fishing activities, along with bushwalking, bird watching and other nature-focused activities. Towns including Lakes Entrance, Metung, Loch Sport, Golden Beach and Lake Tyers are especially popular in summer.

In 2013-14, the tourism industry contributed an estimated \$1.2 billion to the Gippsland economy and employed about 12,400 people, representing 3.7% of the total Gippsland economy (DEDJTR, 2016). Intrastate visitors (i.e., visitors from within Victoria) were the most economically-important sector. Cafes, restaurants and takeaway food services contributed the most to direct regional tourism employment in Gippsland (DEDJTR, 2016).

Consultation with the managers of the Ninety Mile Beach Marine National Park (Parks Victoria and GLaWAC), and the Golden Paradise Beach Rates Payers Association has been undertaken to understand the type and frequency of beach use. This consultation revealed the following:

- The beaches adjacent to the proposed acquisition area are not patrolled (Photo 5.11) and the Golden Beach Surf Life Saving Club is not active;

- Swimmers are encouraged to go to the Seaspray where there is a patrol;
- There is no surf break, although some surfing is observed from time to time; and
- Recreational fishing is undertaken from the beach, particularly during the summer holiday periods and fishing competitions.



Source: CarbonNet (2017).

Photo 5.11. Signage at the Ninety Mile Beach and Golden Beach indicates the beach is not suitable for swimming

5.6.6. Petroleum and GHG Infrastructure, Exploration and Production

Australia’s oil and gas industry has grown significantly since the first discoveries of gas in Bass Strait in the mid-1960s. In 2015, the oil and gas industry produced 76 million barrels (MMbbl) of crude oil, 40.8 MMbbl of condensate, 18 MMbbl of liquefied petroleum gas (LPG) and 3,850.4 million cubic feet (MMcf) of gas (APPEA, 2017).

Victorian Petroleum Production

In 2015, Victoria accounted for 16.5% of Australia’s petroleum liquids production production (APPEA, 2017). However, production has been trending down since it peaked in 2000. Also in 2015, Victoria accounted for 17% of Australia’s conventional gas production (APPEA, 2017), much of which is from the Gippsland Basin.

Petroleum Production in Gippsland

Oil and gas reserves from the Gippsland Basin are currently on the decline. As of 2014, the offshore Gippsland basin has produced 26,089 PJ of liquids and 9,120 PJ of gas (DEDJTR, 2017b).

The Gippsland Basin has 13 exploration permit areas and 25 current offshore production licenses (Victoria State Government, 2012a) and a total of 22 offshore platforms have been installed in Bass Strait since first production was established (excluding subsea production wells) (Figure 5.36).

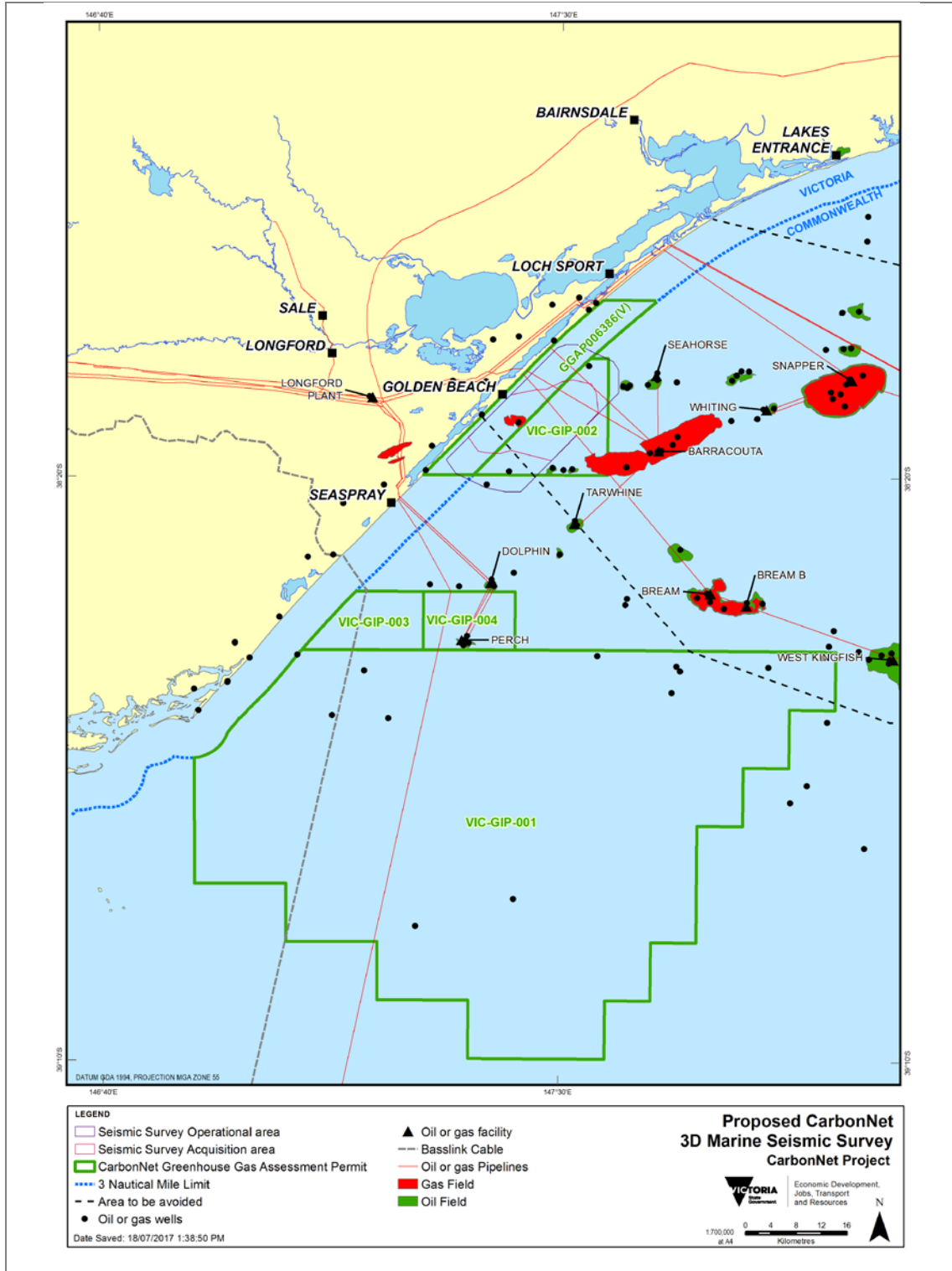


Figure 5.36. Petroleum reservoirs and infrastructure in the Gippsland region

The TasGas pipeline, a pipeline that provides gas from Victoria to Tasmania, is also located in the region, 13 km west of the proposed survey acquisition area (it makes landfall just east of Seaspray, on the eastern edge of the Gippsland Lakes).

Petroleum production from the offshore Gippsland Basin is centred on operations undertaken by Esso Australia Resources Pty Ltd (EARPL), operator for the Gippsland Basin Joint Venture. EARPL produces oil and gas from 23 platforms and subsea developments, hundreds of wells and some 880 km of associated pipelines, tied back to the Longford Gas Plant and Long Island Point. Production first commenced in 1969 from the Barracouta field. The latest fields to come into production were the Kipper-Tuna-Turrum oil and gas fields in 2013.

Historical production from the offshore Gippsland Basin (in addition to production from EARPL) has come from the Patricia Baleen, Longtom and Baska-Manta-Gummy (BMG) gas fields.

Petroleum infrastructure in the proposed operational area

The proposed acquisition area overlaps three petroleum pipelines operated by EARPL. These are located in the eastern half of the proposed acquisition area.

As illustrated in Figure 5.37, five wells are located within the proposed operational area, all of which have been plugged and abandoned. These are Flying Fish-1 (dry hole), Snook-1 (dry hole), Golden Beach-1 (dry hole)/Golden Beach-1A (gas show) and Sealion-1 (dry hole).

Other EARPL oil and gas infrastructure located near, but outside of the proposed acquisition area, are:

- Seahorse subsea well (2.5 km east) – an oil well that commenced production in 1990, located in a water depth of 42 m. The subsea completion has a height of 8 m from the seabed. Oil is transported by pipeline to the Barracouta platform for processing before being transported by pipeline to shore.
- Barracouta platform (11.3 km southeast) – a manned steel jacket platform located in a water depth of 46 m, and with the main deck 20 m above sea level that processes oil and gas. Production commenced in 1969. The platform provides gas lift to the Seahorse and Tarwhine subsea wells.
- Tarwhine subsea well (12 km southeast) - an oil well that commenced production in 1990, located in a water depth of 43 m. The subsea completion has a height of 8.3 m from the seabed.
- Dolphin steel gravity-based monotower (20 km southwest) – a normally unmanned oil production facility that commenced production in 1990. It is located in a water depth of 38 m and the height of the equipment deck above sea level is 17 m. It transports oil to shore via a 300 mm pipeline (alongside a 100 mm gas pipeline from the Perch monotower).

Petroleum Development in Gippsland

Cooper Energy Ltd is currently progressing the development of the Sole Gas Field located in Vic/RL3, located 124 km east of the proposed acquisition area.

This development will involve the drilling of at least one production well and the installation of a 65-km long offshore pipeline to the Orbost Gas Plant where the gas will be treated to sale quality. The Sole Gas Field has 241 PJ of gas and will be produced at 25 PJ/annum. First gas is expected in March 2019. Total development costs are estimated at \$552 million (Cooper Energy, 2017).

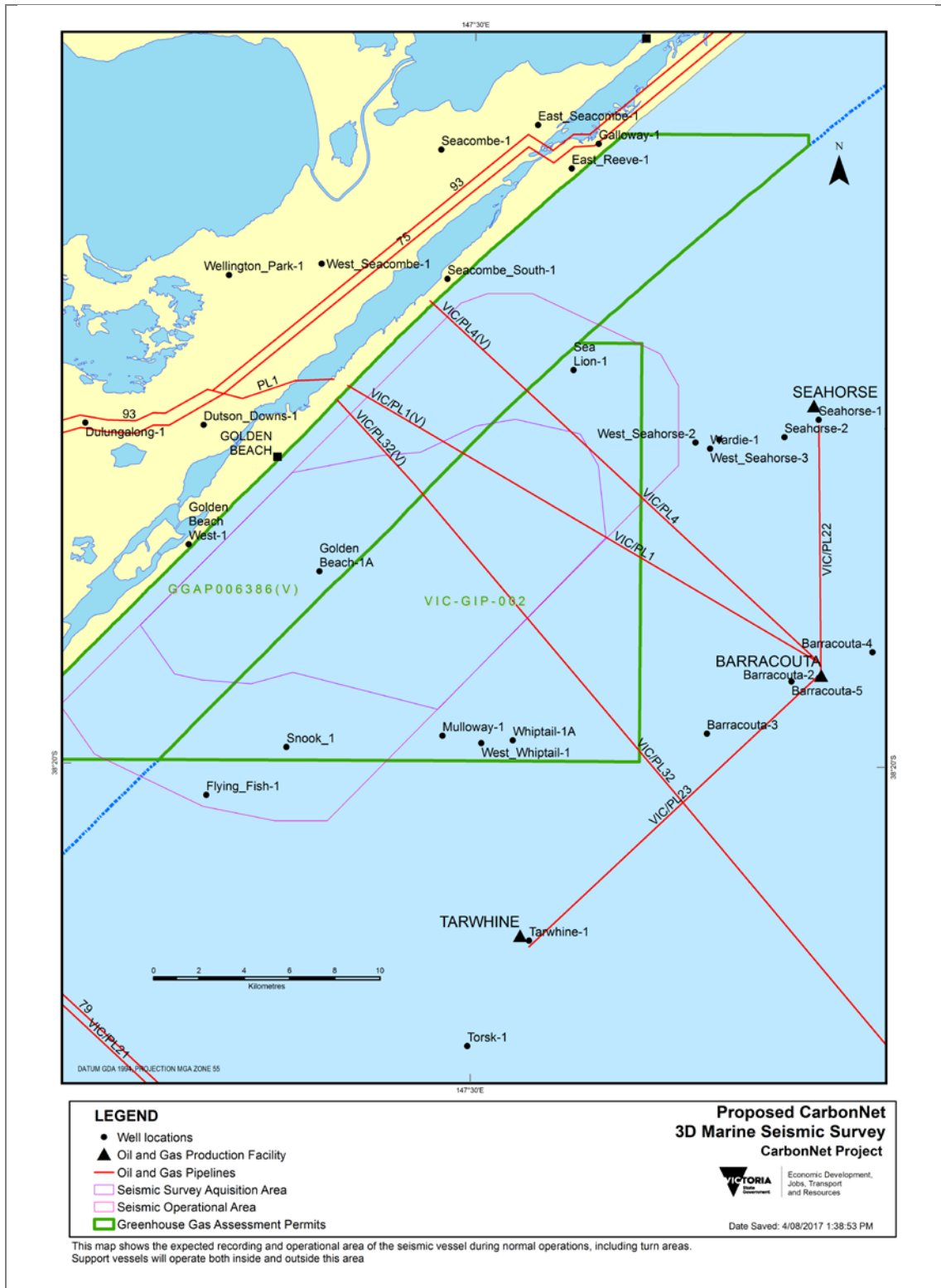


Figure 5.37. Petroleum infrastructure in the proposed operational area

Petroleum and GHG Exploration in Gippsland

Most of the commercial oil and gas discoveries are reservoired within the siliciclastics of the Late Cretaceous to Paleogene Latrobe Group. Remaining reserves are estimated at 400 MMbbl of liquids and 6 Tcf of gas (Geoscience Australia, 2017).

Bass Strait has been the subject of thousands of line kilometres of seismic surveys, as illustrated in Figure 5.38.

In recent years, there has been very little petroleum or GHG exploration (seismic or drilling) in the Gippsland Basin. In the last five years (since the beginning of 2012), the following has taken place:

- 2015 - Gippsland 2D Infill MSS – conducted by Geoscience Australia, mostly through the VIC-GIP-001 permit to the south of the Pelican 3DMSS area. This survey aimed to identify potential sites for the long-term storage of CO₂.
- 2015 – Sealion-1 exploration well – drilled by Carnarvon Hibiscus Pty Ltd and located 3 km to the east of the proposed acquisition area. This well did not encounter commercial volumes of hydrocarbons.

5.6.7. Commercial Shipping

The South-east Marine Region (which includes Bass Strait) is one of the busiest shipping regions in Australia (DoE, 2015a). Shipping consists of international and coastal cargo trade, passenger services and cargo and vehicular ferry services across Bass Strait (DoE, 2015a). Lakes Entrance is an important fishing port for the region (DoE, 2015a).

Most of the proposed Pelican 3DMSS area is overlapped by the Bass Strait 'Area to be Avoided' (Figure 5.58). This area is a routing measure that ships in excess of 200 gross tonnes should avoid due to the high concentration of offshore petroleum infrastructure (oil and gas platforms and pipelines, as described in Section 5.6.6) that can provide a navigational hazard. The total area of the ATBA is 5,645 km². Operators of vessels greater than 200 gross tonnes must apply to NOPSEMA to enter and be present within the ATBA (Australian Border Force, 2017).

AMSA has indicated that high traffic volume shipping areas are located south of the proposed acquisition area (Figure 5.59 and Figure 5.60). AMSA has provided historic AIS traffic plot based off data collected between January 2016 and January 2017 (excludes small domestic commercial vessels such as fishing trawlers and coastal craft). It indicates very light shipping activity occurs through the proposed acquisition area, with higher traffic volume shipping areas located to the south of the acquisition area. AMSA advises that interactions between the source vessel and large commercial ships is expected to be minimal due to the Area to be Avoided.

To the immediate seaward side of the ATBA exist two traffic separation schemes, implemented by AMSA to enhance safety of navigation around the ATBA by separating shipping into one-direction lanes for vessels heading northeast and those heading southwest.

One separation area is located south of Wilson's Promontory, and the other south of the Kingfisher B platform (DIBP, 2017), which is 76 km south of the southern end of the proposed acquisition area.

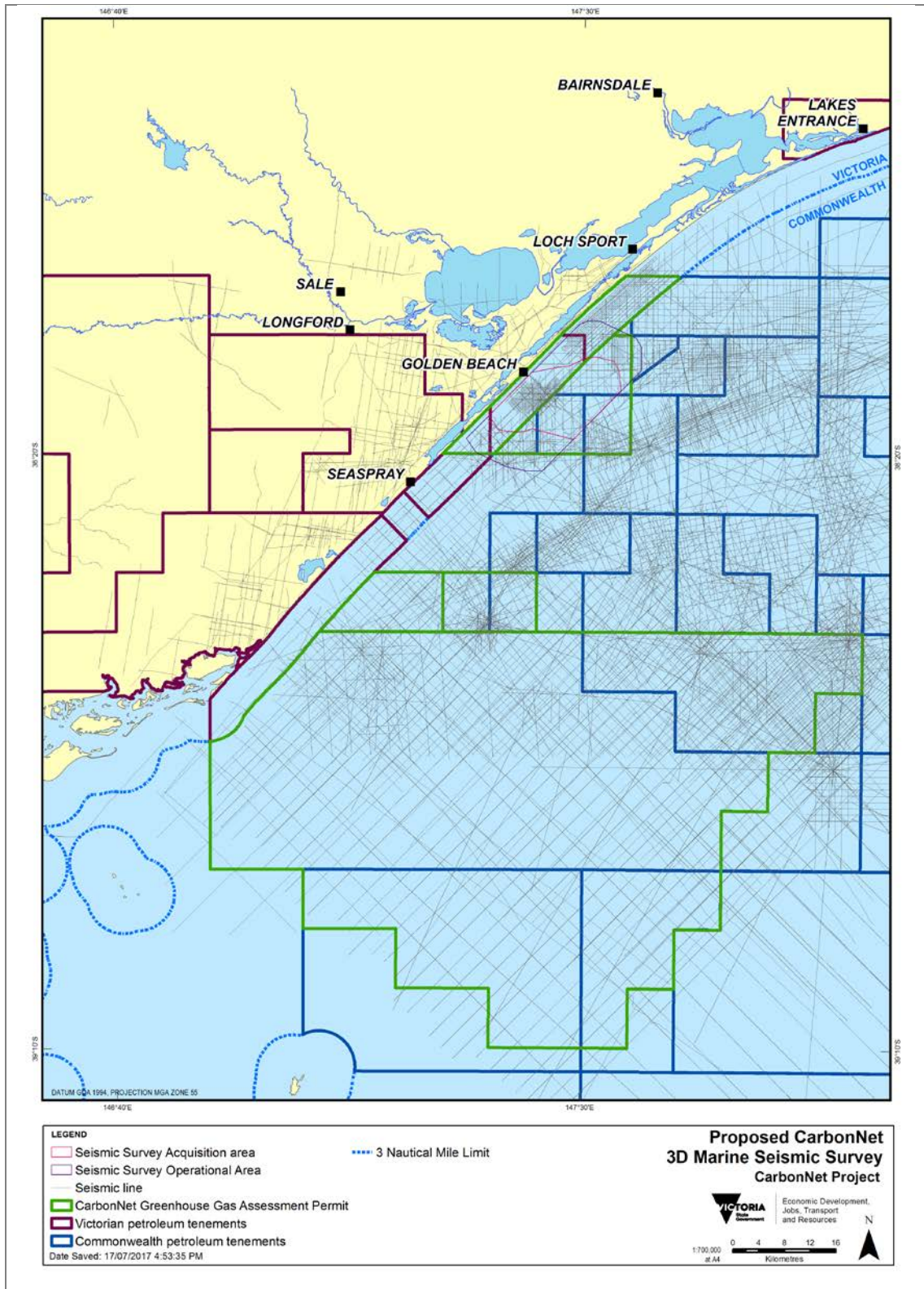
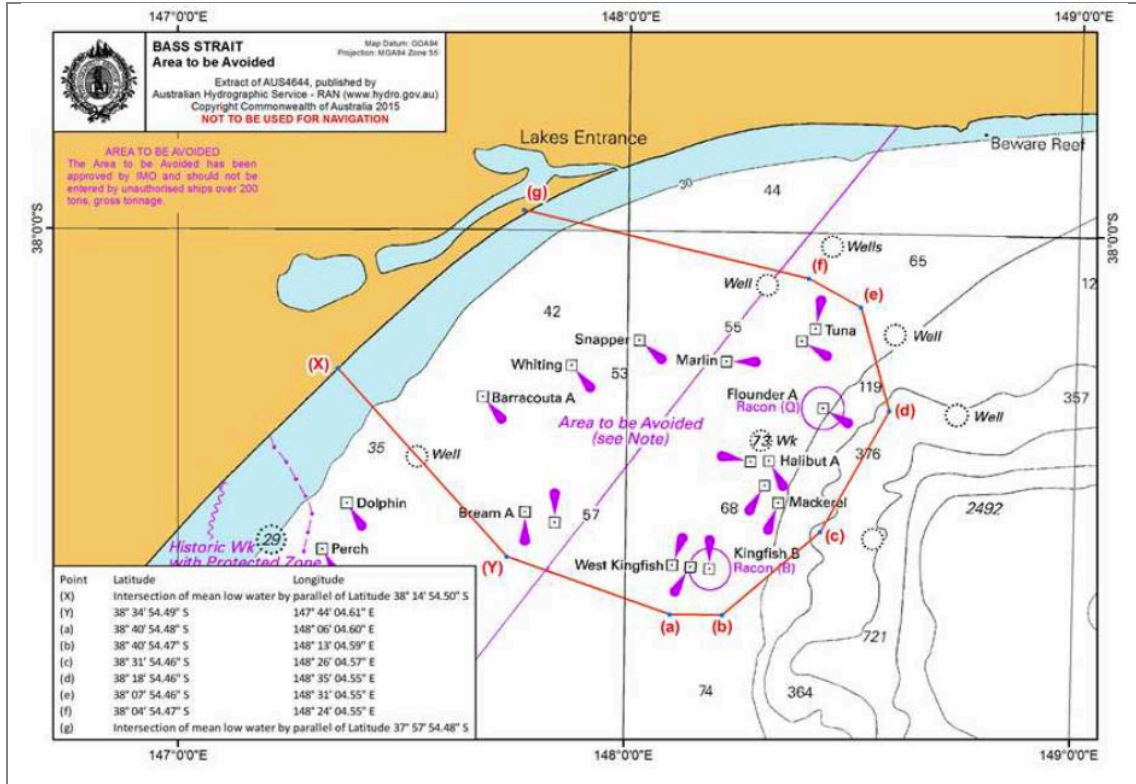
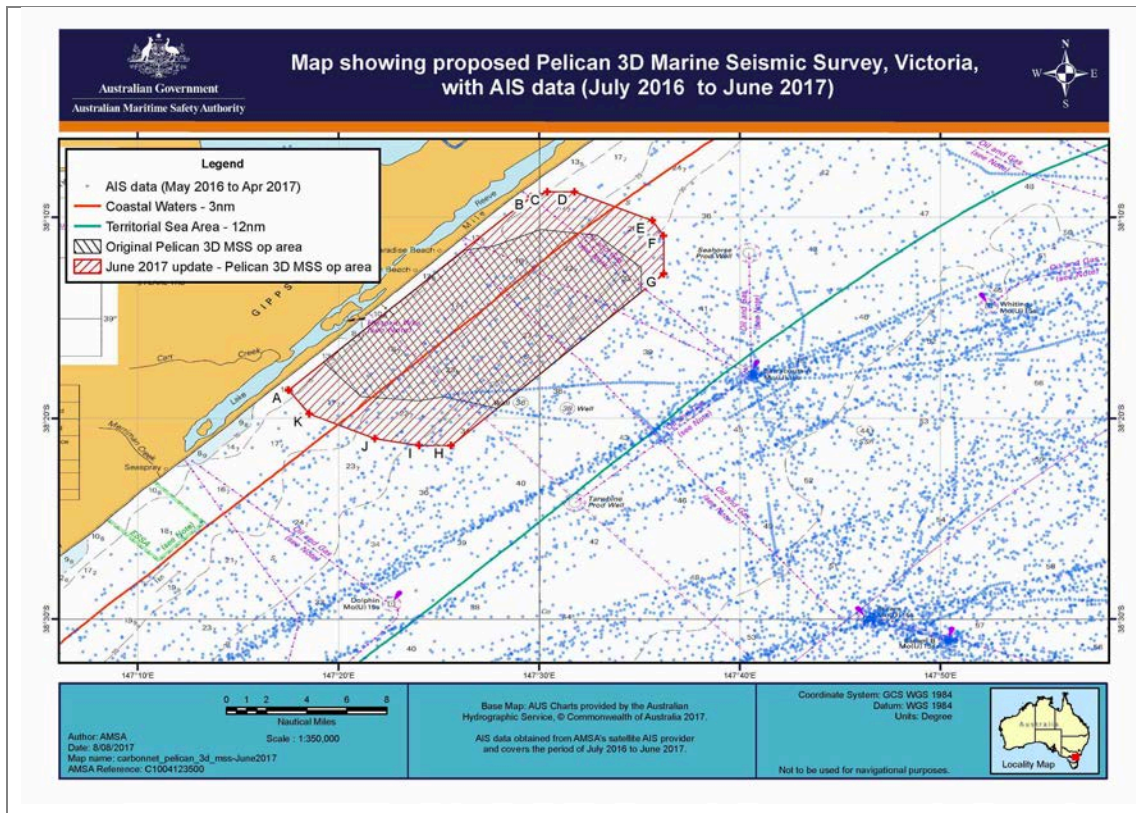


Figure 5.57. Historic seismic lines in the Gippsland Basin



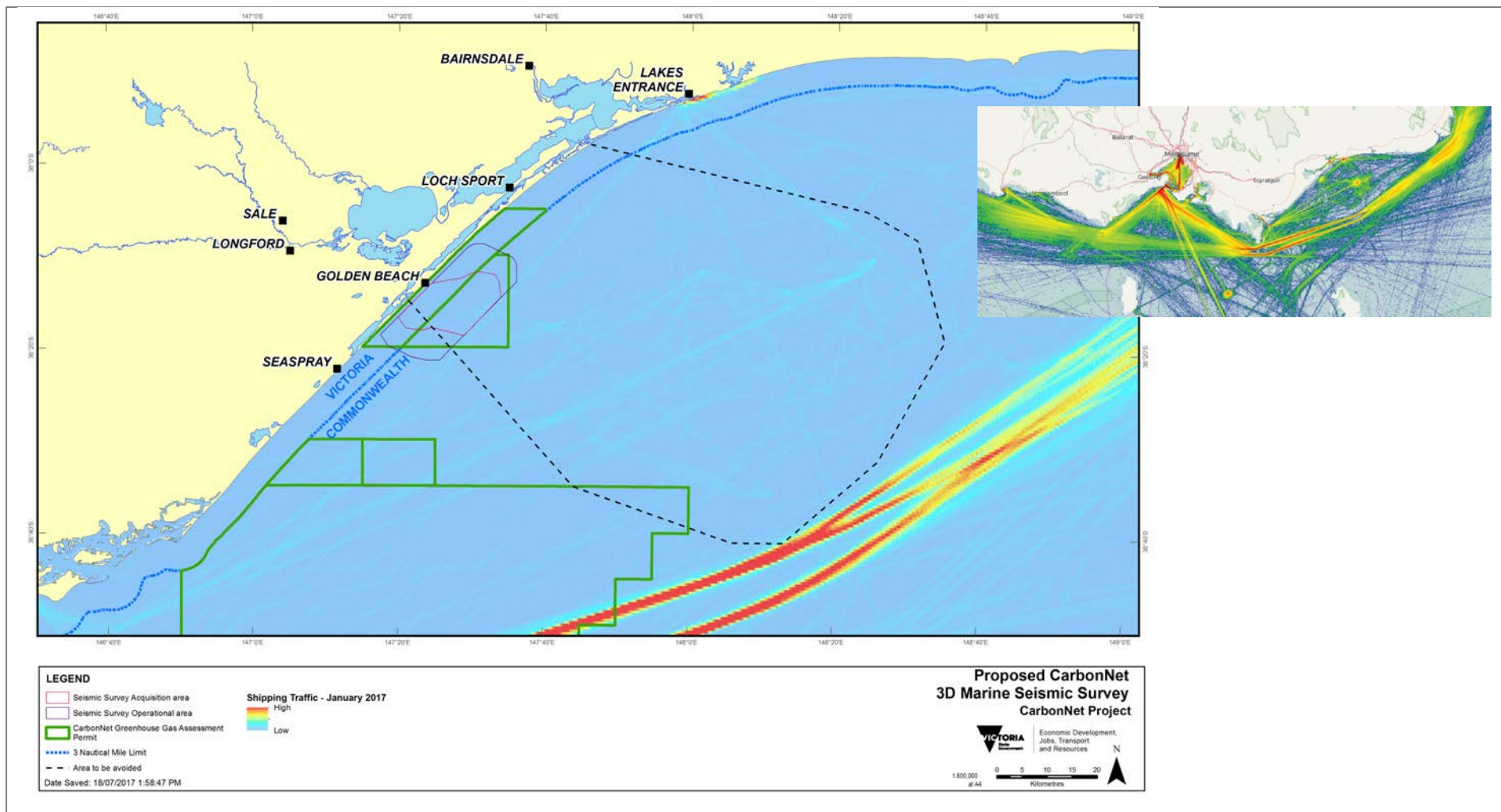
Source: Australian Border Force (2017).

Figure 5.58. The Area to be Avoided in Bass Strait



Source: AMSA (2017).

Figure 5.59. Shipping activity through the proposed operational area



Source: Victorian Government (2017). Lowest density in blue, grading to highest density in red. Data is shown for all vessels fitted with AIS.

Figure 5.60. Indicative vessel traffic density along the Victorian coast

5.6.8. Defence Activities

Defence activities that may take place in the region include transit of naval vessels, training exercises, hydrographic survey, surveillance and enforcement, and search and rescue. There are no defence training areas within the EMBA (DoE, 2015a). The proposed Pelican 3DMSS area is located beneath Defence Restricted Airspace R258D.

5.6.9. Other Infrastructure

Other infrastructure present within the EMBA includes:

- The Basslink electricity interconnector cable, which is located 34 km to the west of the proposed survey acquisition area. This cable connects the Victorian and Tasmanian electricity grids (with landfalls at McGauran Beach, Victoria and Four Mile Bluff, Tasmania) and was laid in 2004.
- The ocean outfalls for ROS at Delray Beach (1 km from the proposed acquisition area) and the SWOP at McGaurans Beach (25 km southwest from the proposed acquisition area). These outfalls are operated by Gippsland Water, and dispose large volumes of highly saline treated wastewater.

The Commonwealth Department of Communications and the Arts has confirmed with CarbonNet that there are no submarine cable protection zones in the vicinity of the proposed acquisition area. The nearest telecommunications cables, which connect Tasmania to the Australian mainland, occur to the west of Wilsons Promontory and are far outside the EMBA.

6. Impact and Risk Assessment Methodology

This chapter briefly outlines the environmental impact and risk assessment methodology employed for the proposed Pelican 3DMSS, in accordance with Regulation 13(5) of the OPGGS(E) and Regulation 15(3)(c) of the OPGGS Regulations.

Note that while ‘impacts’ and ‘risks’ are acknowledged as having different definitions (see Section 6.5), the term ‘risk’ is used throughout this chapter when describing the overall methodology of assessing impacts and risks given that AS/NZS 31000:2009 uses the term ‘risk’ (but is intended to also describe the approach to assessing impacts).

6.1. Risk Assessment Approach

The Victorian Government requires that all Departments approach to risk management be compliant with the Australian New Zealand Risk Management Standard ISO31000:2009 (Risk management-Principles and guidelines), the directions issued under the *Financial Management Act 1994 (Vic)* and the Victorian Government Risk Management Framework (VGRMF) (Department of Treasury and Finance, 2015).

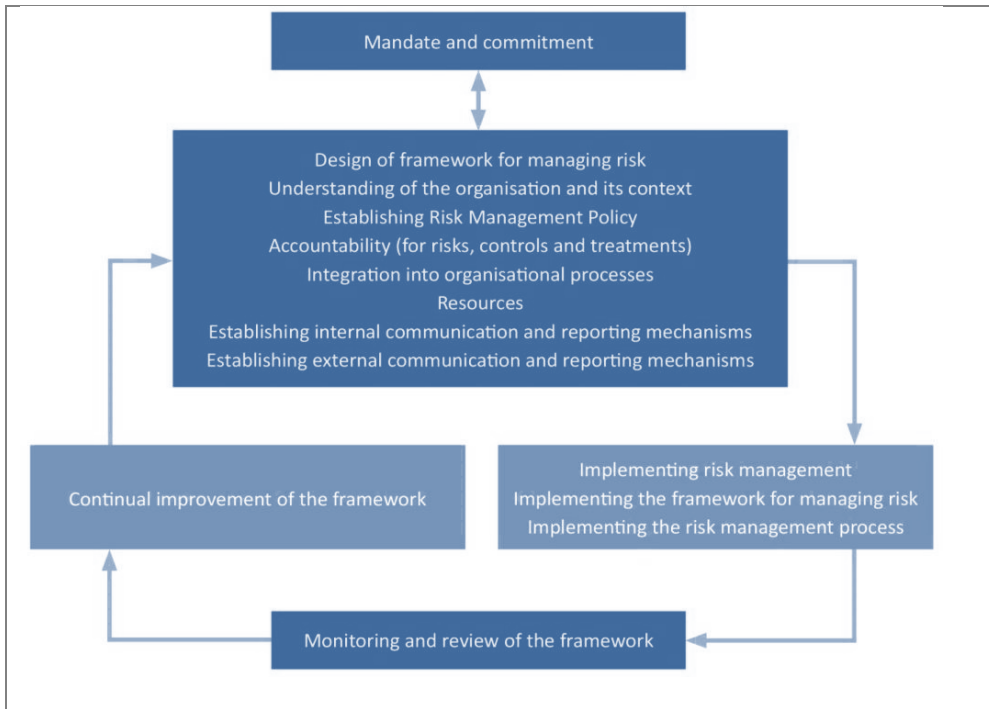
The Department’s policy recognises that the approach to implementation of some requirements may need to be varied, to reflect different structures and staffing arrangements within the different business areas within the Department. The CarbonNet Project: Project Risk Management Strategy (Version 3.0) outlines this approach.

CarbonNet recognises that risk management is an integral part of good governance and management practice. In planning and designing its approach to risk management, the CarbonNet team has sought to embed risk management into the project’s day-to-day processes so that risk management is relevant, effective, efficient and sustained.

The Risk Management Framework is illustrated in Figure 6.1.

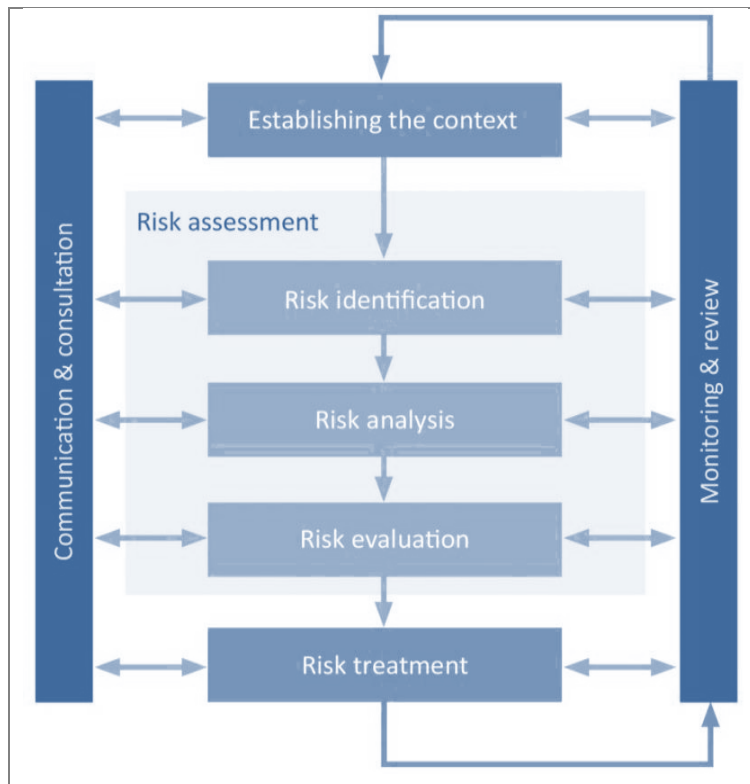
6.2. Risk Management Process

Figure 6.2 illustrates the 5-step risk management process used by CarbonNet, which is consistent with ISO AS/ANZ 31000:2009 and the VGRMF.



Source: VGRMF (2015), adapted from AS/ANZ 31000:2009.

Figure 6.1. Risk management framework



Source: VGRMF (2015), adapted from AS/ANZ 31000:2009.

Figure 6.2. Risk management process

6.3. Risk Identification

In order to identify the environmental risks associated with this project (together with recommendations for their control), CarbonNet held a preliminary environmental risk workshop, which identified the impacts and risks of the project at a high level. This was followed by a detailed risk workshop that focused on refining the causes of the impacts and risks, assigning control measures and impact consequences and risk ratings.

The outcomes of these workshops form the basis for the impact and risk assessment in Chapter 7.

6.4. Risk Analysis

The key process used for analysing risk is to determine the likelihood and the consequence of the risk occurring.

6.4.1. Determining Likelihood of Risk

Likelihood is defined by CarbonNet (as per ISO 31000:2009) as:

the chance that the risk/event will occur.

This is based on the historical or current experience. Existing controls (what is in place now to deal with this event if it does happen) must be considered when the level of likelihood is selected. The likelihood is selected as per Table 6.1.

Chapter 7 presents the 'inherent' likelihood for each hazard (pre-treatment) and the 'residual' likelihood (assuming the successful implementation of controls).

Table 6.1. DEDJTR environmental risk framework – likelihood of occurrence

Rating	Description	Probability
Almost certain	Is expected to occur in most circumstances.	>95-99%
Likely	Will probably occur in most circumstances.	>60-95%
Possible	Might occur at some time.	>40-60%
Unlikely	Could occur at some time.	>5-40%
Rare	May occur only in exceptional circumstances.	<5%


** The probability column assigns a general percentage likelihood of the hazard occurring as a general guide to accompany the description of likelihood.*

6.4.2. Determining Consequence of Risk

Consequence is defined by CarbonNet as:

the possible impact and the extent the risk/event would have in the eight categories of strategy, service delivery, reputation, finance, legal and legislative, safety and wellbeing of staff and visitors, people and culture, and environment.

The effectiveness of existing controls and likelihood (data available) must be taken into consideration when assessing the extent of the consequences. The



consequence is selected as per Table 6.2 (with the environment category highlighted for ease of reference). Chapter 7 presents the 'inherent' consequence for each hazard (pre-treatment) and the 'residual' consequence (assuming the successful implementation of controls).

DEDJTR's risk framework considers existing controls when determining risk (i.e., normally 'inherent' risk is not considered). However, for this EP, 'inherent' risk and/or consequence has been presented to provide an indication of what the risk and/or consequence would be in the event that the controls fail.

A minimum of one category must be selected (in the case of the EP, this will be 'environment'). If more than one category is assessed, there are likely to be a number of different consequence ratings. The *overall* consequence rating is that which is the highest consequence in any of the categories assessed.

Table 6.2. DEDJTR consequence scale

Risk Focus	Insignificant Can be managed with no change in operations or additional resources	Minor Can be managed with no change in operations, but may need resources and priorities to be reallocated	Moderate Changes in operations may be required, additional resources needed, and priorities reallocated	Major Changes in operations and additional resources may be greater than those available to the Group / Division	Critical Changes in operations impacts the wider Department, resources required may exceed the Department's resource capability
Strategic Risk event impacts on the ability of the Department/Group/Division/Program/Project to deliver financial & non-financial outcomes	<ul style="list-style-type: none"> • Failure to meet up to 1% of stated financial or non-financial outcomes. 	<ul style="list-style-type: none"> • Failure to meet 1-5% of stated financial or non-financial outcomes. 	<ul style="list-style-type: none"> • Failure to meet 5-10% of stated financial or non-financial outcomes. 	<ul style="list-style-type: none"> • Failure to meet 10-20% of stated financial or non-financial outcomes. 	<ul style="list-style-type: none"> • Failure to meet greater than 20% of stated financial or non-financial outcomes.
Service Delivery Risk event results in impacts to the day-to-day operations of the Department/Group/Division/Program/Project	<ul style="list-style-type: none"> • Insignificant impact to the department's capability in providing its services/functions • No inconvenience to customer/stakeholders. • Effect on systems and processes minimal and contained to one program area. • Impact may be confined to a single business area. • Minimal management resources required to address event over days. 	<ul style="list-style-type: none"> • Minor short-term temporary impact to the department's capability in providing its services/functions. • Customers/stakeholders slightly inconvenienced. • Effect on systems and processes contained to one Division. • Impact may be confined to a single Division. • Some management resources required to address event over days. 	<ul style="list-style-type: none"> • Moderate impact to the department's capability in providing its services/functions. • Customers/stakeholders inconvenienced. • Inability to deliver services for up to one week in at least one Division or Group. • Impact may be confined to a single Division or Group. • Some management resources required to address event over several weeks. 	<ul style="list-style-type: none"> • Continuing difficulties in delivering the department's critical services/functions. • Major impact on customers/stakeholder. • Inability to deliver services for between 1-3 weeks across the Department. • May impact on multiple Division or Group &/or single locations. • Significant management resources required to address event over several weeks or months. 	<ul style="list-style-type: none"> • Long-term detrimental effect on the department's capability in providing critical services/functions. • Very serious impact to customers/stakeholders. • Inability to deliver services for more than 3 weeks across the Department. • May impact on multiple Division or Group, whole Department &/or multiple regions. • Complete suspension of normal management activities for several weeks or months in order to address event.

Risk Focus	Insignificant Can be managed with no change in operations or additional resources	Minor Can be managed with no change in operations, but may need resources and priorities to be reallocated	Moderate Changes in operations may be required, additional resources needed, and priorities reallocated	Major Changes in operations and additional resources may be greater than those available to the Group / Division	Critical Changes in operations impacts the wider Department, resources required may exceed the Department's resource capability
Reputation Risk event has a sustained impact on the reputation of the Department (or of specific Group, Divisions or Programs within the Department) either within Government or external stakeholders.	<ul style="list-style-type: none"> • Very limited public or political interest. • Minimal adverse local attention (1 day only). • Relationship with central agency remediated promptly. • Complaint from one stakeholder. • Complaint or public criticism resolved promptly by day to day management processes. 	<ul style="list-style-type: none"> • Adverse localised public or political interest. • Limited attention on a single issue in local media over a short period (up to 1 week). • Relationship with central agency requires some management attention. • Complaint or public criticism resolved promptly by day-to-day management processes. 	<ul style="list-style-type: none"> • Adverse localised negative public or political attention. • Short term local media attention (up to 2 months). • Relationship with central agency requires specific management attention. • Local community concern on a single issue over a sustained period (up to 2 months). 	<ul style="list-style-type: none"> • Serious adverse public attention at State/National level (6-12 months). • Negative State/National media on one or more issues over a prolonged period (6-12 months). • Media attention escalates, calls for public enquiry and Ministerial accountability. • Medium-term negative public interest. • Correspondence, phone calls and political interest in Parliament. • Medium term loss of Government or central agency confidence in the Department. 	<ul style="list-style-type: none"> • Very serious public outcry at State/National level (longer than 1 year). • Negative State/National media over a prolonged period (greater than 1 year). • On-going or prolonged negative public interest (correspondence and phone calls) and political interest (in Parliament) (longer than 1 year). • Ministerial inquiry/Royal Commission. • Breakdown of public confidence in the Government/Department/Minister. • Resignation or removal of a Senior Executive and/or Minister. • Long-term loss of Government or central agency trust in the Department.
Financial Risk event impacts the financial position/budget of the Department/Group/Division/Program/	<ul style="list-style-type: none"> • Total Department or Group revenue, expenditure, or budget impacted by up to 1%. • Insignificant financial loss to industry/ 	<ul style="list-style-type: none"> • Total Department or Group revenue, expenditure, or budget impacted by 1-5%. • Minor financial loss to local economy/industry/ environmental 	<ul style="list-style-type: none"> • Total Department or Group revenue, expenditure, or budget impacted by 5-10%. • Moderate financial loss to region/industry/ environmental 	<ul style="list-style-type: none"> • Total Department, Group revenue, expenditure, or budget impacted by 10-20%. • Major financial loss to region/industry/environmental stakeholder. 	<ul style="list-style-type: none"> • Total Department, Group revenue, expenditure, or budget impacted by more than 20%. • Critical financial loss to primary/ industry/environmental

Risk Focus	Insignificant Can be managed with no change in operations or additional resources	Minor Can be managed with no change in operations, but may need resources and priorities to be reallocated	Moderate Changes in operations may be required, additional resources needed, and priorities reallocated	Major Changes in operations and additional resources may be greater than those available to the Group / Division	Critical Changes in operations impacts the wider Department, resources required may exceed the Department's resource capability
Project	environmental stakeholder.	stakeholder.	stakeholder.		stakeholder or the broader state.
Legal & Legislation Risk event results in legal consequences	<ul style="list-style-type: none"> • Non-compliance with legislation, identified internally and resulting in internal acknowledgement and process review. • Minor breach of internal policies and procedures with minimal management resources required. • Breach of contract with minimal management resources required. 	<ul style="list-style-type: none"> • Issue resolved internally with no further escalation. • Resulting in prosecution or civil action involving exposure to minor compensation, and/or minor negative precedent. • Regulatory or contract breach requiring some management resources to address event over days. 	<ul style="list-style-type: none"> • External investigation or report to responsible authority. • Prosecution or civil action, with one of moderate level of compensation or moderate level. • Regulatory or contract breach requiring some management resources to address event over several weeks. 	<ul style="list-style-type: none"> • External investigation or report to responsible authority. • Public enquiry (i.e., Royal Commission/ Parliamentary Committee). • Prosecution or civil action with high level compensation and high level negative precedent. • Sanctions imposed by external regulator. • Regulatory or contract breach leading to financial penalties less than total Department, Group expenditure impacted by 10-20%. 	<ul style="list-style-type: none"> • Prosecution or civil action leading to imprisonment of an officer. • Public enquiry (i.e., Royal Commission/Parliamentary Committee). • Uninsured compensation payments. • Negative precedent requiring very serious impact and major reform to the department. • Severe sanctions imposed by external regulator. • Major prosecution or litigation with potential financial penalties greater than 20% of the Department, Group expenditure.
Safety and Wellbeing Risk event impacts the safety and wellbeing of staff and visitors	<ul style="list-style-type: none"> • On-site first aid treatment only. 	<ul style="list-style-type: none"> • Minor injuries or illness requiring medical attention. 	<ul style="list-style-type: none"> • Injury or illness requiring inpatient hospitalisation. 	<ul style="list-style-type: none"> • Extensive and/or permanent injury or illness. 	<ul style="list-style-type: none"> • Single or multiple deaths or permanent disability or illness.

Risk Focus	Insignificant Can be managed with no change in operations or additional resources	Minor Can be managed with no change in operations, but may need resources and priorities to be reallocated	Moderate Changes in operations may be required, additional resources needed, and priorities reallocated	Major Changes in operations and additional resources may be greater than those available to the Group / Division	Critical Changes in operations impacts the wider Department, resources required may exceed the Department's resource capability
People and Culture Risk event impacts the Department's people and culture	<ul style="list-style-type: none"> • Staff disgruntlement • Lack of consistency in some practices by staff across department. 	<ul style="list-style-type: none"> • Complaints, passively upset, and uncooperative. • Some staff do not engage and collaborate vertically within a group. • Minimal staff turnover with minimal loss of skills, knowledge and expertise. 	<ul style="list-style-type: none"> • Low morale, disengagement, increased absenteeism and workplace conflict. • Some staff are not engaged and there is only partial collaboration vertically within a group and horizontally across groups /divisions. • Minimal turnover of key staff with skills, knowledge and expertise. 	<ul style="list-style-type: none"> • Major morale issues and high absenteeism. • Most staff are not engaged and there is no collaboration vertically within a group and horizontally across groups/divisions. • Resignations of key staff with skills, knowledge and expertise. • Staff are not up skilled to meet Business Plan priorities and commitments. 	<ul style="list-style-type: none"> • Department wide morale issues and mass absenteeism. • Staff are not engaged and there is no collaboration vertically within a group and horizontally across the Department. • Resignations of large numbers of key management level staff with skills, knowledge and expertise. • Staff are not up skilled to meet department corporate objectives and key strategic priorities.
Environment Risk event impacts the natural environment	<ul style="list-style-type: none"> • Negligible effect on the environment. • Environmental recovery is negligible and/or under 1 year. • Contained locally within a single site/area. 	<ul style="list-style-type: none"> • Limited effect on the environment and/or the environment suffers harm for 1-5 years. • Environmental recovery on a minor scale up to 5 years. • Restricted to a single township or locality. 	<ul style="list-style-type: none"> • Moderate effect on the environment and/or environment suffers harm for 5-10 years. • Environmental recovery on a moderate scale and/or over a period 5-10 years. • Impacts on a municipality or multiple localities. 	<ul style="list-style-type: none"> • Major effect on the environment and/or environment suffers harm for 10-20 years. • Environmental recovery on major scale and/or over a period of 10-20 years. • Impacts on a region or multiple municipalities. 	<ul style="list-style-type: none"> • Very serious effect on the environment and/or environment suffers long term harm (20+ years). • Environmental recovery on a very critical scale and/or over a long period (>20 years). • Impacts on the state or multiple regions.

6.4.3. Determining Risk Rating

The risk is determined by 'multiplying' likelihood and consequence, as per Table 6.3. The recommended form of action, escalation and monitoring for each risk level is provided in Table 6.4.

Table 6.3. Risk matrix

Consequence	Likelihood				
	Almost certain	Likely	Possible	Unlikely	Rare
5 – Critical	25	20	15	10	5
4 – Major	20	16	12	8	4
3 – Moderate	15	12	9	6	3
2 – Minor	10	8	6	4	2
1 – Insignificant	5	4	3	2	1

Table 6.4. Recommended actions and reporting requirements for each risk level

Rating	Rating level	Recommended action	Reporting requirements
20-25	High	Highest priority in research, planning, decision-making, allocation of resources, treating and monitoring. Immediate action required by the Executive Manager. Active Management response required.	The Governing Body (i.e., Steering Committee or Board) must review all high-rated risks. Consideration should be given by Programs/Projects for the inclusion of all high-rated risks in the Division's risk register.
12-16	Significant	High priority in planning, allocation of resources, treatment plans and monitoring. Action required by the Executive Manager. Regular monitoring response required.	The Governing Body (i.e., Steering Committee or Board) must review all significant-rated risks.
5-10	Medium	Existing controls, treatment plans and monitoring can be managed within existing operational routines. Action required by the relevant Executive Manager and the Manager of the risk. Periodic monitoring required.	The Program/Project will review all medium-rated risks and determine appropriate actions to lower the target residual risk.
1-4	Low	It is expected that the existing controls are effective with minor additional action required. Routine day-to-day management required by the Manager of the risk.	The Program/Project will review all low-rated risks and determine appropriate controls and monitoring.

6.5. Risk Evaluation

Once the risk rating has been determined, the risk must be evaluated. Table 6.5 outlines the appropriate management response and the activities required based upon the risk levels identified in Table 6.4.

Table 6.5. Appropriate management responses for each risk level

Appropriate management response	Activities required
Active Management	<ul style="list-style-type: none"> • A risk treatment plan(s) must be established and implemented. • These risks should be embedded in the CarbonNet Project Steering Committees. • The risk should be entered on Periscope. • A treatment can be entered on Periscope stating that the risk is being monitored. Progress reports should be entered on Periscope. • Risks should be reported to the DEDJTR Risk and Audit Committee.
Regular Monitoring	<ul style="list-style-type: none"> • Existing good treatments should be maintained. • Additional risk treatments as required should be established and implemented. • These risks should be embedded in the CarbonNet Project Steering Committees. • The risk should be entered on Periscope. • A treatment can be entered on Periscope stating that the risk is being monitored. Progress reports should be entered on Periscope. • Risks should be reported to the DEDJTR Risk and Audit Committee.
Periodic Monitoring	<ul style="list-style-type: none"> • Risks should be monitored over a quarterly period to ascertain as to whether there are any incidents that could increase the severity of the risk. • The risk should be entered on Periscope. • A treatment can be entered on Periscope stating that the risk is being monitored. Progress reports should be entered on Periscope. • Should the severity of the risk increase to 'Regular Monitoring' or 'Active Management' then Periscope should be amended and the action above followed.
No major concern	<ul style="list-style-type: none"> • Risks should be reviewed quarterly to ascertain whether the severity of the risk has changed.

The EP details and evaluate the environmental impacts and risks for the project, including control measures used to reduce the impacts and risks of the activity to ALARP and an acceptable level. This must include impacts and risks arising directly or indirectly from all activity operations (i.e., planned events) or potential emergency or incident conditions (i.e., incident events).

For this activity, CarbonNet has determined that impacts and risks are defined as follows:

- **Impacts** result from activities that are an inherent part of the activity and will result in a change to the environment or a component of the environment,

whether adverse or beneficial. For example, acoustic discharges from the seismic source arrays are an impact on the marine environment and cannot be avoided for the activity to achieve its aims.

- **Risks** result from activities where a change to the environment or component of the environment *may* occur as a result of an event associated with the activity (i.e., there may be impacts if the event actually occurs). Risk is a combination of the consequences of an event and the associated likelihood of the event occurring. For example, a hydrocarbon spill may occur if a vessel's fuel tank is punctured by a collision during the survey. The risk of this event is determined by assessing the consequence of the impact (using factors such as the type and volume of fuel and the nature of the receiving environment) and the likelihood of this event happening (which may be determined qualitatively or quantitatively).

6.6. Risk Treatment

Each of the impacts and risks identified and evaluated in Chapter 7 have associated control measures.

Factors to be considered when determining control measures include:

- The cost of implementing risk treatment options against the potential benefits – this may take the form of a cost-benefit analysis.
- Legal, legislative compliance and social responsibility – these may override cost, especially with regard to occupational health and safety requirements.
- Availability and suitability of ways to eliminate or reduce the hazard – the availability of resources such as infrastructure, equipment and capability need to be considered in light of State policies, procedures, values and behaviours.

7. Environmental Impact and Risk Assessment

This chapter presents the EIA for the environmental impacts and risks identified for the proposed Pelican 3DMSS using the methodology described in Chapter 6, and outlines the control measures to manage the impacts and risks.

The following definitions are used in this section, as defined in Regulation 4 of the OPPGS(E) and Regulation 6 of the Victorian OPGGS Regulations:

- *Environmental performance outcome (EPO)* – a measurable level of performance required for the management of environmental aspects of an activity to ensure that environmental impacts and risks will be of an acceptable level (i.e., a statement of the environmental objective).
- *Environmental performance standard (EPS)* – a statement of the performance required of a control measure.
- *Measurement criteria* (not defined in the regulations) – defines the measure by which environmental performance will be measured to determine whether the EPO has been met.

A summary of the residual impact and risk ratings for each impact identified and assessed in this chapter is presented in Table 7.1.

Table 7.1. Pelican 3DMSS residual environmental impact and risk rating summary

	Known hazards (impacts)	Residual consequence
1	Underwater sound – impacts to biological receptors	
	– plankton	Insignificant
	– fish (with swim bladders)	Insignificant
	– fish (without swim bladders)	Insignificant
	– cetaceans	Insignificant
	– pinnipeds	Insignificant
	– avifauna	Insignificant
	– crustaceans (e.g., southern rock lobster)	Minor
	– molluscs (e.g., commercial scallops)	Minor
	– turtles	Insignificant
2	Underwater sound – disruption to commercial fisheries	
	– commercial scallops (Vic)	Minor
	– southern rock lobster (Vic)	Minor
	– ocean access (Vic)	Insignificant
	– ocean purse seine (Vic)	Insignificant
	– inshore trawl (Vic)	Insignificant
	– southern squid jig (Cth)	Insignificant

	– SESS, gillnet and shark hook (Cth)	Minor
3	Atmospheric emissions	Insignificant
4	Light emissions	Insignificant
5	Sewage and grey water discharges	Insignificant
6	Cooling and brine water discharges	Insignificant
7	Putrescible waste discharges	Insignificant
8	Deck and bilge water discharges	Insignificant
Potential hazards (risks)		Residual risk
9	Underwater sound – risks to divers and swimmers	Low
10	Seabed disturbance	Low
11	Accidental overboard disposal of waste	Low
12	Introduction of marine pests	Low
13	Displacement of or interference with third-party vessels – displacement	Low
	– interference	Low
14	Interference with marine infrastructure – pipelines	Low
	– vessels	Low
15	Vessel strike or entanglement with megafauna – individuals	Low
	– population	Low
16	Diesel spill	Low
Hydrocarbon spill response activities (risks)		Residual risk
17	Surveillance and tracking	Low
18	Protection and deflection – nearshore habitat	Low
	– shoreline habitat	Low
	– fauna disturbance	Low
19	Shoreline assessment and clean-up – shoreline habitat	Medium
	– recreational users	Medium
	– cultural heritage disturbance	Low
20	Oiled wildlife response – fauna injury	Low
	– fauna death	Low

7.1. IMPACT: Generation of Underwater Sound – Impacts on Biological Receptors

7.1.1. Hazard

The following activities will generate underwater sound:

- Sound pulses from the seismic airgun array; and
- Engine noise transmitted through the hull and propeller noise from the source and support vessels.

Seismic source

The dominant source of underwater sound during the seismic survey will be from the operation of the seismic source (airgun array).

The seismic source will be fired at regular intervals, producing pulses of high intensity, low frequency sound. Seismic pulses typically have ~98% of the signal power in dominant frequencies less than 200 Hz; predominantly in the 10 to 200 Hz range (McCauley, 1994), which is the range most useful for seismic data imaging.

The air gun array comprises a series of airguns that are fired in pre-determined order to achieve the desired sound energy and frequency of discharges (shot point interval) with minimal interference. The volume of the airgun array (in cubic inches) is a useful indicator of sound energy (in dB); however, the configuration of individual arrays has a significant effect on the actual power output. CarbonNet commissioned sound transmission loss modelling (STLM) based on a known array configuration that has a higher volume (3,090 cui) than that proposed (2,800 cui). In this way, the STLM results can be considered conservative.

Vessel sound

The survey and support vessels will generate low levels of sound (engine noise transmitted via that portion of the hull below the sea surface and propeller sound). This sound source will be at a much lower level than that emitted from the airgun array. During operation of the airgun array, the underwater sound generated by the vessels will generally be masked by the airgun sound.

There will be very limited periods of time when the seismic source is not operational (e.g., during line turns, maintenance and marine fauna shut-downs), during which engine sound will be the major source. However, it is unlikely that engine sound levels will be greater than that of any other similarly-size vessel normally operating in the area (such as merchant vessels travelling in the nearby shipping fairway). The assessment of underwater sound from general vessel operations below is, therefore, based upon underwater sound from the airgun arrays being the dominant sources.

7.1.2. Known and Potential Environmental Impacts

In general, the impacts and risks resulting from underwater sound are generally well understood with regard to potential mortality and/or physiological injury for species in the water column, however, uncertainty lies in understanding the spatial and temporal extents of behavioural disturbances and the potential effects on populations and requires the application of context-specific

information. The potential environmental impacts to marine fauna from high levels of underwater sound are:

- Physical injury to auditory tissues or other air-filled organs;
- Hearing impairment, temporary threshold shift (TTS – the temporary loss of hearing sensitivity caused by excessive noise exposure) or permanent threshold shift (PTS – a permanent loss of hearing sensitivity caused by excessive noise exposure, considered an auditory injury);
- Direct behavioural effects through disturbance or displacement, and consequent disruption of natural behaviours or processes (e.g., migration, resting, calving or spawning); and
- Indirect behavioural effects by impairing/masking the ability to navigate, find food or communicate, or by affecting the distribution or abundance of prey species.

Specifically, underwater sound from seismic sources has the potential to adversely affect the following environmental values and sensitivities within and in the vicinity of the proposed acquisition area, to varying degrees:

- Plankton (including commercially important fish larvae/eggs);
- Marine invertebrate assemblages;
- Fish:
 - Mobile pelagic and demersal species that are likely to move away from the source as sound levels increase.
 - Site-attached/dependent fish species associated with reef habitats. These species are less likely to move away from the sound source and are expected to seek shelter within reef areas.
- Cetaceans:
 - Migrating and transient whales known to occur in the region (e.g., pygmy blue whales);
 - Dolphin species likely to occur in nearshore habitats (e.g., bottlenose dolphin, common dolphin).
- Pinnipeds - foraging habitat for the Australian fur seal and New Zealand fur seal;
- Foraging habitat for seabirds and shorebirds;
- Target species for commercially-important fisheries known to operate in and around the acquisition area (e.g., scallop, wrasse); and
- Environmental values of nearby marine parks.

The potential impacts on individual animals from exposure to elevated sound levels above ambient sound levels in a given area depends on a number of factors, including the extent of sound propagation underwater, its frequency characteristics and duration, its distribution relative to the location of the organisms, the sensitivity and range of spectral hearing among species (Carroll *et al.*, 2017).

The frequency range from airgun arrays overlaps with the frequency range of some marine fauna groups, but is unlikely to be heard by many marine species. The majority of the energy of the airgun array is predicted to occur below 500 Hz (McPherson *et al.*, 2017). Those marine species most at risk from acoustic disturbance from seismic operations generally are species that hear and communicate in a similar low frequency range to the range of sounds produced by seismic sources (particularly baleen whale species). In addition, fish and invertebrate species that are deemed as truly site-attached (i.e., less able to

swim away from the moving seismic source due to close associations with benthic features) are at increased risk from acoustic disturbance.

7.1.3. Evaluation of Environmental Impacts

Activities that generate underwater sound can affect marine fauna by interfering with aural communication, eliciting changes in behaviour and, potentially, causing either acute or chronic physiological damage. Various studies have investigated the effects of seismic sound upon a range of marine biota and generally concluded that, although a seismic source may pose a potential risk to individuals in very close proximity to the source, the transitory nature of seismic operations and the limited range over which possible effects can occur make it unlikely that seismic noise poses a significant hazard to populations of marine species (McCauley *et al.*, 2000a; Wardle *et al.*, 2001; Gausland, 2000; Thomson *et al.*, 2014).

The information box below describes how underwater sound is measured and referenced.

*The **decibel (dB)** scale is a logarithmic scale that expresses the ratio of two values of a physical quantity. It is used to measure the amplitude or 'loudness' of a sound. As the dB scale is a ratio, it is denoted relative to some reference level, which must be included with dB values if they are to be meaningful. The reference pressure level in underwater acoustics is 1 micropascal (μPa), whereas the reference pressure level used in air is 20 μPa , which was selected to match human hearing sensitivity.*

As a result of these differences in reference standards, sound levels in air are not equal to underwater levels. There are four main metrics for underwater sound (ISO/DIS 18405.2:2017):

- *Zero-to-peak sound pressure (PK), the greatest magnitude of the sound pressure during a specified time interval, unit: dB re 1 μPa ;*
- *Peak-to-peak sound pressure (PK-PK), sum of the peak compressional pressure and the peak rarefactional pressure during a specified time interval, unit: dB re 1 μPa ;*
- *Root-mean-square sound pressure level (SPL), the decibel ratio of the time-mean-square sound pressure, in a stated frequency band, to the square of the reference sound pressure, unit: dB re 1 μPa ; and*
- *Sound exposure level (SEL), a measure related to the sound energy in one or more pulses, or the ratio of the time-integrated squared sound pressure to the specified reference value, unit: dB re 1 $\mu\text{Pa}^2 \cdot \text{s}$.*

SEL is specified in terms of either per-impulse (per-pulse) or accumulation period. In this report, the accumulation period applied is 24 hours, and therefore the SEL is referred to as either per-impulse SEL or $\text{SEL}_{24\text{h}}$.

Source level is a measure of sound at a nominal distance of 1 m from a theoretical point source that radiates the same total sound power as the actual source. It can be expressed as an SPL, SEL or PK. Unit: dB re 1 μPa @ 1 m or dB re 1 $\mu\text{Pa}^2 \cdot \text{s}$.

This report also considers particle motion metrics:

- *Sound particle velocity contribution to velocity of a material element caused by the action of sound, in units of metre per second (m/s).*
- *Sound particle acceleration, the contribution to acceleration of a material element caused by the action of sound, in units of metre per second squared (m/s^2).*

Given the multiple measures commonly used to express sound levels, it's important to ensure any comparisons between specific sound level values are made using the same measures.

Sound Transmission Loss Modelling

While the energy from commercial seismic airgun arrays is highest at low frequencies (typically below 500 Hz), they also produce sound at higher frequencies (Madsen *et al.*, 2006, Hermannsen *et al.*, 2015, Popper *et al.*, 2016). Source levels depend upon the specific array and its configuration, however a typical commercial airgun array used in Australia can have a horizontal per-impulse SEL source level between 221 and 228 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$.

CarbonNet commissioned JASCO to undertake STLM for the proposed Pelican 3DMSS to enable an impact assessment specific to the proposed survey to be undertaken. The STLM includes:

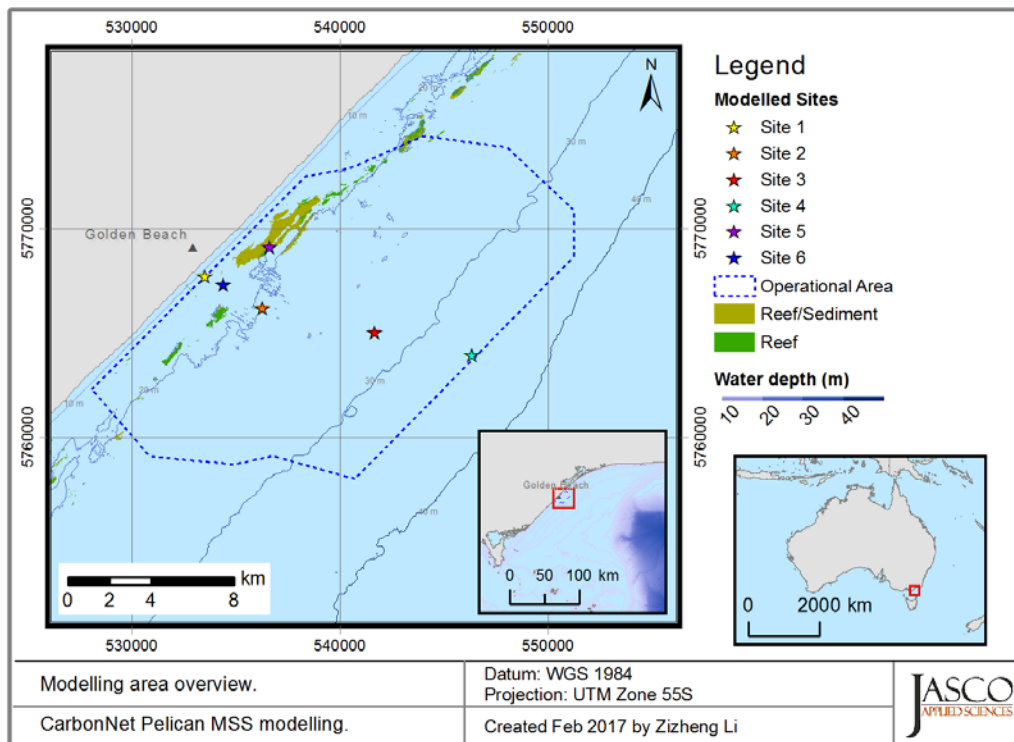
- Adoption of a 3,090 cui sound volume from a known array configuration as a conservative basis for modelling impacts, noting that a 2,800 cui volume array is proposed for the survey;
- Establishing six modelling sites across representative water depths of the proposed acquisition area (12.9 m, 18.7 m, 19 m, 20.7 m, 26.2 m and 36.6 m) (see Table 7.2);
- Single-shot propagation modelling – sampling at each modelling site;
- Accumulated sound exposure level (SEL) – 24-hour SELs for three survey acquisition scenarios; and
- Acoustic particle motion – calculations of the maximum vertical particle velocity levels at the surface layer of the seabed directly below the source array at two of the proposed single shot modelling locations (to assess for impacts to benthic species such as scallops and southern rock lobsters).

The pressure related sound level results are presented as SPL, zero-to-peak pressure levels (PK), and either single shot (i.e., per-pulse) or accumulated SEL as appropriate. Acoustic particle motion has been reported in terms of acceleration and velocity.

Table 7.2 provides the location details for the single shot modelling sites. The representative tow direction for each site is 45° and 225°. Figure 7.1 provides the locations used for short and long-range modelling. Table 7.3 provides the modelled maximum received SEL and SPL data for these locations.

Table 7.2. Location details for the six single-shot modelling sites

Site	Representative of	Water depth	Latitude	Longitude
1	Locations with similar geoacoustic profiles	12.9 m	38° 14' 16.582" S	147° 22' 57.745" E
2		20.7 m	38° 15' 05.969" S	147° 24' 52.471" E
3		26.2 m	38° 15' 41.760" S	147° 28' 33.685" E
4		36.6 m	38° 16' 16.758" S	147° 31' 46.707" E
5	Nearshore reef feature	19.0 m	38° 13' 30.779" S	147° 25' 05.491" E
6	Sandy seabed near reef	18.7 m	38° 14' 29.552" S	147° 23' 35.173" E



Source: JASCO (2017).

Figure 7.1. The acoustic modelling site locations within the proposed acquisition area

Table 7.3 presents the PK and per-pulse SEL source levels in the endfire, broadside, and vertical directions. Here the vertical source level accounting for the surface ghost is also presented for easier comparison to the output of other airgun array source models that include it by default.

Table 7.3. Source level specifications in the horizontal plane for the 3,090 cui array, for a 5 m tow depth (source levels are per-pulse and unweighted)

Direction	Peak pressure level (dB re 1 μ Pa @ 1 m)	SEL (dB re 1 μ Pa ² ·s @ 1 m)	
		10 – 2,000 Hz	2,000 – 25,000 Hz
Broadside	249.4	224.4	184.4
Endfire	245.6	222.9	187.7
Vertical (no ghost)	254.6	228.1	194.9
Vertical (with ghost)	254.9	230.4	197.9

STLM scenarios

The following section is an edited extract from the JASCO STLM report (McPherson *et al.*, 2017).

During a seismic survey, a new portion of sound energy is introduced into the environment with each pulse from the airgun array. While some impact criteria are based on per-pulse energy released, others, such as the marine mammal

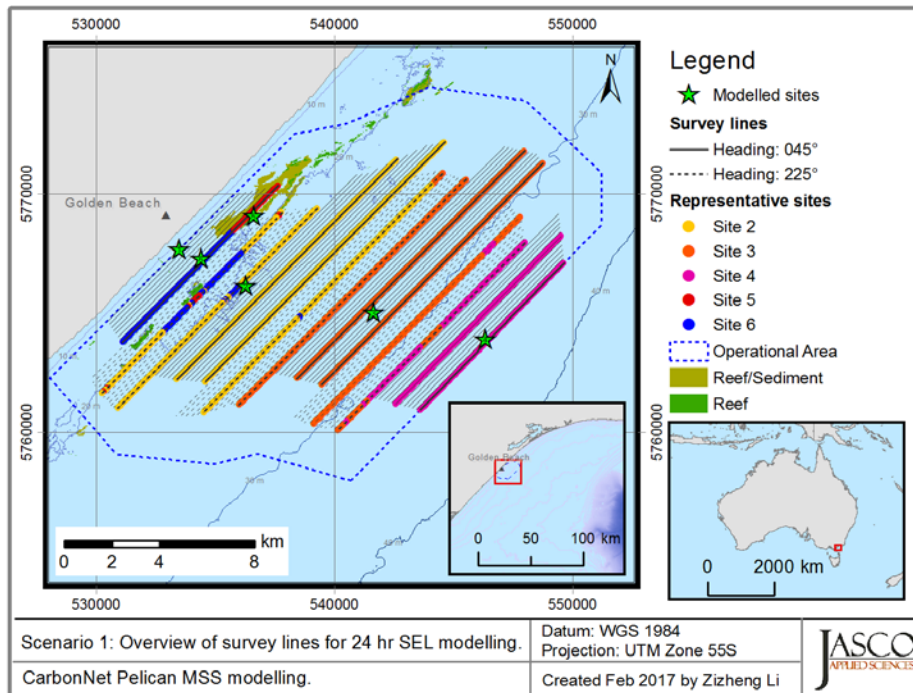
and fish SEL criteria used in this report account for the total acoustic energy marine fauna is subjected to over a specified period of time, defined in this report as 24 hours (SEL_{24h}). An accurate assessment of the cumulative acoustic field depends not only on the parameters of each impulse, but also on the number of impulses delivered in a period and the relative positions of the impulses.

Thousands of shots must be modelled to represent 24 hours of seismic operation. The process of modelling operations can be made manageable by estimating the acoustic fields based on a limited number of single shot sound fields at representative source locations. In this case, the six single shot model sites formed the library of representative footprints. The survey lines within each 24-hour exposure calculation were segmented by classifying shot points to one of the six representative sites based on geographic similarity as shown in Figure 7.2, Figure 7.3 and Figure 7.4.

Three scenarios were defined for assessing accumulated SEL over 24 hours of seismic operation along the supplied acquisition lines. The scenarios represent possible methods for acquisition, as the survey planning was not finalised at the time the STLM was undertaken. These scenarios are:

- Scenario 1 (Figure 7.2) – represents an acquisition pattern traversing the entire acquisition area over 24 hours;
- Scenario 2 (Figure 7.3) – represents sections of a tight turn typical ‘racetrack’ type acquisition pattern, where the turn was of a 45 minute duration, this one examining an offshore section;
- Scenario 3 (Figure 7.4) – represents sections of a tight turn typical ‘racetrack’ type acquisition pattern, where the turn was of a 45 minute duration, this one examining a section closer to shore.

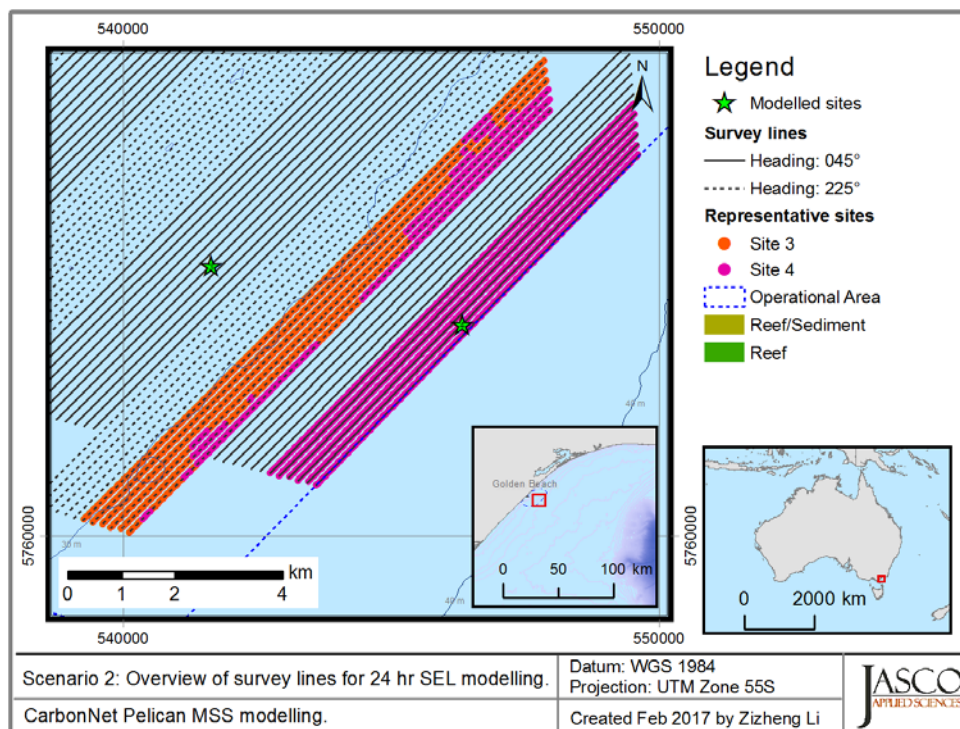
For all scenarios, the vessel is assumed to start at the southern end of the most easterly line, and traverse the survey lines at a speed of approximately 4.5 knots, with a shot interval of 12.5 m.



The representative sites are color-coded to indicate the model scenario classification scheme used to define the noise footprint for each airgun shot point.

Source: JASCO (2017).

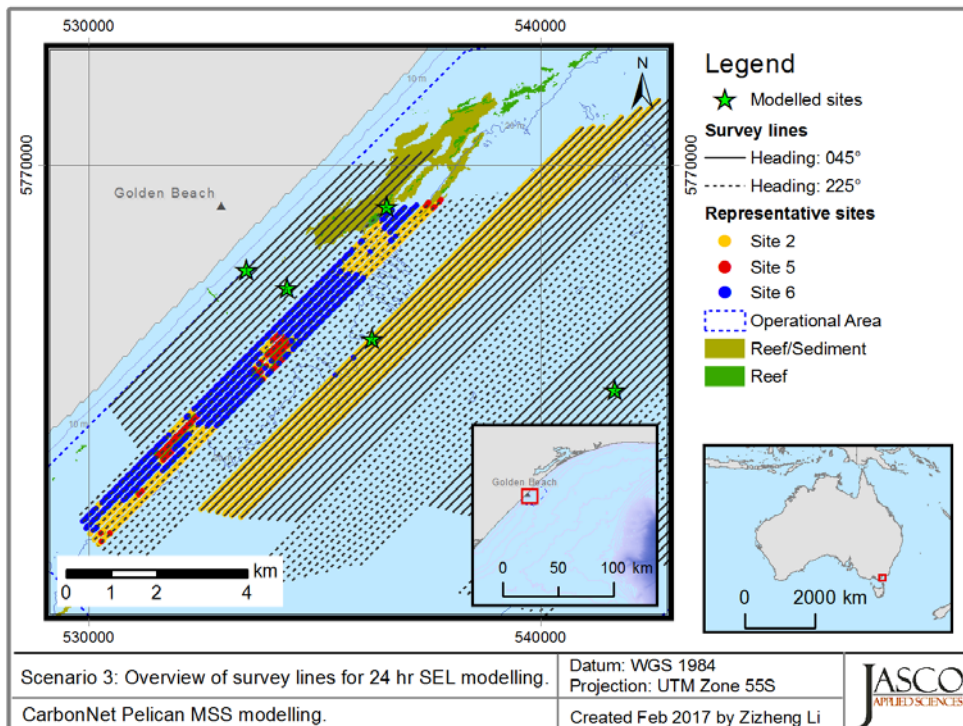
Figure 7.2. Scenario 1 – east to west acquisition scenario considered for SEL_{24h} calculations



The representative sites are color-coded to indicate the model scenario classification scheme used to define the noise footprint for each airgun shot point.

Source: JASCO (2017).

Figure 7.3. Scenario 2 – offshore ‘racetrack’ acquisition scenario considered for SEL_{24h} calculations



The representative sites are color-coded to indicate the model scenario classification scheme used to define the noise footprint for each airgun shot point.
 Source: JASCO (2017).

Figure 7.4. Scenario 3 – nearshore ‘racetrack’ acquisition scenario considered for SEL_{24h} calculations

The following sections provide the EIA for underwater seismic sound on the various groups of biological receptors in the proposed acquisition area.

Impacts to Plankton

Plankton (described in Section 5.4.3) are very widely dispersed throughout the ocean and are transported by prevailing wind and tide driven currents. They cannot take evasive behaviour to avoid seismic sources. However, the potential for population level noise effects is limited due to their widespread distribution and rapid population growth rates. This means that only a small percentage of a cohort will be exposed at any one time.

Research results

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).

Sound-induced mortality in larval fish, where observed, has been in the range of 0.5 to 3 m around the source, in association with relatively high peak energy levels; however, damage may occur out to approximately 5 m (Payne *et al.*, 2008).

In the USA, trials using seismic sound from airguns 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 from the seismic

source, mortalities did not differ from those of controls (Cox *et al.*, 2012 as cited in NSW DPI, 2014).

Gausland (2000) noted several studies confirming that that signal levels exceeding 230-240 dB re 1 μ Pa (PK-PK) are necessary for harm to occur and so therefore physical damage can only occur within a few metres from the air guns.

Booman *et al* (1996) recorded the highest mortality rates of Norwegian fish eggs and larvae within 1.4 m and low or no mortality and infrequent pathology within 5 m of the seismic source.

An important study, although limited in scope, investigated the consequences that seismic-induced mortality of fish larvae may have at a population level (Sætre & Ona, 1996). The work was based on the observed mortality figures for larvae and fry at given distances in Booman *et al* (1996) for five species of fish (cod, saithe, herring, turbot, and plaice). As a worst-case situation, it was estimated that the number of larvae killed during a typical seismic survey (>10 days) was 0.45% of the total larvae population (Sætre & Ona, 1996). When compared with very high natural mortality rates for species (e.g., cod and herring eggs/larvae have a natural mortality of 5 to 15% per day), the potential loss associated with a seismic survey is negligible. Parry *et al* (2002) also indicates there is no evidence of mortality-associated population effects such as reduced abundance or catch rates in plankton a few hours after exposure.

Despite these results, research released by McCauley *et al* (2017) stated that there have been no published studies conducted on the impacts of seismic sound on plankton and as such, our understanding of these impacts is still developing. The McCauley *et al* (2017) study was undertaken in early March 2015, using two replicated experiments in Storm Bay in southeastern Tasmania. It involved the deployment of acoustic noise loggers to measure air gun signals, and used an airgun volume of 150 cui and operating pressure of 2,000 psi. The study measured zooplankton abundance and the proportion of the population that was dead at three distances from the airgun - 0, 200 and 800 m. The experiment estimated the proportion of the zooplankton that was dead, both before and after exposure to airgun sound, 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).

The results of the experiment found that zooplankton exposure to airguns increased the mortality rate from a natural level of 19% per day to 45% per day (on the day of exposure), with this mortality rate observed out to 1.2 km. This is more than two orders of magnitude greater than the 10 m previously assumed (McCauley *et al.*, 2017).

This study postulates that the external sensory hairs that zooplankton possess may be extremely sensitive and in response to seismic sound, may 'shake' to the point where damage could accrue to sensory hairs or tissue. Importantly, the study notes that for anthropogenic sources to have significant impacts to plankton at an ecological scale, the spatial or temporal scale of the impact (i.e.,

the seismic survey) must also be large when compared to the impacted ecosystem.

In response to this research, APPEA commissioned the CSIRO to assess the potential local and regional impacts on zooplankton of a typical MSS. A large-scale seismic survey conducted on the North West Shelf of Australia was modelled in a hydrodynamic model using the McCauley et al (2017) mortality results. This is reported in Richardson et al (2017). The modelled survey parameters include a survey area of 2,900 km², 60 survey lines, waters 300-800 m deep, an airgun source of 3,000-3,200 cui and operating pressure of 2,000 psi. This paper reports that impact is recorded within the survey area and within 15 km of it, but that these impacts are not discernible at the bioregion scale and barely discernible within

150 km of the survey area. Zooplankton populations recovered quickly after seismic exposure due to their fast growth rates and due to the dispersal and mixing of zooplankton from both inside and outside of the impacted region. The modelling undertaken by Richardson et al (2017) found that while there was a maximum decline of 22% in zooplankton populations in the survey and a 14% decline within 15 km of the survey area, it took only 3 days following the completion of the survey for zooplankton biomass to recover to pre-seismic survey levels within the survey area and within an area of 15 km around the survey area. The study notes that because zooplankton growth rates are slower in colder regions (e.g., Bass Strait), the recovery rate of zooplankton populations following exposure to MSS is likely to be slower.

The IAGC (2017) conducted its own review of the McCauley et al (2017) paper, noting that:

“... 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.”

The IAGC (2017) also noted that the McCauley et al (2017) paper has not yet been accepted by the expert scientific community.

Thresholds adopted for the STLM

Table 7.4 presents the exposure criteria for airguns for fish eggs and larvae. This was developed by Popper et al (2014) based on results from the Working Group on the Effects of Sound on Fish and Turtles.

The studies undertaken by McCauley et al (2017) and Richardson et al (2017), while important in increasing the industry's knowledge of the potential impacts of MSS on plankton, do not in themselves set new thresholds for modelling the impacts of MSS on plankton. Consequently, CarbonNet has elected to use the thresholds developed by Popper et al (2014) for the STLM as they are well established and represent years of ongoing work in this field.

Table 7.4. Exposure criteria for seismic sources – fish eggs and larvae

Mortality and potential mortal injury	Distance from the source	Impairment			Behaviour
		Recoverable injury	TTS	Masking	
210 db SEL _{24h} or >207 dB PK	Near	Moderate	Moderate	Low	Moderate
	Intermediate	Low	Low	Low	Low
	Far	Low	Low	Low	Low

Adopted from Popper et al (2014).

STLM results

Table 7.5 presents the STLM predicted ranges for the effects criteria and isopleths of interest for fish eggs and larvae (plankton).

Table 7.5. Maximum (R_{max}) horizontal distances from the source array to modelled seafloor PK levels from four transects for fish eggs and larvae

Peak pressure level (dB re 1 µPa)	Distance R _{max} (m)				
	Site 1	Site 2	Site 3	Site 4	Site 5
207	300	260	230	250	220

Cell highlighted in red indicate maximum predicted extent of sound.

Table 7.6 presents the STLM SEL_{24h} results for three operational scenarios for plankton with the estimated ranges to the appropriate cumulative exposure criterion contour. The distances in this section represent the perpendicular distance from to the closest survey line to the relevant isopleth.

Table 7.6. Maximum-over-depth distances to SEL_{24h}-based plankton criteria for three possible scenarios within the Pelican 3DMSS acquisition area

Threshold for SEL _{24h} (dB re 1 µPa ² .s)	Scenario 1		Scenario 2		Scenario 3	
	R _{max} (km)	Area (km ²)	R _{max} (km)	Area (km ²)	R _{max} (km)	Area (km ²)
Mortality and potential mortal injury						
210	0.03	2.93	0.04	4.1	0.06	4.85
Recoverable injury						
203	0.22	31.5	0.58	36.1	0.55	37.6

Cells highlighted in red indicate maximum predicted extent of sound.

The distance to sound levels associated with mortality and potential mortal injury on fish eggs and fish larvae based on Popper et al (2014), using the SEL_{24h} metric, are smaller than those estimated using the PK-based metric. Therefore, in line with the conditions of the criteria, the PK metric should be used to assess these impacts, which is 300 m (see Table 7.5).

CarbonNet acknowledges that the recent studies by McCauley et al (2017) and Richardson et al (2017) prompt the project to consider the degree of certainty in assessing potential impacts, and as such has adopted a precautionary approach as described in the following section.

Predicted impacts

The proposed Pelican 3DMSS represents 5.7% by area and up to 77% by days (assuming upper estimate of 27 days) of the study undertaken by Richardson et al (2017).

The hydrodynamics of Bass Strait are conducive to continual mixing and replenishment of plankton, noting the slower growth rate of plankton in cooler temperate waters. Taking this into consideration, the outcomes of the Richardson et al (2017) research hold, in that recovery of plankton populations are likely to be in the order of days post-MSS as opposed to weeks.

The proposed acquisition area is not located within an upwelling KEF. The distance to sound levels associated with recoverable injury using the PK metric (being 300 m) means that seismic sound will not impact the 'Upwelling East of Eden' KEF (important phytoplankton blooms that form the basis of productive food chains), which is located 37 km east of the proposed acquisition area.

At a bioregional level, the proposed acquisition area (and associated area of effects on plankton) overlaps a miniscule proportion of the South-east Marine Region (0.01%) with a similarly miniscule overlap with the finer scale 'Southeast Shelf Transition' provincial bioregion (0.09%).

The timing of the survey avoids the key spawning period (i.e., planktonic phase) of many species of commercial and recreational fishing species, and is likely to overlap with the influence of the EAC, meaning that currents travelling from the east will act as a source of replenishment for plankton populations in and around the proposed acquisition area. Consequently, the assessment of impacts to plankton is insignificant.

The results of the assessment suggest that the impacts on plankton are likely to be insignificant at both a local and population level or compared with natural variability and mortality rates for plankton organisms.

Any reduction in plankton biomass in and immediately around the proposed acquisition area is not likely to have a significant impact on the foraging habits of baleen whales, such as the pygmy blue whale, because:

- The reduced biomass is temporary;
- They have vast foraging grounds with the proposed acquisition area representing a miniscule proportion of these foraging grounds. In Victoria, foraging grounds are concentrated on the southwest coast (associated with the Bonney Upwelling) rather than the Gippsland coast.

Impacts to Fish

Fish species known to occur within the proposed acquisition area and surrounds are listed and/or described in Section 5.4.4 and Section 5.6.3.

Research results

All fish studied to date are able to detect sound, with the main auditory organs in teleost (bony) fish being the otolithic organs of the inner ear (Carroll *et al.*, 2017). Hearing in fish primarily involved the ability to sense acoustic particle motion via direct inertial stimulation of the otolithic organs or their equivalent.

Many species also have the ability to sense sound pressure using an indirect path of sound stimulation involving gas-filled chambers such as the swim bladder (Carroll *et al.*, 2017).

There are substantial differences in auditory capabilities from one fish species to another, hence the use of anatomy to distinguish fish groups, as done by Popper *et al.* (2014) (Table 7.7). Within these categories, two groups have an increased ability to hear. The first of those are fish with swim bladders close, but not intimately connected to the ear, can hear up to about 500 Hz, and are sensitive to both particle motion and sound pressure. Fish with swim bladders mechanically linked to the ear are primarily sensitive to pressure, although they can still detect particle motion. These fishes have the widest hearing range, extending to several kilohertz, and are generally more sensitive to sound pressure than any of the other groups of fish (Hawkins and Popper, 2016). The predominant frequency range of seismic survey sound, which for the proposed Pelican 3DMSS is below 500 Hz, is within the detectable hearing range of most fish.

Table 7.7. Exposure criteria for seismic sources – fish

Type of fish	Mortality and potential mortal injury	Impairment			Behaviour
		Recoverable injury	TTS	Masking	
Fish with no swim bladder	>219 db 24 hr SEL or >213 dB peak	>216 db 24 hr SEL or >213 dB peak	>186 db 24 hr SEL	(N) Low	(N) High
				(I) Low	(I) Moderate
				(F) Low	(F) Low
Fish with swim bladder not involved in hearing	210 db 24 hr SEL or >207 dB peak	>203 db 24 hr SEL or >207 dB peak	>186 db 24 hr SEL	(N) Low	(N) High
				(I) Low	(I) Moderate
				(F) Low	(F) Low
Fish with swim bladder involved in hearing	207 db 24 hr SEL or >207 dB peak	>203 db 24 hr SEL or >207 dB peak	>186 db 24 hr SEL	(N) Low	(N) High
				(I) Low	(I) High
				(F) Moderate	(F) Moderate

Adapted from Popper et al (2014).

Distance from the source

(N) Near = tens of metres.

(I) Intermediate = within hundreds of metres.

(F) Far = thousands of metres.

Underwater noise levels significantly higher than ambient levels can have a negative impact on fish, ranging from physical injury or mortality, to temporary effects on hearing and behavioural disturbance effects.

The effects of underwater sound on fish within the vicinity of a source array will vary depending on the size, age, sex and condition of the receptor among other physiological aspects, and the topography of the benthos, water depth, sound intensity and sound duration. The effect of noise on a receptor may be either

physiological (e.g., injury or mortality) or behavioural, as described in the following sub-sections.

Physiological impacts

Direct physical damage may occur to fish if they approach within a few metres (<5 m) of the seismic source (Gausland, 2000; McCauley *et al.*, 2000a; Parvin *et al.*, 2007).

Lethal effects of seismic surveys on fish have not been reported, but those with a swim bladder closely connected to the inner ear are more susceptible than those without (McCauley, 1994). Fish with thin-walled, lightly damped and large swim bladders will be most susceptible to mechanical damage or trauma from seismic pulses. Other fish, including the elasmobranchs (sharks and rays), family Scombridae (mackerels and tuna) and many of the flatfish and flounder species do not possess a swim bladder and so are not susceptible to swim bladder-induced trauma (McCauley, 1994). Table 7.8 presents a summary from Carroll *et al* (2017) for investigations into the impacts of seismic airgun sound on fish, which supports the assertion that lethal effects of seismic surveys on fish have not been observed. This table has been edited by JASCO to revise sound units.

Behavioural impacts

Gausland (2000) postulates that while seismic airgun operation causes little direct physical damage to fish at distances greater than 1-2 m from the source, it is evident that fish respond to sounds emitted from airguns, and that avoidance seems to be the primary response for all species.

Table 7.8. A summary of the studies conducted on the effects of seismic surveys on fish mortality

Organism	Source	Source levels	Distance of receptor from source	Received levels	Results	Reference	Relevance to Pelican 3DMSS
Pallid sturgeon (<i>Scaphirhynchus albus</i>) and on Paddlefish (<i>Polyodon spathula</i>) ⁺	620 cui airguns	Not relevant, not shown	0–33.75 m Control 160 m	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. 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 re 1 µPa.	(Popper et al. 2016) ^C	Highly relevant, indicates the criteria applied in the STLM are highly conservative.
European seabass (<i>Dicentrarchus labrax</i>)	Playbacks (see spectrograms in (Radford et al. 2016))	Not relevant	<1 m	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	(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 this EP.

Organism	Source	Source levels	Distance of receptor from source	Received levels	Results	Reference	Relevance to Pelican 3DMSS
					<p>seismic noise for 12 weeks no longer responded with an elevated ventilation rate to the same noise type.</p> <p>Fish exposed long-term to playback of pile-driving noise also no longer responded to short-term playback of seismic noise.</p> <p>The lessened response after repeated exposure was likely driven by increased tolerance or a change in hearing threshold.</p>		
Rainbow trout (<i>Salmo gairdneri</i> , Salmon smolt (<i>Salmon smolts</i>))	130 cui airguns	229 (estimated, and likely PK)	150–4,000 m	142 PK-PK at the cages (4 km) (M) 186 PK-PK at 150 m from airguns (M)	No mortality observed.	(Thomsen, 2002) ^{*,C,#}	Not relevant to mortality as levels significant lower than those in criteria.
Demersal fish, blue whiting and some pelagic fish	4,752 cui airgun array	222–250 PK	1–10, 150–300 m	200-210 (E)	No mortality observed.	(Dalen and Knutsen, 1987) ^{*,C,#}	Relevant – study with large commercial array.
Red snapper (<i>Lutjanus synagris</i>),	635 cui airgun array	196 PK	7 m horizontal at 5m depth.	Not available	No mortality at any distances.	(Boeger et al., 2006) ^{*,C,#}	Relevant – study with small commercial array.

Organism	Source	Source levels	Distance of receptor from source	Received levels	Results	Reference	Relevance to Pelican 3DMSS
Schoolmaster snapper (<i>Lutjanus apodus</i>), Atlantic spadefish (<i>Chaetodipterus faber</i>)			2.5 m below array And 1 m horizontal distance				
Sandeel (<i>Ammodytes marinus</i>)	3,090 cui airgun array	256.9 PK (vertical) 247.7 PK broadside	55–7,500 m	Sand eels within the near-field of the array on the seafloor under tracklines	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 similar sized commercial array to this survey. Tracklines directly over habitat with no impact shown.
Twelve species	Single 20 cui airgun	223 PK-PK,	5–800 m	146-195 PK-PK (M)	No immediate mortality. No delayed mortality (up to 58 days) for one 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 (e.g., Popper et al., 2005 ; Song et al., 2008), see below.
Broad whitefish (<i>Coregonus nasus</i>), lake chub (<i>Couesius</i>)	720 cui airgun array	Not specified, not relevant	13–17 m	Average mean of 207 PK (M) Mean SEL (single shot) 177 m (M)	No mortality of fish from the 3 species held for 24 hours after exposure.	(Popper et al., 2005) ^{*,C1}	Relevant – no mortality at close range, However, limited ability to compare to McCauley

Organism	Source	Source levels	Distance of receptor from source	Received levels	Results	Reference	Relevance to Pelican 3DMSS
<i>plumbeus</i>), Northern pike (<i>Esox pucius</i>) ⁺						1. Caged outdoor tanks	et al 2004 – different paradigm, species, airgun, and transmission loss environment.
Juvenile sea bass (<i>Dicentrarchus labrax</i>)	Airguns 2500 in ³ array	Not shown	180–6,500 m	210 at 180 m (E) 204 at 800 m (E) 199 at 2500 m (E)	No mortality up to 72 hours post exposure.	(Santulli et al. 1999) ^{*,C}	Relevant – real world study with commercial array.
Juvenile saithe (<i>Pollachius virens</i>) and cod (<i>Gadus morhua</i>), adult pollock (<i>Pollachius pollachius</i>) and mackerel (<i>Scomber scombrus</i>)	Airguns	Not shown	109, 16 and 5.3 m	195, 210, 218 PK	No indication of mortality.	(Wardle et al. 2001) ^{*,F,#}	Highly relevant, indicate criteria applied to the STLM are highly conservative.

Source: Carroll et al (2017).

Sound levels are reported as zero to peak (PK), peak-to-peak (PK-PK), root-mean-square SPL (units of dB re 1 µPa), or SEL (units of dB re 1 µPa².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.

Available evidence suggests that behavioural change for some fish species may occur, however this is thought to be localised and temporary, with displacement of pelagic or migratory fish populations having insignificant repercussions at a population level (McCauley, 1994). Behavioural changes such as startle or alarm responses are expected to be localised and temporary, with displacement of pelagic or migratory fish likely to have insignificant repercussions at a population level (McCauley, 1994; McCauley & Kent, 2012; Popper *et al.*, 2015; Popper *et al.*, 2007). Studies by Przeslawski *et al* (2016b), Streever *et al* (2016), Slotte *et al* (2004), Wardle *et al* (2001), McCauley *et al* (2000), Dalen *et al* (1996) and Gausland (2000) support this.

Impacts to site-attached fish, such as those that may occur in the inshore reef areas of the proposed acquisition area, can be assessed through comparison with studies undertaken by Woodside at Scott Reef on tropical reef fish during the Maxima 3D seismic survey activities (Woodside, 2012a; b; c). The Scott Reef study identified the following impacts to site-attached reef fish:

- No lethal or sub-lethal effects on fish were experienced. Behavioural responses were observed at close range with general movement from the water column to the seabed, however normal feeding behaviour returned within 20 minutes of the survey vessel passing and when the vessel was beyond a distance of 1.5 km (Woodside, 2012a).
- Fish exposed to acoustic pulses showed no structural abnormalities, tissue trauma or lesions, or auditory threshold changes (highest exposure level 190 dB re $1\mu\text{Pa}^2\cdot\text{s}$). However, a small number of damaged hair cells (less than 1% of fish hearing capacity) were observed in fish exposed to acoustic noise (Woodside, 2012b).
- No significant decreases in the diversity and abundance of fish after the seismic survey were detected compared with the long-term temporal trend before the survey (Woodside, 2012c).
- The lack of significant impacts to fish species considered sensitive because of their site-fidelity requirements (i.e., being restricted to reef habitat and unable to move far when the seismic sound approaches) indicates that pelagic fish able to swim away from disturbing noise are likely to be even less at risk of impacts from seismic sound.

While lethal effects to fishes from seismic testing have not been observed, sub-lethal effects have been reasonably well documented. Whilst the ecological effects of sub-lethal effects have not been well studied it is possible that they could expose some fishes to increased mortality via increased predation through lowered fitness (Popper & Hastings, 2009) depending on the fishes' life history. Additionally, the lack of significant impacts to fish species considered sensitive because of their site-fidelity requirements (i.e., being restricted to reef habitat and unable to move far when the seismic sound approaches) indicates that pelagic fish able to swim away from disturbing noise are likely to be even less at risk of impacts from seismic sound.

Per-pulse SEL, SPL and accumulated SEL at the boundary of The Ninety Mile Beach MNP (see Section 5.1.4) are predicted to be below levels that create behavioural disturbance. As such, impacts to fish in the MNP from the MSS are not expected.

A summary of the potential impacts of low-frequency seismic sound on fish is presented in Figure 7.5.

Limited research has been conducted on responses from elasmobranchs (sharks and rays, including juveniles) to marine seismic surveys (as highlighted in Figure 7.5). Sharks and rays differ from bony fish in that they have no accessory organs of hearing (i.e., a swim bladder) and therefore are unlikely to respond to acoustical pressure (Myrberg, 2001). Elasmobranchs sense sound via the inner ear and organs and as they lack a swim bladder it is thought that they are only capable of detecting the particle motion component of acoustic stimuli (Myrberg, 2001). 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 μ Pa above background ambient noise levels) when approaching within 10 m of the sound source. The available evidence indicates sharks will generally avoid seismic sources, so the likely impacts on sharks are expected to be limited to short-term behavioural responses, such as avoidance of waters around the operating seismic array. For the purposes of this EIA, sharks are included in the same group as fish without swim bladders.

Thresholds adopted for the STLM

Table 7.7 (presented earlier) presents the exposure criteria for airguns for fish. This was developed by Popper et al (2014).

The SEL metric integrates noise intensity over some period of exposure. Because the period of integration for regulatory assessments is not well defined for sounds that do not have a clear start or end time, or for very long-lasting exposures, it is required to define a time period. This is done for marine mammals in the Southall et al (2007) criteria, where it is 24 hours or the duration of the activity, whichever is longer.

Popper et al (2014) summarises that in all TTS studies considered, fish that showed TTS recovered to normal hearing levels within 18–24 hours. Due to this, a period of accumulation of 24 hours has been applied in this study for SEL, which is similar to that applied for marine mammals in Southall et al (2007) and NMFS (2016).

The criteria is a dual criteria, with the largest distance resulting from either SEL or PK being required to be applied.

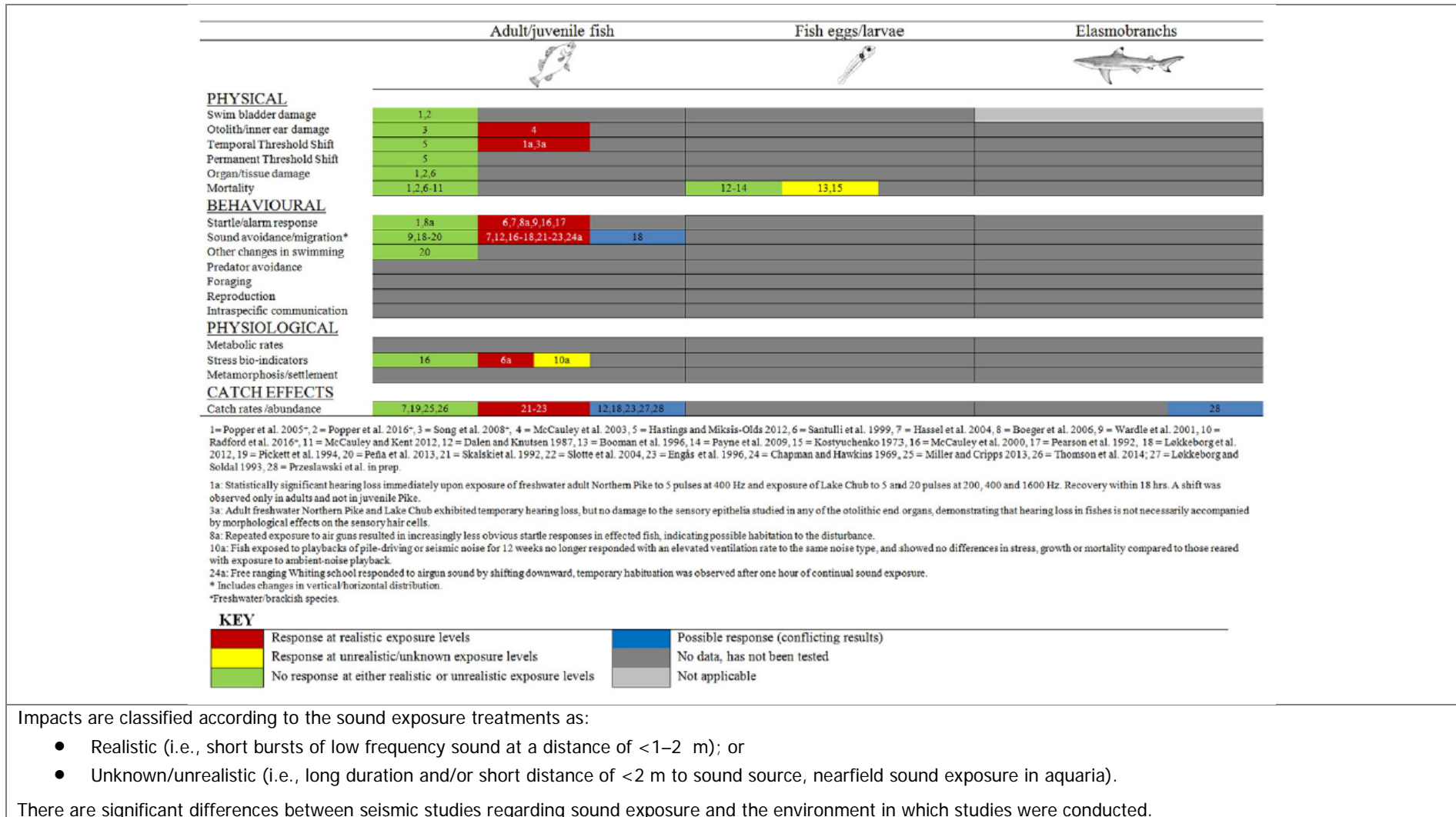


Figure 7.5. Summary of potential impacts of low-frequency seismic sound on marine fish

STLM results

Table 7.9 presents the STLM predicted ranges for the per-pulse effects criteria and isopleths of interest for fish.

Table 7.9. Maximum (R_{max}) horizontal distances from the source array to modelled seafloor PK levels from four transects for fish

Type of fish	Peak pressure level (dB re 1 μ Pa @ 1 m)	Distance R_{max} (m)				
		Site 1	Site 2	Site 3	Site 4	Site 5
I	213	80	105	100	115	115
II & III	207	300	260	230	250	220

Cells highlighted in red indicate maximum predicted extent of sound.

I – fish with no swim bladder

II – fish with a swim bladder not involved in hearing.

III – Fish with a swim bladder involved in hearing.

Table 7.10 presents the SEL_{24h} exposure results for three operational scenarios for fish with the estimated ranges to the appropriate cumulative exposure criterion contour. The distances in this section represent the perpendicular distance from to the closest survey line to the relevant isopleth.

Table 7.10. Maximum-over-depth distances (in km) to SEL_{24h} based fish criteria for three possible scenarios within the Pelican 3DMSS acquisition area

Type of fish	Threshold for SEL_{24h} (dB re 1 μ Pa ² .s)	Scenario 1		Scenario 2		Scenario 3	
		R_{max} (km)	Area (km ²)	R_{max} (km)	Area (km ²)	R_{max} (km)	Area (km ²)
Mortality and potential mortal injury							
I	219	0.02	0.60	0.02	1.0	0.01	0.28
II	210	0.03	2.93	0.04	4.1	0.06	4.85
III	207	0.05	8.3	0.09	18.1	0.13	18.6
Recoverable injury							
I	216	0.02	0.60	0.02	1.0	0.01	0.28
II, III	203	0.22	31.5	0.58	36.1	0.55	37.6
TTS							
I, II, III	186	4.86	302	8.11	244	5.92	190

Cells highlighted in red indicate maximum predicted extent of sound.

The distance to sound levels associated with mortality and potential mortal injury on fish, fish eggs and fish larvae based on Popper et al. (2014), using the SEL_{24h} metric, are smaller than those estimated using the PK-based metric. Therefore, in line with the conditions of the criteria, the PK metric should be used to assess these impacts to fish, turtles, fish eggs, and fish larvae.

The relevant sound level for the most sensitive fish groups, fish eggs and fish larvae, is 207 dB re 1 μ Pa PK, and the associated maximum distance is 300 m (Site 1).

For recoverable injury to fish based on Popper et al (2014), the distance to the sound levels and the metric associated with these distances (either PK or SEL_{24h}), depends on the scenario:

- Scenario 1: The distance determined using the PK metric is 300 m, which is larger than that determined using SEL_{24h}, which is 220 m.
- Scenario 2 and 3: The distance determined using the SEL_{24h} metric is either 580 or 550 m, which is larger than that determined using PK, which is 300 m.

Table 7.9 indicates that the distance to sound levels associated with mortality and potential mortal injury on fish using the PK metric may occur up to a maximum distance of 115 m (for fish without a swim bladder, including elasmobranchs) to 300 m (for fish with a swim bladder).

The results in Table 7.10 indicate that, assuming fish remain stationary for 24 hours:

- The distance to sound levels associated with mortality and potential mortal injury may occur up to a maximum distance of 20–100 m from the source array, dependent on the type of fish and scenario;
- Recoverable injury may occur up to a maximum distance of 20–590 m from the source array, dependent on the type of fish and scenario; and
- TTS may occur up to a maximum distance of 8.1 km from the source array, dependent on the type of fish and the scenario.

Predicted impacts

The ecological significance of the physiological and behavioural effects is expected to be low based on the following factors:

- Long-term or permanent displacement of any fish species from the reef habitat is highly unlikely (e.g., Woodside, 2012a;b;c);
- The short distances from the sound source associated with injury and mortality of fish and larvae are unlikely to affect their predators, including fauna such as seals, dolphins, whales, penguins and other seabirds, due to the vast expanse of similar habitat and prey available in the region. Like the fish, their predators are also likely to exhibit avoidance behaviour around the seismic source. This means that both fish and their predators are not likely to be present around the operating seismic source, resulting in no net loss of feeding opportunities;
- The MSS will not result in destruction or modification of the sparse reef habitat; and
- The timing of the MSS has been narrowed down to February or March, thereby avoiding the peak spawning period of November to January for up to 13 species of commercial and recreational fishing importance.

Mortality of fish (both immediate and delayed) is considered highly unlikely based on no documented cases of fish mortality upon exposure to seismic airgun sound under experimental or field operating conditions.

The MSS will not have a 'significant' impact on critically endangered or vulnerable fish species (see Section 5.4.4) when assessed against the EPBC Act Significant Impact Guidelines 1.1 (DoE, 2013).

The impacts on fish are likely to be insignificant at both a local and population level or compared with natural variability.

Impacts to Cetaceans

Marine mammal species evolved from terrestrial mammals and share basic hearing anatomy and physiology with their terrestrial ancestors. Marine mammals, however, have broader hearing frequency ranges due to the much higher sound speed underwater compared to in air. Odontocetes (toothed whales and dolphins) hear best at higher frequencies, while mysticetes (baleen whales) hear better at lower frequencies (Wartzok and Ketten, 1999; Mooney *et al.*, 2012). Mysticetes and potentially odontocetes increased their ability to receive sound through the skull and both modified their middle ear structures to increase the amplitude of low-frequency sounds in particular (Ketten, 1992; Cranford and Krysl, 2015).

Sound is very important to whales and dolphins for effective hunting, navigation and communication. Mysticetes (e.g., humpback and blue whales) communicate at low frequencies (20 Hz to approximately 5 kHz) using predominantly tonal type calls. Odontocetes (e.g., killer whales and bottlenose dolphins) communicate using both tonal signals (up to approximately 30 kHz) and echolocation clicks (peak frequencies range from approximately 40 – 130 kHz), which they also use for hunting and navigation (Au *et al.*, 2000).

The type and scale of the effect on cetaceans to seismic sounds will depend on a number of factors including the level of exposure, the physical environment, the location of the animal in relation to the sound source, how long the animal is exposed to the sound, the exposure history, how often the sound repeats (repetition period) and the ambient sound level. The context of the exposure plays a critical and complex role in the way an animal might respond (Gomez *et al.*, 2016, Southall *et al.*, 2016).

High levels of anthropogenic underwater noise can have potential effects on cetaceans ranging from changes in their acoustic communication, behavioural disturbances and in more severe cases physical injury or mortality (Richardson *et al.*, 1995)

Research results

Physiological impacts

Physiological impacts such as physical damage to the auditory apparatus (e.g., loss of hair cells or permanently fatigued hair cell receptors), can occur in marine mammals when they are exposed to intense or moderately intense sound levels and could cause permanent or temporary loss of hearing sensitivity. While the loss of hearing sensitivity is usually strongest in the frequency range of the emitted noise, it is not limited to the frequency bands where the noise occurs but can affect a broader hearing range. This is because animals perceive sound structured by a set of auditory bandwidth filters that proportionately increase in width with frequency.

A TTS is hearing loss from which an animal recovers, usually within a day at most, whereas PTS is hearing loss from which an animal does not recover (permanent hair cell or receptor damage). The severity of TTS is expressed as the duration of hearing impairment and the magnitude of the shift in hearing sensitivity relative to pre-exposure sensitivity, in decibels (dB). TTS occurs at lower exposure levels than PTS. The cumulative effects of repeated TTS, especially if the animal receives another

sound exposure near or above the TTS threshold before recovering from the previous sensitivity shift, could cause PTS. If the sound is intense enough, an animal could succumb to PTS without first experiencing TTS (Weilgart, 2007). Though the relationship between the onset of TTS and the onset of PTS is not fully understood, a specific amount of TTS can be used to predict sound levels that are likely to result in PTS. For example, in establishing PTS thresholds, Southall et al (2007) assume that PTS occurs with 40 decibels of TTS. While there are results from TTS and PTS studies on odontocetes exposed to impulsive sounds (Finneran, 2016), there is no data for mysticetes. There is no conclusive evidence of a link between sounds of seismic surveys and mortality of cetaceans (Gotz *et al.*, 2009).

For seismic surveys in Australian waters, the EPBC Act Policy Statement 2.1 determines suitable exclusion zones with an unweighted per-pulse SEL threshold of 160 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (DEWHA, 2008). This threshold value is used in the policy to determine whale exclusion zones where seismic surveys must lower their acoustic power output, or shut down completely, in order to prevent significant exposure to sound levels that could induce TTS. Policy Statement 2.1 does not apply to smaller dolphins and porpoises, as DEWHA assessed these cetaceans as having peak hearing sensitivities occurring at higher frequency ranges than those that seismic arrays typically produce.

Behavioural impacts

A secondary concern arising from sound generation is the potential non-physiological effects on cetaceans including:

- Increased stress levels;
- Disruption to underwater acoustic cues;
- Masking;
- Behavioural changes; and
- Displacement.

Behavioural responses to underwater sound are difficult to determine because animals vary widely in their response type and strength, and the same species exposed to the same sound may react differently (Nowacek *et al.*, 2004, Gomez *et al.*, 2016, 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. A number of biological and environmental factors can affect an animal's response, such as:

- 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);
- Motivational state (e.g., hunger, fear of predation, courtship) at the time of exposure; and
- Perceived proximity, motion, and biological meaning of the sound and nature of the sound source.

Animals might temporarily avoid anthropogenic sounds, but could display other behaviours such as approaching novel sound sources, increasing vigilance, hiding and/or retreating, that might decrease their foraging time (Purser and Radford, 2011). Some cetaceans might also respond acoustically to seismic survey noise in a range

of ways, including by increasing the amplitude of their calls (Lombard effect), changing their spectral (frequency content) or temporal vocalisation properties, and in some cases, cease vocalising (IWC McDonald *et al.*, 1995; 2007, Parks *et al.*, 2007; Di Iorio and Clark, 2010; Castellote *et al.*, 2012; Hotchkin and Parks, 2013; Blackwell *et al.*, 2015). Masking can also occur (Erbe *et al.*, 2015).

The BRAHSS (Behavioural Response of Australian Humpback whales to Seismic Surveys) project conducted studies at Peregian Beach, Qld, and Dongara, WA, to better understand the behavioural responses of humpback whales to noise from the operation of seismic air gun arrays (Cato *et al.*, 2013). Results from the first sets of experiments have been published (Dunlop *et al.*, 2015; Dunlop *et al.*, 2016; Godwin *et al.*, 2016), together with concurrent studies of the effects of vessel noise on humpback whale communications (Dunlop, 2016). In most exposure scenarios, a distance increase from the sound source was observed and interpreted as potential avoidance. The study, however, found no difference in the 'avoidance' response to either 'ramp-up' or the constant source producing sounds at a higher level than early ramp-up stages. In fact, a small number of groups showed inspection behaviour of the source during both treatment scenarios. 'Control' groups also responded, which suggested that the presence of the survey vessel alone had some effect on the behaviour of the whales. Despite this, the majority of groups appeared to avoid the survey vessel at distances greater than the radius of most injury-based mitigation zones.

Small odontocetes responded to airgun sounds by moving laterally away from the sound, showing the strongest lateral spatial avoidance, compared to mysticetes and killer whales that showed more localised spatial avoidance.

Dolphins. The small oceanic dolphins that may be encountered during the survey (such as the bottlenose dolphin *T. truncatus* and common dolphin *D. delphis*) have very broad distributions and habitat requirements. Both of these species are known to ride the bow waves of vessels (Bannister *et al.*, 1996, Perrin, 1998; Ross, 2006; Hawkins and Gartside, 2009; Barkaszi *et al.*, 2012; Barry *et al.*, 2012). Bow riding of seismic vessels is also a common occurrence, though likely to occur less frequently when the source is operating.

Burrnan dolphins (*Tursiops australis*), present in the Gippsland Lakes and Port Phillip Bay, are unlikely to be impacted by the seismic survey for the same reasons (in the event that individual dolphins are swimming between the Gippsland Lakes and Port Phillip Bay at the time of the survey). The resident population in the Gippsland Lakes will not be exposed to the seismic sound, as the coast provides a barrier to sound transmission between the ocean and the lakes.

Pygmy blue whales. There are very few peer-reviewed papers that examine the responses of blue or pygmy blue whales to seismic surveys. The only study that specifically examines responses was that from Di Iorio and Clark (2010), who found that blue whales increased their discrete, audible calls during a MSS.

Numerous seismic surveys have occurred along the Bonney coast since the Blue Whale Study was initiated in 1998. The Blue Whale Study uses aerial surveys to assess distribution and migration movements of marine mammals, with particular attention to great whales, in Bass Strait and the Otway Basin. Aerial surveys of blue whale distributions during MSS have observed the following:

- In February 2011, during the blue whale peak migration period, aerial surveys (conducted by Origin) observed only a single blue whale within the Astrolabe

3DMSS (Otway Basin), and eight blue whales within a 10 km buffer area around the survey area. The total number of blue whale sightings during the February 2011 aerial surveys was 51, of which 42 were located outside the 10 km buffer around the Astrolabe study area. Blue whales continued feeding behaviour at a distance of approximately 30 km from the seismic vessel, irrespective of the seismic operations.

- Morrice et al (2004) stress that the proximity of whales to seismic vessels must be interpreted in the context of their pressing need to consume tonnes of food per day. Blue whales may need to feed into their zone of acoustic discomfort if the only krill available is in proximity to a seismic vessel. Blue whales have been sighted within approximately 2.4 km of an active seismic source array and cow and calf pairs, which are considered the most sensitive of whale aggregations, were recorded within 7.1 km (Morrice *et al.*, 2004).
- In December 2003, Santos carried out a 2D seismic survey (3,150 cui source size) in EPP32 west of Kangaroo Island (SA) where blue whales were observed. Some of the whales approached as close as 2.4 km to the operating seismic vessel, feeding on dense krill swarms.
- During a seismic survey in VIC/P51 in November 2003, blue whales were sighted near krill swarms approximately 18 km from the seismic vessel, and left the area as the vessel approached closer. It is unknown if the approach of the vessel triggered the whales to move from the area.
- During November-December 2002, Santos conducted 2D and 3DMSS in VIC/P51 and VIC/P52 (3,150 cui source size) with no blue whale sightings within 60 km of the operating seismic vessel.
- During the 1999-2000 season, Woodside conducted a 3DMSS in VIC/P43 (2,250 cui sound source). During aerial surveys, no blue whales were sighted within 90 km of the operating seismic vessel, despite abundant krill surface swarms in the area.
- Aspects of the seismic survey that may affect whales (e.g., vessel movements and associated seismic sound) will be transitory at any given location as the vessel traverses the acquisition area at a rate of approximately 6 knots (11 km/hr), and will potentially involve only very temporary and localised exposure. It is considered unlikely that any marine mammals will be exposed to levels likely to cause physiological damage because of their ability to avoid the vessel and seismic source array (McCauley, 1994).

Given these observations, it is recognised that the proposed Pelican 3DMSS has the potential to cause behavioural disturbance or avoidance behaviour for pygmy blue whales, especially if undertaken during foraging times (likely to be between January and April in eastern Bass Strait).

Southern right whales. The closest known calving/nursery grounds to the proposed acquisition area occurs at Logan's Beach off the southwest Victorian coast (approximately 430 km west of the proposed acquisition area) (see Section 5.4.5). Southern right whales are therefore unlikely to be present in the BIA for migration/resting on migration (present along the entire Victorian coast) at the time of the survey.

If southern right whales were migrating during the period of the survey, based on the literature summarised above, it is possible that they will experience masking of their communications, and perhaps exhibit avoidance. Any localised avoidance of an active seismic source when leaving the coastline could plausibly add a few tens of kilometres to this migration. Such a marginal increase is not considered likely to

significantly affect the metabolic demands of individuals whose migrations occur over thousands of kilometres.

Humpback whales. While the migration BIA for humpback whales is only intersected in the eastern-most portion of the EMBA (beyond the eastern Victorian border), there are occasional sightings of humpback whales in Gippsland from helicopters, vessels and oil and gas production platforms associated with Esso's production facilities (see Section 5.6.6), with Esso advising that the period from September to November usually results in the most sightings of humpback whales (Bok, pers. comm., March 2017).

Humpback whales have not been observed to be significantly displaced from their migratory pathways as a result of seismic sound, with the most consistent observed response to seismic activity being an alteration of course and swimming speed (McCauley *et al.*, 2000a). Cows with young calves may have greater susceptibility to acoustic disturbance (McCauley *et al.*, 2000a). The BRAHSS experiment previously described found that in most exposure scenarios, a distance increase from the sound source was observed and interpreted as potential avoidance from the seismic source.

Thresholds adopted for the STLM

In August 2016, the NMFS finalised technical guidance for assessing the effect of anthropogenic sound on marine mammal hearing (NMFS, 2016).

There are two categories of auditory threshold shifts or hearing loss: PTS (a physical injury to an animal's hearing organs) and TTS (a temporary reduction in an animal's hearing sensitivity as the result of receptor hair cells in the cochlea becoming fatigued). To assist in assessing the potential for injuries to marine mammals in addition to the application of EPBC Act Policy Statement 2.1, JASCO's STLM (and thus the EP) applies the criteria recommended by NMFS (2016).

Southall et al (2007) extensively reviewed marine mammal behavioural responses to sounds. Considering the complexity of information in the field, NMFS has historically used a relatively simple sound level criterion for potentially disturbing a marine mammal. For impulsive sounds, this threshold is 160 dB re 1 μ Pa SPL cetaceans (NMFS, 2013).

A summary of the threshold criteria used to assess impacts of underwater sound for each of the cetacean functional hearing groups is presented in Table 7.11.

Table 7.11. The unweighted per-pulse SPL, SEL and SEL_{24h} and PK thresholds for acoustic effects on cetaceans

Cetacean hearing group	DEWHA (2008)	NMFS (2013)	NMFS (2016)	
	Unweighted per-pulse SEL (dB re 1 μ Pa ² .s)	Behaviour	Injury (PTS)	
		SPL (dB re 1 μ Pa)	Weighted SEL _{24h} (dB re 1 μ Pa ² .s)	PK (dB re 1 μ Pa)
LFC	160	160	183	219
MFC			185	230
HFC			155	202

Cetacean functional hearing groups:

- Low-frequency cetaceans (LFC) – mysticetes (baleen whales, including southern right, blue, humpback and fin whales);

- Mid-frequency cetaceans (MFC) – some odontocetes (toothed whales and dolphins); and
- High-frequency cetaceans (HFC) – odontocetes specialised for using high frequencies (e.g., harbour porpoise and Amazon river dolphin).

STLM results

Table 7.12 presents the STLM predicted ranges for the five modelling sites for the per-pulse effects criteria (maximum-over-depth) and isopleths of interest for cetaceans.

Table 7.12. Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances (km) from the source arrays to modelled maximum-over-depth DEWHA and NFMA marine mammal behaviour criteria

Threshold	Site 1		Site 2		Site 3		Site 4		Site 5	
	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)
DEWHA (2008). Unweighted per-pulse SEL: 160 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$	3.30	2.62	3.28	2.81	3.72	2.93	3.84	3.17	3.72	2.93
NMFS (2013). Marine mammal behaviour, SPL: 160 dB re 1 μPa	6.14	5.07	6.01	4.92	7.48	5.46	8.13	6.28	6.68	5.32

Cells highlighted in red indicate maximum predicted extent of sound.

Table 7.13 presents the STLM predicted ranges for the five modelling sites for the per-pulse effects criteria (seafloor PK levels) and isopleths of interest for cetaceans.

Marine mammals could experience PTS based on the criteria applied (NMFS, 2016). This is a dual metric criterion, requiring consideration of both PK and accumulated SEL. The peak pressure criteria were exceeded at a maximum horizontal distance of 60 m for LFC, within 15 m for MFC and 540 m for HFC. Distances are from the centre of the array, but as the array is not a point source (8 x 14 m), the actual ranges from the edge of the airgun array are small for all but HFC. The maximum distances are all associated with Site 1.

Table 7.13. Maximum (R_{max}) horizontal distances from the source array to modelled seafloor PK levels from four transects for cetaceans

Group	Peak pressure level (dB re 1 μPa @ 1 m)	Distance R_{max} (m)				
		Site 1	Site 2	Site 3	Site 4	Site 5
LFC	219	60	35	45	40	50
MFC	230	15	10	5	5	10
HFC	202	540*	500*	390	370	130

* Ranges extrapolated using $n \log(r) + A$

Cells highlighted in red indicate maximum predicted extent of sound.

The SEL_{24h} exposure results are presented for three possible operational scenarios (as described earlier in this section). Table 7.14 shows the estimated ranges to the appropriate cumulative exposure criterion contour for cetaceans. The radii in this

table represent the perpendicular distance from to the closest survey line to the relevant isopleth.

Table 7.14. Maximum-over-depth distances (in km) to SEL_{24h}-based marine mammal criteria for three possible scenarios within the Pelican 3DMSS acquisition area

Group	Threshold for SEL _{24h} (dB re 1 µPa ² .s)	Scenario 1		Scenario 2		Scenario 3	
		R _{max} (km)	Area (km ²)	R _{max} (km)	Area (km ²)	R _{max} (km)	Area (km ²)
LFC	183	3.29	230.0	6.8	165.0	4.58	129.0
MFC	185	-	-	-	-	-	-
HFC	155	0.03	4.61	0.07	8.04	0.08	12.6

Cells highlighted in red indicate maximum predicted extent of sound.

The results from Table 7.12 predict that the maximum distance at which the NMFS (2013) marine mammal behavioural response criterion of 160 dB re 1 µPa could be exceeded is 8.13 km. The results from Table 7.14 predict that the maximum distance at which PTS onset may occur is 6.8 km.

Predicted impacts

Cetaceans may be exposed to sound levels that cause behavioural effects or TTS (within a few kilometres of the source). However, the known temporal and spatial characteristics of cetaceans that may occur in and around the proposed acquisition area make it unlikely that they will be impacted in this manner because:

- There is no defined nearshore migration corridor for southern right whales, and their presence in and around the proposed acquisition area is likely to be limited to the months outside of the survey period (generally between May and October).
- Southern right whales are unlikely to be present in or near the acquisition area at the time of the survey and that the closest known calving/nursery grounds to the proposed acquisition area occurs at Logan’s Beach off the southwest Victorian coast (approximately 430 km west of the proposed acquisition area), the effects of seismic sound on southern right whales are likely to be negligible.
- Pygmy blue whales are unlikely to be present in the area (they are known to occur mainly in southwest Victoria, with a low possibility of occurrence in or around the proposed acquisition area towards the tail end of the proposed survey period). The risk of significantly reducing foraging habitat as a consequence of sound generated by the seismic survey is considered to be negligible.
- Humpback whales may be encountered in the proposed acquisition area during their southern migration in November and December, but this likelihood is considered low due to their preference for migrating along the edge of the continental shelf (in water depths of about 200 m).
- In the absence of BIAs in and around the proposed acquisition area for cetacean breeding and calving, it is highly unlikely that cetaceans will mill around in this area (or remain stationary) for a 24-hour period, so the cumulative SELs noted in Table 7.12 are unlikely to be realised.
- Cetaceans have an observed ability to avoid vessels and acoustic sound sources.

- The MSS will not have a 'significant' impact on critically endangered or vulnerable cetacean species (see Section 5.4.5) when assessed against the EPBC Act Significant Impact Guidelines 1.1 (DoE, 2013).
- Soft start and start-up delay procedures (implemented by MMOs) will be implemented during the survey.

The impacts on cetaceans are likely to be insignificant at both a local and population level.

Impacts to Pinnipeds

Pinnipeds (seals and sea lions) produce sounds over a generally lower and more restricted bandwidth (generally from 100 Hz to several tens of kHz) than cetaceans. Their sounds are used primarily in critical social and reproductive interactions (Southall *et al.*, 2007). Most pinniped species have peak sensitivities between 1 and 20 kHz (NRC, 2003).

Pinnipeds are divided into two groups:

- Otariid pinnipeds – fur seals and sea lions ('eared' seals, using foreflippers for propulsion). This is the group of most relevance to this project (see Section 5.4.6).
- Phocid pinnipeds – true seals ('earless' species).

Research results

Pinnipeds may tolerate seismic pulses of high intensity and may be able to approach operating seismic vessels to a close range because their hearing is poor in low frequencies (McCauley, 1994). However, it is also suggested that MSS may affect pinniped prey abundance or behaviour, particularly if the survey runs for long periods.

Fur seals are less sensitive to low frequency sounds (<1 kHz) than to higher frequencies (>1 kHz). McCauley (1994) suggests that the sound frequency of seismic air gun pulses is below the greatest hearing sensitivity of Otariid pinnipeds, but data is lacking for Australian species. Aerial sounds produced by the Australian fur-seal (*Arctocephalus pusillus*) have strong tonal components at frequencies that are less than 1 kHz, although they all range up to 6 kHz with most energy between 2-4 kHz. If the low frequency components of calls are used, then seals may also hear at low frequency and may be affected by seismic source pulses. However, Shaughnessy (1999) states that seismic activity will only be a threat to pinnipeds if it takes place close to critical habitats.

Gotz *et al* (2009) reports that controlled exposure experiments with small airguns (215 – 224 dB re 1 μ Pa) were carried out over 1 hour to individual harbour seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*), and in seven out of eight trials with harbour seals, the animals exhibited strong avoidance reactions. Two harbour seals equipped with heart rate tags showed immediate, but short-term, startle responses to the initial airgun pulses. The behaviour of all harbour seals returns to normal soon after the end of each trial, even in areas where disturbance occurred on several consecutive days. Only one harbour seal showed no detectable response to the airguns and approached the airgun to within 300 m, and seals remaining in the water returned to pre-trial behaviours within two hours of the end of the experiment

(Gotz *et al.*, 2009). General avoidance behaviour of other northern hemisphere seal species was exhibited at exposure levels above 170 dB re 1 μ Pa.

Thresholds adopted for the STLM

The NOAA (2016) guidance suggests that seals are split into two groups based on functional hearing and PTS onset thresholds levels, as outlined in Table 7.15.

Table 7.15. The unweighted per-pulse SPL, SEL and SEL_{24h} and PK thresholds for acoustic effects on pinnipeds

Hearing group	DEWHA (2008)	NMFS (2013)	NMFS (2016)	
	Unweighted per-pulse SEL (dB re 1 μ Pa ² .s)	Behaviour	Injury (PTS)	
		SPL (dB re 1 μ Pa)	Weighted SEL _{24h} (dB re 1 μ Pa ² .s)	PK (dB re 1 μ Pa)
Phocid pinnipeds in water	Not applicable	160	185	218
Otariid pinnipeds in water			203	232

STLM results

Table 7.16 presents the STLM predicted ranges for the five modelling sites for the per-pulse effects criteria (seafloor peak levels) and isopleths of interest for pinnipeds.

Table 7.16. Maximum (R_{max}) horizontal distances from the source array to modelled seafloor PK levels from four transects for pinnipeds

Group	PK threshold (dB re 1 μ Pa)	Distance R _{max} (m)				
		Site 1	Site 2	Site 3	Site 4	Site 5
Phocid pinnipeds in water	218	65	35	55	50	50
Otariid pinnipeds in water	232	10	5	-	-	5

Dashed line indicates threshold is not reached.

Cells highlighted in red indicate maximum predicted extent of sound.

The SEL_{24h} exposure results are presented for three possible operational scenarios (as described earlier in this section). Table 7.17 shows the estimated ranges to the appropriate cumulative exposure criterion contour for pinnipeds. The radii in this table represent the perpendicular distance from the closest survey line to the relevant isopleth. These results indicate that otariid pinnipeds (the group present in the EMBA) are not impacted by cumulative sound.

Table 7.17. Maximum-over-depth distances (in km) to SEL_{24h} based pinniped injury criteria for three possible scenarios within the Pelican 3DMSS acquisition area

Group	Threshold for SEL _{24h} (dB re 1 µPa ² .s)	Scenario 1		Scenario 2		Scenario 3	
		R _{max} (km)	Area (km ²)	R _{max} (km)	Area (km ²)	R _{max} (km)	Area (km ²)
Phocid pinnipeds in water	185	0.07	4.16	0.08	12.6	0.11	15.9
Otariid pinnipeds in water	203	-	-	-	-	-	-

Dashed line indicates threshold is not reached.

Cells highlighted in red indicate maximum predicted extent of sound.

The STLM results indicate that the distance to sound levels associated with the onset of PTS (using the SEL_{24h} metric) is not reached for Otariid pinnipeds (see Table 7.17), and only reached within 10 m using the PK metric (see Table 7.16). As described in Section 5.4.6, the proposed acquisition area is located a significant distance from known critical locations (i.e., breeding sites) of the Australian fur-seal and New Zealand fur-seal.

Predicted impacts

The impacts on fur-seals are likely to be insignificant because:

- Pinnipeds are omnipresent throughout the South-east Marine Bioregion. There is no limiting habitat restricting these species to foraging only within the proposed acquisition area, with breeding taking place outside the proposed acquisition area.
- Temporary avoidance is likely to be the single largest effect on pinnipeds.
- The severity of the MSS on pinnipeds will be insignificant as the STLM indicate that the distance to sound levels associated with the onset of PTS (using the SEL_{24h} metric) is not reached for fur-seals.

Impacts to Avifauna

Seabirds

The proposed acquisition area contains potential foraging habitat for a diverse array of seabirds. In the event that individual birds or flocks are present in the acquisition area during operations, vessel movement is expected to temporarily deter them from foraging in the immediate vicinity of the vessel. The risk of underwater sound significantly impacting a population of any given species or even individuals (during plunge/dive feeding) is extremely low.

An indirect impact may occur if seismic source discharges cause changes to the abundance or behaviour of prey species (fish). However, the extent to which temporary 'descending' or 'tightening' responses of schooling prey fish such as pilchards (if it occurs) affects availability to avifaunal predators either positively or negatively, is not known.

Seabird species that may occur in the proposed acquisition area (see Section 5.4.8) all have considerable foraging habitat present throughout Bass Strait. The small size

of the proposed acquisition area is not significant relative to their normal foraging environment. Any temporary dispersal of prey species (i.e., fish) due to acquisition activities would not result in any significant decrease in availability of prey species that is of biological significance for these populations.

Threatened albatross and petrel species are generally absent from the region during the warmer months of southern Australia, meaning they are unlikely to be present (or at least not in high numbers) at the time of the survey.

Shorebirds

Shorebird species such as the Australian fairy tern and hooded plover are not expected to be affected by seismic survey activities, given their preference for species of prey occurring within the intertidal part of the coastline.

Other birds

Little penguins. Penguins communicate via calls (vocalisations) that allow partners to recognise each other and their chick. There is a lack of information on the auditory systems and communication of penguins, however the hearing range of most birds lies between 0.1 - 8 kHz (McCauley, 1994). It is therefore inferred that penguins have relatively poor hearing thresholds in the lower frequencies, which is where seismic surveys have the most energy (10-250 Hz) (McCauley, 1994). This is supported in part by observations made by dedicated on-board MMO personnel of little penguins approaching seismic vessels during survey acquisition in eastern Bass Strait during 2001 and 2002 (Doodie, pers. comm., 2003; Pinzone, pers. obs., 2003), while previous seismic surveys conducted in the Otway region observed a similar situation, suggesting that this species is not disturbed by the seismic sound source. It may be that the penguins are unaffected as they are in the seismic 'shadow' area, predominantly above the downward focus of the pulse.

Passive acoustic monitoring (PAM) commissioned by Origin and undertaken from April 2012 to January 2013, 5 km offshore from the coastline east of Warrnambool in southwest Victoria, identified that ambient underwater noise in coastal areas is generally higher than further offshore, with a mean of 110 dB re 1 μ Pa and maximum of 161 dB re 1 μ Pa (McCauley & Gavrilov, 2013).

During the 2014 Enterprise 3D transition zone seismic survey (2,500 cui source array), undertaken in Victorian coastal waters in depth ranges 20 to 65 m and located 1 km from the coast, breeding little penguin adults were equipped with GPS and depth recorders before and concomitantly with seismic survey activities in the vicinity of known colonies. The differences in behaviour characteristics of the little penguin, such as trip duration, maximum distance travelled during foraging, path length, dive frequency, dive time and average dive depth between survey and non-survey periods was not statistically significant, confirming little penguins do not appear to be disturbed by seismic sound sources (Pichegru *et al.*, 2016).

As with other predatory avifauna, penguins may be indirectly affected if air gun discharges alter the abundance or behaviour of prey. However, given this species routinely forages over distances of 15 – 50 km from their colonies and are highly mobile in the water, this is not expected to have any significant impact to the species. The nearest known breeding colony of penguins is located 139 km west of the proposed survey area at Wilsons Promontory. Given that little penguins forage within 5-25 km of the coast during the breeding season, and up to 75 km from the coast at

other times (SARDI, 2011), it is unlikely that high numbers of little penguins will be found in the proposed acquisition area.

Predicted impacts

As most seabirds spend very little time under the water surface, and when they do it is for several seconds at a time, impacts to seabirds are predicted to be nil to negligible. The proposed acquisition area does not contain spatially limiting food sources, with Bass Strait providing abundant foraging grounds.

Impacts to Marine invertebrates - Scallops

Research results – invertebrates in general

Invertebrates detect sound by sensing either the ‘particle motion’ (Przeslawski *et al.*, 2016a;b; Carroll *et al.*, 2017), through other external and internal physiological structures such as hairs, statocysts and muscles; or ‘pressure’ component (or both) of a sound field in the marine environment. Because they lack gas-filled bladders, marine invertebrates are unable to detect the pressure changes associated with sound waves (Carroll *et al.*, 2017; Parry & Gason, 2006).

However, all cephalopods as well as some bivalves, echinoderms and crustaceans have a sac-like structure called a statocyst, which includes a mineralised mass (statolith) and associated sensory hairs (Carroll *et al.*, 2017). The statocyst organs are utilised by animals to maintain their equilibrium and orientation and to direct their movements through the water. 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; Edmonds *et al.*, 2016; Roberts and Breithaupt, 2016).

There has recently been a number of comprehensive reviews of seismic noise impacts to invertebrates (de Soto, 2016), including Carroll *et al.* (2017) and Edmonds *et al.* (2016), and reviews that have focused generally on behavioural impacts (e.g., Tidau and Briffa, 2016).

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 (Popper *et al.*, 2014), crabs (Pearson *et al.*, 1994) or scallops (Carroll *et al.*, 2017).

Marine invertebrates generally have far lower mobility than pelagic vertebrates and are often localised to particular microhabitats. As such, they generally have less ability to avoid seismic sound by moving away from an area. The exception to this are cephalopods that are very mobile and have the ability to move away from areas where sound levels might have the capacity to cause physiological damage.

There is, however, no evidence of population level impacts on invertebrates from seismic noise. McCauley *et al.* (2000) extensively reviewed seismic surveys and their effects on marine life, reporting that the amount of exposure to air gun signals for the larvae of a given invertebrate species will depend upon its abundance, spatial distribution, depth distribution, seasonal timing and the persistence of seismic surveys in the region where it occurs. McCauley *et al.* (2000) concluded that a single seismic survey has a negligible impact on larval supply by comparisons with the size

of the larval populations involved. This has been supported by the conclusions of Day et al (2016a) and Przeslawski et al (2016b). Przeslawski et al (2016b) also note that various studies conducted in the 2000s detected no significant differences to marine invertebrates between sites exposed to seismic operations and those not exposed.

A summary of the potential impacts of low-frequency sound on various responses of marine invertebrates is presented in Figure 7.6 (from Carroll *et al.*, 2017).

Research results – molluscs (including scallops)

This section assesses impacts to molluscs, which belong to the Mollusca phylum. Molluscs are distinguished by three features, these being the presence of a mantle (a cavity used for breathing and excretion), a radula (a 'rasping' tongue, except for bivalves) and the structure of the nervous system. Molluscs include scallops, abalone, oysters, clams, mussels, limpets, squids, octopus and cuttlefish.

The potential impacts of seismic sound on molluscs has not, until very recently, been well studied.

The most recent Australian studies have focussed on the molluscs of key commercial fishing value, the Bass Strait commercial scallop (*Pecten fumatus*). This has included grey literature studies conducted by Parry et al (2002), Harrington et al (2010), Day et al (2016a;b) and Przeslawski et al (2016a), and the summary of Przeslawski et al (2016a) in Przeslawski et al (2016b). The Parry et al (2002) and Harrington et al (2010) studies had experimental design issues (Carroll *et al.*, 2017) which complicates the comparison of results, however they were opportunistic and still contribute useful information. Parry et al (2002) is not considered as relevant as the scallops were suspended in nets during exposure, and as such, were not subject to the ground-borne vibrations.

It is important to note that in shallow water environments that scallops inhabit, sound pressure measurements cannot be directly related to particle motion, and to accurately characterise particle motion in these habitats, it is necessary to make measurements using particle-motion sensors, in particular accelerometers (Nedelec *et al.*, 2016).

TAFI 2010 Bass Strait study

The Tasmanian Aquaculture and Fisheries Institute (TAFI) was commissioned by AFMA (as reported in Harrington *et al.*, 2010) to undertake a before-after-control-impact (BACI) *in situ* survey to determine if short-term impacts of a MSS on adult scallops in eastern Bass Strait (north of Flinders Island) could be detected. The 2D MSS was run for the Geological Survey of Victoria between February and April 2010, using a single airgun array with a volume of 4,130 cui and operating pressure of 2,000 psi. Part of the survey was conducted over a known commercial scallop bed. Scallop dredging was undertaken about 6 weeks prior to the MSS and 8 weeks after the conclusion of the MSS. Scallops were collected by means of dredging in order to assess the abundance of live and dead scallops within the impacted and control sites. Animals collected in the surveys were separated into one of four shell categories; live scallops, clappers (very new dead scallops with two shell halves still joined together), new dead shells and old dead shells. Sub-lethal impacts were investigated by examining changes in roe and meat condition within each of the areas sampled.

Results of this study were:

- Live scallops were the most abundant shell category identified in all sample locations during both the before and after surveys.
- There were no statistical differences in live scallop abundances in any of the stratum before and after seismic surveying, as would have been expected if MSS had a lethal effect on scallop survivorship.
- The length frequency distribution of all shell categories remained unchanged within the impacted and semi-impacted survey stratum after seismic surveying
- Greater than 90% of scallops caught from all survey strata during both surveys were classified as normal meats.

The study concluded that there was no evidence of a short-term (<2 months) impact on the survival or health of adult commercial scallops in this fishery, though it was reported there was a later die-off of these scallops. No further information is available about the extent or cause of this die-off.

GA-FRDC 2015 Bass Strait study

Rachel Przeslawski advised CarbonNet in March 2017 that it is important to note that the study reported by Przeslawski et al (2016b) supersedes Przeslawski et al (2016a) (*Potential short-term impacts of marine seismic surveys on scallops in the Gippsland Basin*), as Przeslawski et al (2016b) includes and expands upon the results presented in Przeslawski et al (2016a).

The GA-FRDC study detailed in Przeslawski et al (2016a;b) focused on potential short-term impacts of MSS on scallops in the Gippsland Basin. This study was carried out by Geoscience Australia in collaboration with the Australian Maritime College in response to concerns from the fishing industry about an April 2015 MSS in the Gippsland Basin. The study aimed to acquire baseline data that might be useful in quantifying the potential impacts of seismic operations on marine organisms and their habitats. From March to June 2015, the 2D MSS took place (2,530 cui source array, pressure of 2,000 psi), and in conjunction several field experiments were conducted to investigate the potential impacts of airgun operations on scallops and other marine invertebrates in the Gippsland Basin. The experimental components included:

- Sound monitoring with moored hydrophones – four stations;
- Sound modelling using both field-based and theoretical approaches;
- Seafloor image analysis from autonomous underwater vehicle (AUVs); and
- Analysis of scallops collected from dredging.

Each component incorporated control (> 10 km from seismic survey) and experimental (0–1 km from seismic survey) zones, and data was acquired both before and two months after the seismic survey where possible. Two methods were used to assess scallop condition in response to the MSS; dredging (using a commercial box dredge) and the use of AUV to quantify scallop condition *in situ*.

All live scallops were photographed to quantify size, and at least 10 ten animals (if available) from each dredge were opened and photographed to examine various metrics of scallop condition. Samples were frozen for analysis of fatty acids and

sterols to identify potential depletion of energy reserves due to excessive summing activity in response to the seismic source. The AUV imagery showed:

- There was no interaction between zones (experimental, control) and time (short-term, long-term) on commercial scallop types (live, clapper, dead shell, unknown), indicating that no long-term effects attributable to the MSS were detected on commercial scallops. It is noted though that short-term or moderate effects could not be tested due to the lack of AUV data before the MSS.
- There were negligible dead doughboy scallops (clappers and shells) detected in the experimental zone during short- or long-term survey, indicating an absence of adverse impacts of the MSS.
- The dredging results indicated that:
 - The abundance of live scallops and recently dead scallop shells were not significantly different among zone or time.
 - There was no effect of zone or time on commercial scallop shell assemblages, nor any interactions.
 - There was no detectable impact due to the MSS on commercial scallop shell size (growth), adductor muscle diameter, gonad size or gonad stage.
 - There was a significant effect of zone, with scallops in the control zone showing smaller shells, adductor muscles and gonads than in the experimental zone. This relationship existed before and after the survey.
 - Commercial scallops showed no differences in fatty acids, sterols or the ratio of fatty acids to sterols among zone or time.
- There is no clear evidence of adverse effects on scallops due to this survey, although in the study area assessed, commercial scallops (*P. fumatus*) were present but not abundant.
- There were no detectable impacts of the MSS on the abundance of live scallops, catch of live or dead scallops or gonad condition.

Table 7.18 (from Przeslawski *et al.*, 2016b) summarises the studies and results of the investigations into the impacts of MSS on scallops, while this section provides a more in-depth discussion of the findings from these recent studies.

However, due to the high variance amongst sites small or sub-lethal changes resulting from acoustic exposure may have been obscured, but it was argued that detection of large effects such as mass mortalities would have been detected. They recommended that future studies should focus efforts on the long-term or physiological effects of MSS on scallops and other invertebrates, rather than short-term gross effects such as mortality.

Table 7.18. Summary of studies investigating the effects of MSS on scallops

Study	Species	Type of Study	Sound Source	Duration of sound exposure	Responses measured	Key Findings	Study Strengths	Study Limitations
Przeslawski et al. 2016 (GA-FRDC study)	<i>Pecten fumatus</i> (Commercial scallop), <i>Mimachlamys asperima</i> (Doughboy scallop)	Field (observational)	Airgun array (2530 cubic inches, 16 airguns)	9-day seismic operations (shots every 18.75m)	Abundance (live, dead), gonad stage, meat condition, size, fatty acid and sterol profiles	No short- or long-term changes in measured responses due to sound exposure	Field conditions, <i>in situ</i> scallops monitored throughout experiment, sound pressure measured and modelled	Low sample sizes or missing data before seismic surveys
Day et al. 2016 (UTAS-FRDC study)	<i>Pecten fumatus</i>	Field (manipulative)	Single airgun (45 and 150 cubic inches) *	1, 2 and 4 airgun passes, each pass having between 51–167 shots every 11.6 seconds	Mortality, haemolymph biochemistry, haemocyte counts, righting reflect, reccessing rate, condition indices	Long-term mortality effects, short-term haemolymph effects, delay in righting reflex and increase in reccessing reflex after sound exposure	Sound pressure and motion accurately measured, field conditions during exposure, multiple metrics measured	Scallops handled and long-term effects measured suspended in captivity (lantern nets), mechanism of effects remains unknown
Aguilar de Soto 2015	<i>Pecten novaezelandiae</i> (New Zealand scallop) (larvae)	Lab	Recording of airgun array	Pulse every 3 seconds for 90 hours	Developmental stage, abnormality rate	Delayed development and higher abnormality rate in larvae exposed to seismic noise	Only study to examine scallop larvae	Acoustic conditions in small tanks make extrapolations to field conditions challenging, sound exposure durations are unrealistic
Harrington et al. 2010	<i>Pecten fumatus</i>	Field (observational)	Airgun array (4130 cubic inches)	2-week seismic operations (shots every 5 seconds)	Abundance (live, dead), size, gonad stage, meat condition	No short-term changes in measured responses due to sound exposure	Field conditions, <i>in situ</i> scallop exposure	Long-term effects not included, control 3.5 km from seismic operations
Parry et al. 2002	<i>Pecten fumatus</i>	Field (manipulative)	Airgun array (3642 cubic inch, 24 airguns)	4-day seismic operations (shots every 18.75m)	Mortality, adductor muscle strength	No immediate changes in measured responses due to sound exposure	Field conditions	Scallops not in contact with substrate, only immediate effects considered (17 days after seismic survey complete)

* The estimated cumulative sound exposure levels received by test animals in Day et al. (2016a) were considered similar to that of a large commercial seismic array passing at ~ 30 to 524 m for the 45 and 150 in³ sources. The magnitude from the ground borne motion from the 150 in³ air gun emulated that measured for a 3130 in³ array at around 100-200 m.

Source: Przeslawski et al (2016b).

UTAS-FRDC 2014 Tasmanian study

In the UTAS-FRDC field experimental (manipulative) study reported by Day et al (2016a), sample populations of scallops (20 individuals in each cohort) were exposed to the same seismic source parameters and similar exposure conditions during 2013, 2014 and 2015.

The research program involved exposure of cohorts of scallops to multiple seismic airgun pulses in sandy substrate in 10-12 m water depths off the coast of Tasmania. The exposed scallops and control lobsters (no exposure) were examined during subsequent analyses undertaken at 0, 14, and 120 days post-exposure. Exposure experiments were undertaken in July 2013 (45 cui airgun, 2,000 psi), July 2014 (150 cui airgun, 1,300 psi and 2,000 psi) and February 2015 (150 cui airgun, 2,000 psi). The airgun was towed at approximately 5 m depth from a distance of 1 km away from the scallop enclosure and at a speed of approximately 3-4 nm per hour (approximately 5.5-7.4 km/hr) and the shot interval was 11.6 seconds. The maximum calculated exposures were 212 dB re 1 μPa PK-PK, a per-pulse SEL of 190 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$, an accumulated SEL of 199 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ and maximum peak magnitude of ground acceleration of 68 ms^{-2} . However, this was likely an outlier.

Captive scallops were subject to multiple passes from the MSS source at close range; zero passes (control specimens), one, two and four passes. A summary of the results and conclusions for the commercial scallop is as follows:

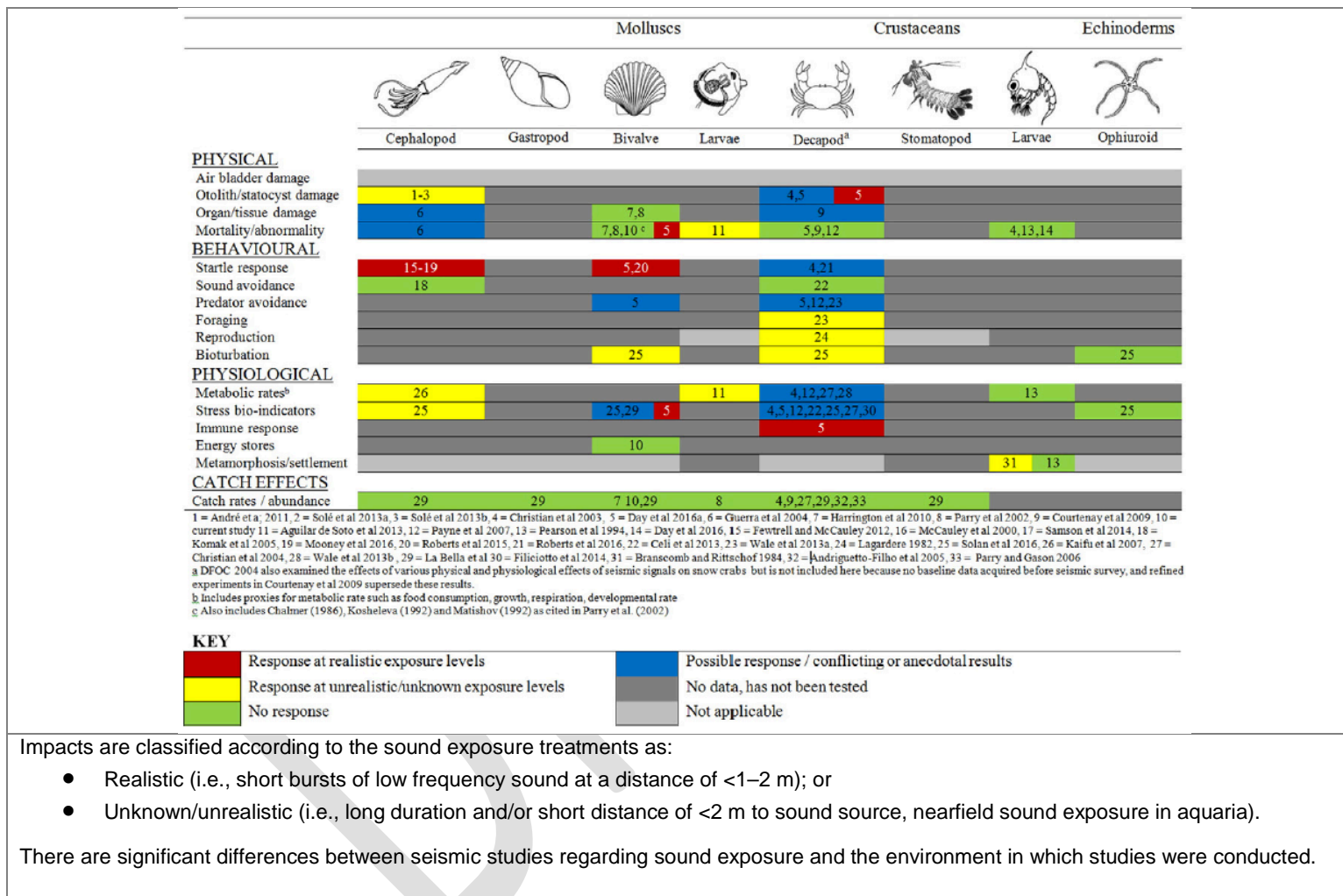
- Exposures did not result in immediate mass mortalities, and overall mortality rates in all three experiments were at the low end of the range of naturally occurring mortality rates in the wild (documented as ranging between 11-51%, with a 6-year mean of 38%). Gwyther and McShane (1988) recorded natural mortality rates in scallops in Port Phillip Bay of up to 40%.
- Repeated exposures resulted in increased mortality rates with time post-exposure when compared with control specimens.
- After 120 days, the following mortalities were recorded for the 0-pass, 1-pass, 2-pass and 4-pass treatments:
 - 2013 experiment - mortalities of 3.8%, 8.9%, 10.3% and 13.3% were recorded.
 - 2014 experiment - mortalities of 3.6%, 11.3%, 16% and 17.5% were recorded.
 - 2015 experiment - complete mortality of all control and exposed scallops occurred by day 120.
- Most mortalities were recorded 120 days following multiple passes of the seismic source, indicating that exposures may have a chronic effect on scallops.
- Haemolymph biochemistry was also impacted up to 120 days post-exposure.
- Scallop behaviour was altered by exposure to air gun signals, with a decrease in classic behaviours (positioning, mantle irrigation and swimming) and increase in novel behaviours. Exposure did not elicit energetically expensive behaviours such as swimming or extensive valve closure.
- Scallop reflexes were affected, with exposure resulting in faster recessing in sediments and some specimens in one experiment showing a possible reduced ability to right itself following exposure.
- Additional measurements were made measuring adductor muscle mass; shell length, width and height; and whole animal mass, wet tissue mass and

shell mass. None of these measurements showed any statistical difference between control and exposure level.

The results indicate that exposure to impulses from an airgun source associated with a MSS may result in the mortality of some scallops as well as some impaired reflexes and immunity response if the seismic source passes in close proximity or directly overhead. Day et al (2016a) also indicated that exposure, particularly repeated exposure, did result in significantly increased mortality compared to unexposed controls.

The authors of Day et al (2016a) rejected the hypothesis that 'exposure to seismic airguns causes immediate mass mortality, defined as an increase in mortality rate of sufficient proportion to affect population size significantly'.

The experimental mortality rates at 120 days' post-seismic airgun exposure were between 9.4% and 20%. These are towards the low end of what might be expected from natural mortality rates. Even the highest levels of mortality recorded, 17.5% and 20% suffered by 4-pass treatments from the 2014 and 2015 experiments, were assessed by the authors to be modest compared to naturally occurring mortality rates in scallops.



Source: Carroll et al (2017).

Figure 7.6. A summary of the potential impacts of low-frequency sound on various responses of marine invertebrates

Thresholds for STLM

The Day et al (2016a) study is one of the first to report persistent physiological effects (for scallops and lobsters) and increased mortality (for scallops) from exposure to an airgun. However, the science around which metrics relate to a potential effect, and the relationship therefore to impact, is an area needing further research.

NOPSEMA has publicly stated that the seafloor levels derived from Day et al (2016a) should be used to assist in the assessment of potential impacts on scallops (and lobster) in the absence of definitive established thresholds.

It is not clear from the Day et al (2016a) experiment whether the effects observed resulted from the particle motion to which the animals were exposed, or whether it was exposure to sound pressure that resulted in the effects. This complicates the analysis in terms of presenting a metric for application in an impact assessment.

Additionally, cumulative metrics like the SEL used in many studies must be treated with caution, particularly when considering more than one pulse. During a real seismic survey there may be short periods of high sound exposure interspersed with longer periods of much reduced exposure. Attempts to estimate an average exposure level may result in false conclusions about the effects of sound exposure. Recent studies have provided quantitative data to define the levels of impulsive sound that result in the onset of physical injury to fish (e.g., (Halvorsen *et al.*, 2011, 2012; Casper *et al.*, 2013). From these studies, the investigators were able to reject the hypothesis (referred to as the “equal energy hypothesis”) that the same type and severity of injury would occur for the same total cumulative energy level of exposure (SEL) regardless of how that was reached (e.g., through many low-energy impulsive sounds or fewer high-energy impulsive sounds). The way the energy is delivered, in terms of both the duty cycle (the proportion of time during which sound is present) and the energy within the individual pulses of sound, will influence the effects of sound exposure, whether these effects are in terms of injury or behavioural responses.

It has been determined for this EP based upon discussions with JASCO that the key sound parameter for the assessment of potential impacts on scallops is likely to be associated with particle motion exposure combined with a cumulative property (e.g., proportional to the total energy received, time above a threshold, or number and duty cycle of exposures), but such a metric does not yet exist to their knowledge, and it has not been examined experimentally.

The measurements made by Day et al (2016a) using bottom-mounted accelerometers were presented in units of maximum absolute magnitude of acceleration per airgun shot, in linear (ms^{-2}) or dB values ($\text{dB re } 1\text{ms}^{-2}$). As particle motion is a vector quantity, different metrics were explored but the simplest was chosen - the maximum magnitude of the three component acceleration vector - termed the ground roll acceleration by the authors.

Day et al (2016a) included a section which attempted to relate their measured exposures with those incurred by the operation of a hypothetical commercial array in a 3D survey of 5 sail lines with 400 m line spacing and 25 m shot intervals. The relationship for the maximum magnitude of ground roll with range was derived from a 3,130 cui source operating in 40 m of water, and this transmission loss function was

used to predict maximum magnitude of ground roll. However, the derivation or use of the transmission loss function used by Day et al was not clear, making it difficult to evaluate, thereby limiting confidence in its use or application.

A regression of particle acceleration vs. range for the single 150 cui airgun used in Day et al (2016) (minimum range of 6 m) showed that acceleration at 10 and 100 m range were typically 26 and 5 ms⁻², respectively. CarbonNet will present particle acceleration results at 10m, 100m and 500m ranges to inform the predicted impacts.

CarbonNet has also assessed the pressure metrics in the STLM reporting for completeness (and comparison to Day *et al.*, 2016a):

- Per-pulse SEL: 186–190 dB re 1 μPa².s
- Accumulated SEL: 192–199 dB re 1 μPa².s
- Peak-peak pressure: 209–212 dB re 1 μPa.

Additionally, in acknowledgement of the uncertainties in the evolving science and adopting a precautionary approach, CarbonNet has also considered the established sound pressure metric of PK-PK 202 dB re 1 μPa from Payne et al (2007) as it is shown to have no effect on delayed mortality or damage to mechano-sensory systems associated with animal equilibrium and posture.

STLM results

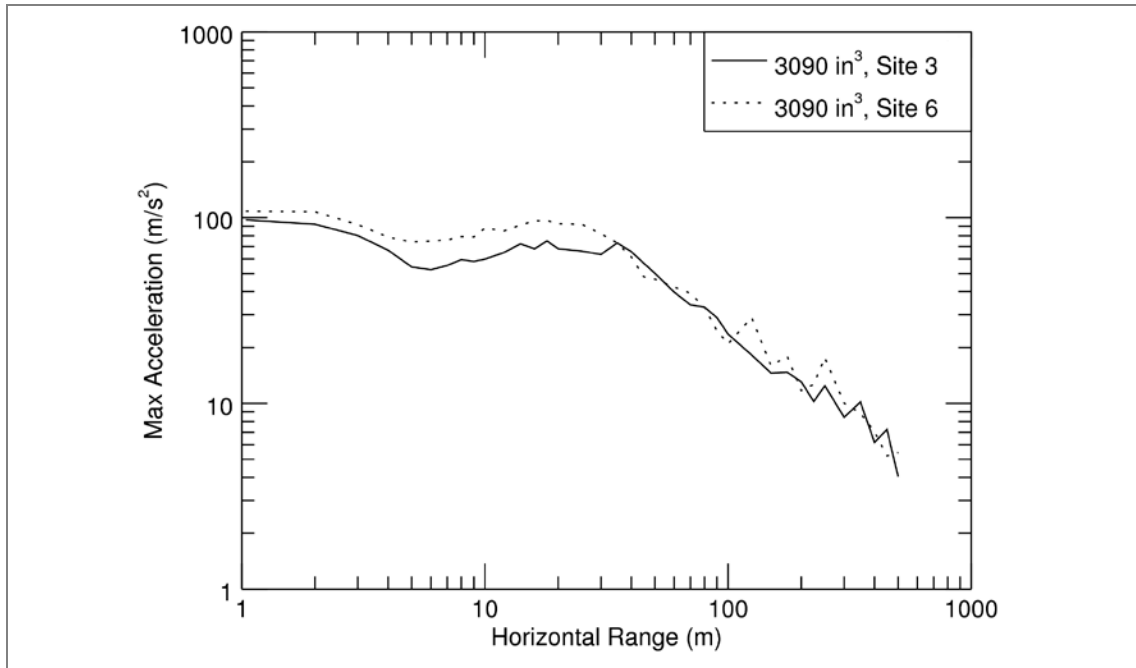
The following tables provide information on the predicted particle motion levels and sound relevant to potential effects on scallops from the proposed Pelican 3DMSS at two representative sites (Site 3 and Site 6).

Particle motion estimates were computed in the time-domain from synthetic waveform calculations. As VSTACK does not compute particle motion directly, particle acceleration and velocity were derived mathematically from the numerical gradient of the acoustic pressure.

Figure 7.7 and Figure 7.8 show maximum particle acceleration and velocity, respectively, as a function of horizontal range from the centre of the airgun arrays. The assessment has focused on particle acceleration, as this is the metric that was presented in Day et al (2016a).

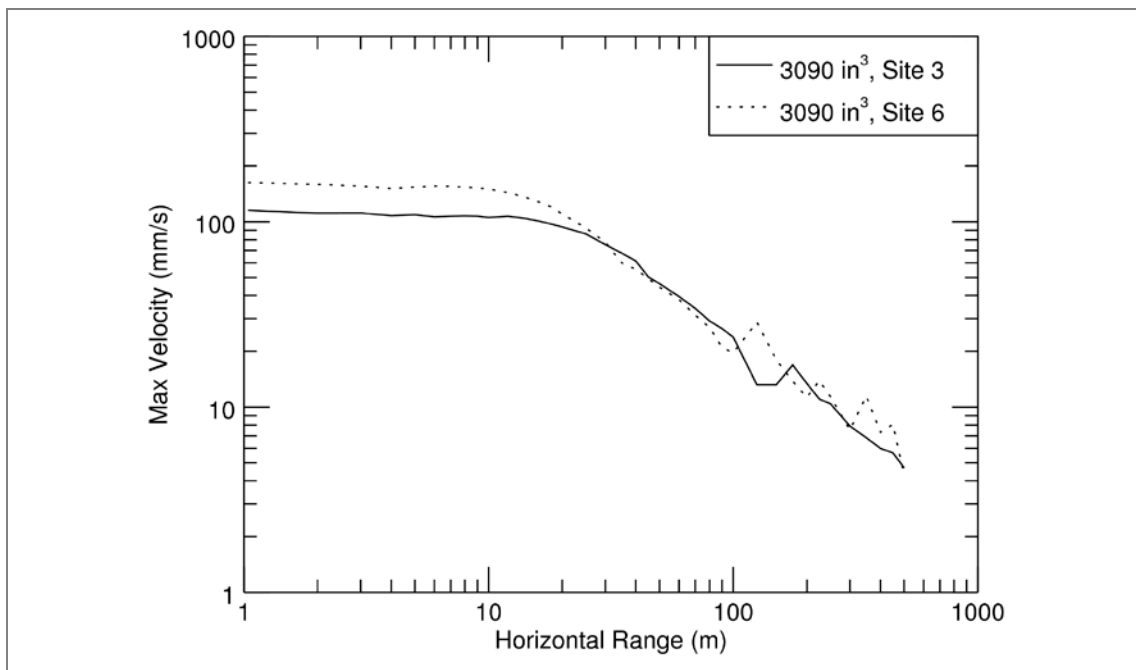
At close range, the maximum particle acceleration was larger at Site 6 (18.7 m water depth) than at Site 3 (26.2 m water depth). This difference is due to the shallower water at Site 6, as the distance between the array and the seafloor is less than in deeper waters. The maximum particle acceleration for both sites is greater than 73 ms⁻² out to a distance of 35 m from the centre of the array, and from a distance of 40 to 100 m has a median decay rate of approximately 5.8 ms⁻² every 10 m.

Table 7.19 presents the results for the maximum particle acceleration and velocity ranges, and of note are higher than the values reported in Day et al notwithstanding the limitations in interpreting and applying this experimental data. However, Day et al (2016a) also reference an unpublished maximum particle acceleration measurement of 6.2 m/s² from a 3,130 cui airgun array at 477 m range in 36 m of water, which is comparable to the acceleration predicted in this study.



Source: McPherson et al (2017).

Figure 7.7. Maximum particle acceleration at the seafloor as a function of horizontal range from the centre of the airgun arrays in the broadside direction



Source: McPherson et al (2017).

Figure 7.8. Maximum particle velocity at the seafloor as a function of horizontal range from the centre of the airgun arrays in the broadside direction

Table 7.19. Maximum particle acceleration and velocity at range

Range (m)	Maximum distance (m/s ²)	Maximum velocity (mm/s ⁻¹)
10	87.9	150.2
100	23.6	23.8
500	5.4	4.7

Per-pulse results for the proposed survey are presented for the five underwater sound modelling representative sites, with Table 7.20 showing the estimated ranges for the various applicable per-pulse SEL isopleths of interest (using the R_{max} for the sake of conservativeness, the largest distances are highlighted in red).

Table 7.20. Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances (km) from the source array to modelled seafloor per-pulse SEL isopleths

Per-pulse SEL (dB re 1 μ Pa ² .s)	Site 1		Site 2		Site 3		Site 4		Site 5	
	R_{max} (m)	$R_{95\%}$ (m)	R_{max} (m)	$R_{95\%}$ (m)	R_{max} (m)	$R_{95\%}$ (m)	R_{max} (m)	$R_{95\%}$ (m)	R_{max} (m)	$R_{95\%}$ (m)
190	150	120	100	90	110	90	120	100	140	130
189	160	130	110	90	110	100	120	110	150	140
188	170	140	160	130	120	110	130	110	220	150
187	180	160	170	150	140	110	140	120	240	200
186	190	170	180	150	150	120	150	120	260	220

Cells highlighted in red indicate maximum predicted extent of sound.

Table 7.21 shows the estimated maximum horizontal distances from the source array to modelled seabed PK-PK levels from four transects at the five modelling sites.

Table 7.21. Maximum (R_{max}) horizontal distances from the source array to modelled seabed PK-PK levels from four transects

Peak-peak pressure level threshold (dB re 1 μ Pa)	Distance R_{max} (m)				
	Site 1	Site 2	Site 3	Site 4	Site 5
213	260	190	220	240	210
212	310	240	230	260	220
211	380	240	230	270	230
210	400	270	280	270	240
209	400	340	340	280	240
202*	1,220	1,020	910	830	540

* Ranges extrapolated using $n \log(r) + A$. The 202 dB re 1 μ Pa threshold represents the observation by Payne et al (2007) of no effects.

Cells highlighted in red indicate maximum predicted extent of sound.

Table 7.22 provides the 24-hour cumulative exposure results for the proposed survey for the three cumulative exposure scenarios, showing the estimated ranges to the seabed isopleths. The distances represent the perpendicular distance from to the closest survey line to the relevant isopleth.

Table 7.22. Horizontal distances (in km) to seabed SEL_{24hr} isopleths for three possible scenarios within the Pelican 3DMSS acquisition area

SEL _{24h} isopleth (dB re 1 $\mu\text{Pa}^2\cdot\text{s}$)	Scenario 1		Scenario 2		Scenario 3	
	R _{max} (km)	Area (km ²)	R _{max} (km)	Area (km ²)	R _{max} (km)	Area (km ²)
199	0.91	117	1.73	59.8	1.16	58.4
198	0.92	133	2.05	67.1	1.39	64.6
197	0.98	148	2.39	74.9	1.94	71.2
196	1.16	158	2.74	83.3	2.26	78.5
195	1.4	168	3.13	92.4	2.6	86.3
194	1.68	179	3.53	103	2.97	94.7
193	1.96	190	3.93	114	3.31	104
192	2.17	202	4.33	126	3.65	113

Cells highlighted in red indicate maximum predicted extent of sound for each scenario.

In summary, the maximum distances and areas associated with the various sound metrics for crustaceans and bivalves are presented in Tables 7.23 to Table 7.25.

Table 7.23. Maximum seafloor per-pulse SEL at range

Per-pulse SEL at seafloor (dB re 1 $\mu\text{Pa}^2\cdot\text{s}$)	Maximum distance (m)
190	150
189	160
188	220
187	240
186	260

Table 7.24. Maximum seafloor PK-PK at range

PK-PK pressure level threshold (dB re 1 μPa)	Maximum distance (m)
213	260
212	310
211	380
210	400
209	400
202*	1,220

* Ranges extrapolated using $n \log(r) + A$

Table 7.25. Maximum SEL_{24h} at range and ensoufied area

SEL _{24h} isopleth (dB re 1 $\mu\text{Pa}^2\cdot\text{s}$)	Maximum distance and area	
	R _{max} (km)	Area (km ²)
199	1.73	117
198	2.05	133
197	2.39	148
196	2.74	158
195	3.13	168
194	3.53	179
193	3.93	190
192	4.33	202

Predicted impacts

The discussion in the sections above outline that the science around which metrics relate to a potential effect on scallops, and the relationship therefore to impact, is an area in need of further research.

Impacts have been determined though consideration of these results, the observations from Day et al (2016a), Przeslawski et al (2016a;b), Harrington et al (2010) and Payne (2007), the habitat present within and close to the proposed acquisition area, and the potential presence of scallops.

Increased stress and risk of mortality (up to 100 m)

Scallops, if present within 100 m of the array, will be exposed to sound levels greater than those studied in Day et al (2016a), which could potentially lead to increased stress, and therefore a higher risk of longer term mortality, but not mass mortality (Przeslawski *et al.*, 2016a).

Impaired reflexes, immunity response and potential increased mortality (260 m)

Considering the highest exposure levels in Day et al (2016a), 213 dB re 1 μPa (PK-PK) and 26 or 37.57 ms^{-2} , these align with a distance of 260 m (PK-PK, 213 dB re 1 μPa) and approximately 100 or 70 m (particle acceleration) from the STLM for the Pelican 3DMSS.

Therefore, within the proposed acquisition area, and at approximately these radii from each seismic impulse location, scallops will be exposed to PK-PK pressure and particle acceleration levels equivalent to those measured by Day et al (2016a), levels potentially associated with the higher levels of effect.

For simplicity, this has been approximated to the range of the PK-PK metric, 260 m. Therefore, scallops within this distance (260 m) from each seismic impulse location, if present, may experience some impaired reflexes and immunity response. Exposure, particularly repeated exposure, may result in increased mortality rates compared to scallops not exposed to the seismic sound.

Behavioural effects (400 m)

Applying the results from Day et al (2016a), effects could be expected if scallops were closer to the array. As behavioural effects were observed by Day et al (2016a) at 209 dB re 1 μ Pa (PK-PK), these behavioural effects on scallops, if present, are predicted to occur at a distance of 400 m from each seismic impulse location for the proposed Pelican 3DMSS (which corresponds to a maximum particle acceleration predicted of 7 ms⁻²).

No Effects (beyond 1,220 m)

Applying the observation by Payne et al (2007) of no effects at 202 dB re 1 μ Pa (PK-PK), no effects on scallops, if present, are expected beyond a distance of 1.2 km from each seismic impulse location for the proposed Pelican 3DMSS.

For the scallops dredged by a fisher to the immediate northeast of the proposed survey area in July 2017 (see Section 5.6.3), which is closest to and at a similar depth to STLM site 4, the distance to the no effects 'threshold' of 202 dB re 1 μ Pa (PK-PK) is 830 m (see Table 7.21). As the scallops recovered during the experimental dredge to the northeast of the survey area are located 840 m from the proposed acquisition area, these scallops are not likely to be affected by the survey.

CarbonNet has assessed the potential impact on local populations of scallops as 'minor.'

Impacts to Marine Invertebrates – Southern Rock Lobsters

Research results – invertebrates in general

As per 'scallops.'

Research results

This section assesses impacts to crustaceans, which belong to the Arthropoda phylum. Crustaceans include rock lobsters, prawns, crabs, and barnacles.

Specific studies examining the effect of seismic survey signals on crustaceans, including larval stages, are relatively rare, though recent Australian studies (e.g., Day et al., 2016a; Przeslawski et al., 2016a;b and reviews by Carroll et al., 2017), have aimed to narrow the knowledge gap.

The following studies conducted outside Australia, but considered in the recent review papers, are highly relevant in establishing possible impacts to crustaceans present in the proposed acquisition area:

- Wale et al (2013) undertook controlled tank-based experiments and showed that noise from lower level sources, such as ships, altered behaviour in the shallow water European shore crab (*Cancer maenus*) by disrupting feeding, slowing reaction time to threats, and hastening turn-over times for crabs placed on their backs.
- Payne et al (2007) conducted a pilot study of the effects of exposure to seismic sound on various health endpoints of the American lobster (*Homarus americanus*). Adult lobsters were exposed either 20 to 200 times to 202 dB re 1 μ Pap-p or 50 times to 227 dB re 1 μ Pap-p, and then monitored for changes to survival, food consumption, turnover rate, serum protein level, serum enzyme levels, and serum calcium level. It is noted that lobsters exposed to

seismic pulses were located at very close range to the source (~2 m). The SEL that the lobster were exposed to was not described in the report but can be estimated to be up to 207 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$. Observations were made over a period of a few days to several months.

- Results indicated no effects on delayed mortality or damage to the mechanosensory systems associated with animal equilibrium and posture (as assessed by turnover rate).
 - There was a decrease in the levels of serum protein, particular serum enzymes and serum calcium in the haemolymph of animals exposed to seismic sound. Statistically significant differences were noted in serum protein at 12 days post-exposure, serum enzymes at 5 days post-exposure, and serum calcium at 12 days post-exposure. Serum enzymes are valuable in detecting major organ damage whereby enzymes leak into the blood upon cellular rupture. Within this study two enzymes, Aspartate transaminase (AST) and Creatine kinase (CK), were not elevated in seismic-exposed animals reflecting the absence of major cellular rupture or necrosis being affected by seismic including high exposure conditions. Similar results were obtained in studies with snow crabs (Christian *et al.*, 2003). However, there was evidence of decreased serum enzymes in some trials, indicating the possibility of hemodilution or uptake of excess water by the animals. A similar decrease in serum protein and calcium was noted in some trials indicating a potential for disturbance to osmoregulation (i.e., the process by which the body regulates the osmotic pressure of any organisms' fluids in order to keep the homeostasis of the organisms' water level constant). Altogether, the results suggest a potential for osmo-regulatory disturbance in lobsters exposed to seismic.
 - During the histological analysis conducted 4 months post-exposure, no structural differences in hepatopancreatic tissues were noted, which would denote cell or tissue rupture, necrosis or inflammation. There was also no evidence of tissue necrosis or inflammation in the ovaries. However, histology identified elevated deposits of carbohydrates, thought to be glycogen, in the hepatopancreas of seismic-exposed animals. Such abnormal accumulations are believed to be due to disturbance in cellular processes connected with synthesis and secretion, however, the report concludes that further research is required to assess whether this particular observation is due to organ stress. These studies are noted as being exploratory in nature, with the authors cautioning against over-interpretation.
- 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_{0-p}) and SELs (<130–187 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$) 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.
 - There was a significant difference in the development rate noted between the exposed and unexposed fertilised eggs/embryos in this study with the egg mass exposed to seismic energy demonstrating a higher proportion of less-developed eggs than the unexposed mass. However, this experiment was performed on eggs stripped from a single berried female and cultured in a laboratory for six weeks prior

- to exposure and eighteen weeks following exposure. Subsequent work on larvae that had been exposed to seismic array signals as embryos but were allowed to hatch normally without being stripped from berried females did not suffer any negative effects (Payne *et al.*, 2008).
- Stress indicators in the haemolymph of adult male snow crabs were monitored immediately after exposure of the animals to seismic survey sound (Christian *et al.*, 2003; 2004) and at various intervals after exposure. No significant acute or chronic differences between exposed and unexposed animals in terms of the stress indicators (e.g., proteins, enzymes, cell type count) were observed.
 - Christian *et al.* (2003) also investigated the behavioural effects of exposure to seismic survey sound on snow crabs. Caged animals on the ocean bottom at a depth of 50 m were monitored with a remote video camera during exposure to seismic sound and did not exhibit any overt startle response during the exposure period. Eight animals were equipped with ultrasonic tags, released, and monitored for multiple days prior to exposure and after exposure. None of the tagged animals left the immediate area after exposure to the seismic survey sound. Five animals were captured in the snow crab commercial fishery the following year, one at the release location, one 35 km from the release location, and three at intermediate distances from the release location.
 - In 2003, a collaborative study was conducted in the southern Gulf of St. Lawrence, Canada, to investigate the effects of exposure to sound from a commercial seismic survey on egg-bearing female snow crabs (DFO, 2004). Caged animals were placed on the ocean bottom at a location within the survey area and at a location outside of the survey area. The maximum received SPL was ~195 dB re 1 μPa_{0-p} . The crabs were exposed for 132 hours of the survey, equivalent to thousands of seismic shots of varying received SPLs. The animals were retrieved and transferred to laboratories for analyses. Neither acute nor chronic lethal or sub-lethal injury to the female crabs or crab embryos was indicated. DFO (2004) reported that some exposed individuals had short-term soiling of gills, antennules and statocysts, bruising of the hepatopancreas and ovary, and detached outer membranes of oocytes. However, they were found to be completely cleaned of sediment when sampled five months later and any differences could not be conclusively linked to exposure to seismic survey sound.
 - In a field study, Pearson *et al.* (1994) exposed Stage II larvae of the dungeness crab to single discharges from a seven-airgun array and compared their mortality and development rates with those of unexposed larvae. For immediate and long-term survival and time to molt, this study did not reveal any statistically significant differences between the exposed and unexposed larvae, even those exposed within 1 m of the seismic source.
 - Morris *et al.* (2017) undertook a study into the effects of 2D MSS on the snow crab fishery. Snow crab harvesters in Atlantic Canada contend that seismic noise from widespread hydrocarbon exploration has strong negative effects on catch rates. This study repeated a Before-After-Control-Impact (BACI) study over two years to assess the effects of industry scale seismic exposure on catch rates of snow crab along the continental slope of the Grand Banks (North Atlantic Ocean) of Newfoundland, Canada. The results did not support the contention that MSS 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.

In order to further understand interactions between seismic operations and marine invertebrates, the CarbonNet Project contributed funding (along with the Commonwealth Government's Fisheries Research Development Corporation [FRDC] and Origin Energy Ltd) to a research program assessing the impact of marine seismic surveys on the commercial scallop (*Pecten fumatus*) and southern rock lobster (*Jasus edwardsii*). This program study was undertaken by researchers from the Institute for Marine and Antarctic Studies (IMAS) at the University of Tasmania, with the report (Day *et al.*, 2016a) released in October 2016. Information from this report as it relates to southern rock lobsters is provided herein.

The research program involved exposure of cohorts of southern rock lobster to multiple seismic airgun pulses at two sites (sandy substrate and limestone rock platform), both in 10-12 m water depths off the coast of Tasmania. The exposed lobsters were captive and control lobsters (no exposure) were also examined during subsequent analyses undertaken at 0, 14, and 120 days post-exposure. Exposure experiments were undertaken in July 2013 (45 cui airgun, 2,000 psi), July 2014 (150 cui airgun, 1,300 psi and 2,000 psi) and February 2015 (150 cui airgun, 2,000 psi). The airgun was towed at approximately 5 m depth from a distance of 1 km away and at a speed of approximately 3-4 nm per hour (approximately 5.5-7.4 km/hr) and the shot interval was 11.6 seconds. The seismic source circled in close proximity to the lobster pots. The maximum calculated exposures were 212 dB re 1 $\mu\text{PaPK-PK}$, a per-pulse SEL of 190 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$, an accumulated SEL of 199 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ and maximum peak magnitude of ground acceleration of 68 ms^{-2} . However, this was likely an outlier.

While a regression of particle acceleration versus range for the single 150 cui airgun used in the study (minimum range of 6 m) showed that acceleration at 10 and 100 m range were typically 26 and 5 ms^{-2} respectively, Day *et al* (2016a) describes findings related to seismic exposure of egg-bearing female spiny lobsters and subsequent larval development, which concludes:

- Exposure to seismic sound did not result in any mortalities of adult lobsters, even at close proximity.
- There was no difference in fecundity between control and exposed lobsters.
- A small but significant difference in the length of the larvae was observed in the exposed lobsters. No difference was found in width or dry mass of the larvae and no hatches were found to suffer from high mortality rates or deformities.
- No energy difference was identified between larvae from control and exposed lobsters.
- Larval activity/survival between control and exposed lobster groups was not significant. 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.
- The ability of exposed lobsters, and one cohort of control lobsters, to right themselves, a complex reflex, was compromised in the long term (120 days post-exposure) in three of the four experiments. This response was linked to damage to sensory hairs of the statocyst, the primary mechano-sensory and balance organ in lobsters.

- Tail extension, a simple behavioural reflex response, showed reduction in exposed lobsters in one of the four experiments. However, it is unclear how significant this finding is, as the warm summer water conditions during this particular experiment may be a contributing factor.
- Haemolymph (blood) biochemistry showed little effects on metabolic and respiratory stress, or vitality following exposure.
- Haemocyte count (indicative of immune response function) in exposed lobsters showed a long-term decline to 120 days post-exposure. However, haemocyte counts subsequently recovered to double the number of haemocytes in control lobsters at 365 days post-exposure, which may indicate a possible immune response to pathogens.
- Seismic exposure did not cause any immediate mass mortality. The authors rejected the hypothesis that 'exposure to seismic airguns causes immediate mass mortality, defined as an increase in mortality rate of sufficient proportion to affect population size significantly'. Not considering when both the control and exposed groups suffered mass mortality, the experimental mortality rates at 120 days' post-seismic airgun exposure were between 9.4% and 20%. These fall towards the low end of what might be expected from natural mortality rates. Even the highest levels of mortality recorded, 17.5% and 20% suffered by 4-pass treatments from the 2014 and 2015 experiments, were assessed by the authors to be modest compared to naturally occurring mortality rates.

Overall, no direct lethal effects to adult lobsters or impacts to embryos were observed and impacts were limited to statocyst condition, behavioural reflexes and immune response functions in adult lobsters. Day et al (2016a) note that these effects could have some affect on longer-term survivability.

However, Day et al (2016a) also report that lobsters used for the 2014 experiments, which were collected from the Crayfish Point Reserve in the Derwent Estuary near Tarooma, were found to have pre-existing damage to statocysts, likely resulting from prolonged exposure to shipping traffic noise in shallow water at this location. The lobster population at Crayfish Point Reserve has been subject to long-term monitoring. The population is thought to be at carrying capacity (Kordjazi *et al.*, 2015) and survival rates within this reserve have been estimated through capture and release studies at around 95% (Green and Gardner, 2009).

The abundance of southern rock lobsters within the Crayfish Point Reserve can reasonably be ascribed to the exclusion of the lobster fishery since 1971. Lobster populations within marine protected areas have consistently been found to demonstrate higher biomass and higher abundance of larger size classes than lobster populations subject to fishing pressure (Barret *et al.*, 2009a;b; Young *et al.*, 2016). Barret et al (2009) suggested that exploitation had reduced southern rock lobster biomass in the fishery adjacent to the Maria Island marine protected area, east coast Tasmania, to <10% of natural values, with consequent severe ecological effects on rocky reef ecosystems (Ling *et al.*, 2009, Ling & Johnson, 2012).

Thus, whilst the ecological effects of damaged statocysts in the southern rock lobster has not been the subject of dedicated experimental studies, long-term monitoring of the lobster population with damaged statocysts at Cray Point Reserve indicates that any population-level survivability effects are not significant and, importantly, ecological effects are likely to be negligible relative to the effect of fishing mortality.

On the basis of these studies, the following broad conclusions can be drawn about impacts to southern rock lobster exposed to seismic surveys in water depths similar to that of the proposed Pelican 3DMSS:

- Mortality of adult lobsters at a rate greater than natural mortality is unlikely;
- Increased mortality, delayed development or abnormal development to the egg mass carried by any 'berried' females, if present, or larvae produced from those eggs, is highly unlikely;
- Changes to haemolymph biochemistry, an indicator of acute or chronic metabolic stress, in adult lobsters in close proximity to the acoustic source are unlikely;
- Damage to statocysts in adult lobsters in close proximity to the acoustic source is likely, and it is not known whether a significantly damaged statocyst or impaired reflexes might disadvantage the growth or survival of lobsters in the wild;
- Statocyst damage is known to exist in wild southern rock lobster populations that have very high survival rates and are near carrying capacity;
- Changes to haemocyte count, an indicator of immune response function, in adult lobsters in close proximity to the acoustic source is likely; and
- Increased probability of mortality, delayed development or abnormal development of crustacean larvae in the water column is only possible at very close range.

STLM Thresholds

As per 'scallops.'

STLM Results

As per 'scallops.'

Predicted impacts

The discussion in the sections above outline that the science around which metrics relate to a potential effect on rock lobsters, and the relationship therefore to impact, is an area in need of further research.

Impacts have been determined through consideration of these results, the observations from Day et al (2016a), Przeslawski et al (2016a;b), Harrington et al (2010) and Payne (2007), the habitat present within and close to the proposed acquisition area, and the potential presence of southern rock lobsters.

Increased stress and risk of mortality (up to 100 m)

Rock lobsters, if present within 100 m of the array, will be exposed to sound levels greater than those studied in Day et al (2016a), which could potentially lead to increased stress, and therefore a higher risk of longer term mortality, but not mass mortality (Przeslawski *et al.*, 2016a).

Impaired reflexes, immunity response and potential increased mortality (260 m)

Considering the highest exposure levels in Day et al (2016a), 213 dB re 1 μ Pa (PK-PK) and 26 or 37.57 ms^{-2} , these align with a distance of 260 m (PK-PK, 213 dB re 1 μ Pa) and approximately 100 or 70 m (particle acceleration) from the STLM for the Pelican 3DMSS.

Therefore, within the proposed acquisition area, and at approximately these radii from each seismic impulse location, rock lobsters will be exposed to PK-PK pressure and particle acceleration levels equivalent to those measured by Day et al (2016a), levels potentially associated with the higher levels of effect.

For simplicity, this has been approximated to the range of the PK-PK metric, 260 m. Therefore, rock lobsters within this distance (260 m) from each seismic impulse location, if present, may experience:

- Damage to statocysts in adult lobsters and changes in reflexes;
- Changes to haemocyte count, an indicator of immune response function;
- Increased probability of mortality; and
- Delayed development or abnormal development of crustacean larvae.

Behavioural effects (400 m)

Applying the results from Day et al (2016a), effects could be expected if lobsters were closer to the array. As behavioural effects were observed by Day et al (2016a) at 209 dB re 1 μ Pa (PK-PK), these behavioural effects on rock lobsters, if present, are predicted to occur at a distance of 400 m from each seismic impulse location for the proposed Pelican 3DMSS (which corresponds to a maximum particle acceleration predicted of 7 ms^{-2}).

No effects (beyond 1,220 m)

Applying the observation by Payne et al (2007) of no effects at 202 dB re 1 μ Pa (PK-PK), no effects on rock lobsters, if present, are expected beyond a distance of 1.2 km from each seismic impulse location for the proposed Pelican 3DMSS.

CarbonNet has assessed the potential impact on local populations of rock lobsters as 'minor.'

Impacts to Turtles

Research results

There is limited information on sea turtle hearing. Morphological studies of green and loggerhead turtles (Ridgway *et al.*, 1969; Wever, 1978; Lenhardt *et al.*, 1985) found that the sea turtle ear is similar to other reptile ears, but has some adaptations for underwater listening. A thick layer of fat may conduct sound to the ear in a similar manner as the fat in jawbones of odontocetes (Ketten *et al.*, 1999), but sea turtles also retain an air cavity that presumably increases sensitivity to sound pressure. Sea turtles have lower underwater hearing thresholds than those in air, owing to resonance of the aforementioned middle ear cavity, and hence they hear best underwater (Willis, 2016).

Electrophysiological and behavioural studies on green and loggerhead sea turtles found their hearing frequency range to be approximately 50–2,000 Hz, with highest sensitivity to sounds between 200 and 400 Hz (Ridgway *et al.*, 1969, Bartol *et al.*, 1999; Ketten and Bartol, 2005; Bartol and Ketten, 2006; Yudhana *et al.*, 2010, Piniak *et al.*, 2011, Lavender *et al.*, 2012, Lavender *et al.*, 2014)), although these studies were all conducted in-air. Underwater audiograms are only available for three species. Two of these species, the red-eared slider (Christensen-Dalsgaard *et al.*,

2012), the loggerhead turtle (Martin *et al.*, 2012), both demonstrated higher sensitivity at around 500 Hz (Willis, 2016). Recent work on green turtles has refined their maximum underwater sensitivity to be between 200 and 400 Hz (Piniak *et al.*, 2016). Yudhana *et al.* (2010) measured auditory brainstem responses from two hawksbill turtles in Malaysia and found that peak frequency sensitivity occurred at 457 Hz in one turtle and at 508 Hz in the other.

Nelms *et al.* (2016) conducted a review of seismic surveys and turtles that considers the studies detailed below. A common theme is the complex nature of the studies, from the interpretation of behavioural responses, determining responses due to airguns or vessel noise/presence, through to difficulties in visually detecting animals. Most studies looking at the effect of seismic noise on marine turtles have focused on behavioural responses given that physiological impacts are more difficult to observe in living animals.

Sea turtles have been shown to avoid low-frequency sounds (Lenhardt, 1994) and sounds from an airgun (O'Hara and Wilcox, 1990), but these reports did not note received sound levels.

Weir (2007) carried out observations from onboard a seismic survey vessel during a 10-month 3D MSS offshore from West Africa, concluding 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 1,000 m of the array.”

The reduction in the number of turtles observed within 1,000 m during operation of a full airgun array (Weir, 2007) is therefore reasonably consistent with the observations of McCauley *et al.* (2003), which indicated an avoidance response threshold of approximately 175 dB re 1 μ Pa (SPL).

At very close distances to the seismic array, there is also the possibility of temporary hearing impairment or perhaps even permanent hearing damage to turtles. However, there are very few data on temporary hearing loss and no data on permanent hearing loss in sea turtles exposed to airgun pulses. Although some information is available about effects of exposure to sounds from a single airgun on captive sea turtles, the long-term acoustic effects (if any) of a full-scale MSS on free-ranging sea turtles are unknown. The greatest impact is likely to occur if seismic operations occur in or near areas where turtles concentrate, and at seasons when turtles are concentrated there.

Thresholds adopted for the STLM

Table 7.26 presents the exposure criteria for airguns for turtles. This was developed by Popper *et al.* (2014) based on results from the Working Group on the Effects of Sound on Fish and Turtles.

Additionally, based on the limited data in regards to noise levels that illicit a behavioral response in turtles, a level of 166 dB re 1 μ Pa drawn from NSF (2011) is typically applied, both in Australia and by NMFS, as the threshold level at which behavioural disturbance could occur.

Table 7.26. Exposure criteria for seismic sources – turtles

Mortality and potential mortal injury	Distance from the source	Impairment			Behaviour
		Recoverable injury	TTS	Masking	
210 db 24hr SEL or >207 dB peak	Near	Moderate	Moderate	Low	Moderate
	Intermediate	Low	Low	Low	Low
	Far	Low	Low	Low	Low

Cells highlighted in red indicate maximum predicted extent of sound.

Distance from the source

Near = tens of metres.

Intermediate = within hundreds of metres.

Far = thousands of metres.

STLM results

Table 7.27 presents the STLM predicted ranges for the per-pulse effects criteria and isopleths of interest for turtles for both source array options.

Table 7.27. Maximum (R_{max}) horizontal distances from the source array to modelled seafloor PK levels from four transects for turtles

Peak pressure level (dB re 1 μ Pa @ 1 m)	Distance R_{max} (m)				
	Site 1	Site 2	Site 3	Site 4	Site 5
207	300	260	230	250	220

Cells highlighted in red indicate maximum predicted extent of sound.

Table 7.28 presents the 24-hour cumulative exposure results for the three possible operational scenarios, and indicates that scenario 1 results in the smallest area of underwater sound exposure over a 24-hour period compared with scenarios 2 and 3.

Table 7.28. Maximum-over-depth distances (in km) to SEL_{24h} -based turtle criteria for three possible scenarios within the Pelican 3DMSS acquisition area

Threshold for SEL_{24h} (dB re 1 μ Pa ² .s)	Scenario 1		Scenario 2		Scenario 3	
	R_{max} (km)	Area (km ²)	R_{max} (km)	Area (km ²)	R_{max} (km)	Area (km ²)
210	0.03	2.93	0.04	4.1	0.06	4.85

Cells highlighted in red indicate maximum predicted extent of sound.

Predicted impacts

The acquisition area for the Pelican 3DMSS does not overlap any marine turtle BIAs and the likelihood of encountering marine turtles off the Victorian coast is considered very low (see Section 5.4.7). Based on this and the adoption of soft-start procedures, the risk of injury or mortality to individual turtles is negligible (as is the potential for impacts to turtles at a population level).

Impacts to Marine Protected Areas

The conservation values of marine protected areas in proximity and affected by the proposed Pelican 3DMSS are described in Section 5.2.1 and Section 5.2.9. The

nearest marine protected area to the proposed acquisition area is the Ninety Mile Beach MNP, located 14.5 km to the southwest. The nearest CMR (Beagle) is located 88 km to the southwest of the proposed acquisition area, outside the proposed survey's underwater sound EMBA.

The STLM has identified that the received sound at the eastern-most offshore boundary of this MNP will not exceed any thresholds likely to cause behavioural impacts to fish, cetaceans, crustaceans or bivalves, or disturbance to divers, as outlined in Table 7.29 and Table 7.30.

Table 7.29. Underwater sound results at the eastern-most offshore boundary of the Ninety Mile Beach MNP

Received SPL (dB re 1 µPa)				
Site 1	Site 2	Site 3	Site 4	Site 5
132.0	131.5	128.0	122.8	130.2

Cells highlighted in red indicate maximum predicted extent of sound.

Table 7.30. Maximum-over-depth distances (in km) to SEL_{24h} at the eastern-most offshore boundary of the Ninety Mile Beach MNP

Received SEL _{24h} (dB re 1 µPa ² .s)		
Scenario 1	Scenario 2	Scenario 3
160.1	155.9	164.6

Cells highlighted in red indicate maximum predicted extent of sound.

No impacts to the management strategies for the Ninety Mile Beach MNP due to underwater sound generated by the proposed MSS are predicted to occur.

7.1.4. Control Measures & Impact Consequence

The following control measures will be implemented to minimise the impacts of underwater sound on biological receptors:

- The underwater sound validation study is undertaken during the in order to validate the STLM results and determine whether the effects of MSS on benthic invertebrate remain within the 1,220 m radius zone.
- A marine environmental assessment is undertaken pre- and post-MSS (in order to determine whether mass mortality of commercial scallops or southern rock lobsters attributable to the MSS occurs.
- *Conditional EPS: A further assessment is conducted within 5 years in order to quantify the abundance of commercial scallops, in the context of the most recent whole of scallop fishery stock assessment data.*
- CarbonNet has modified its operating window to exclude November and December (in addition to January) so as to avoid overlapping with the most important period of the year for spawning and larval dispersal for many fish of commercial and recreational fishing importance.
- The EPBC Act Policy 2.1 Part A Standard Management Procedures (Section A.3) is implemented for the duration of the survey from the survey vessel.
- Two MMOs will be contracted and will be based aboard the survey vessel.

- In accordance with Part A.2 of the EPBC Act Policy Statement 2.1 (Part A), the MMOs undertake cetacean awareness sessions for key vessel crew.
- CarbonNet will ensure the MMOs conduct marine mammal observations for the duration of the survey (including during soft starts) and are trained and experienced in the requirements of the policy.
- Cetacean strategy will be discussed each day to assess all available data on whale presence. This information will be used to inform the operational strategy for the following day.
- CarbonNet will report cetacean sightings online to the DoEE within 2 months of survey completion using the online Cetacean Sightings Application (<http://www.marinemammals.gov.au/sorp/sightings>).
- In the event that CarbonNet is made aware of the potential for another survey/s to take place in the same area at the same time as this survey (CarbonNet is currently unaware of any such plans), at least a 40 km (21 nm) separation will be maintained between active sources to ensure sound from one source doesn't interfere with sound from the other and to reduce the possibility of cumulative sound impacts.
- Engines and thrusters are maintained in accordance with manufacturer's instructions via the Planned Maintenance System (PMS) to ensure they are operating efficiently.

Table 7.31 presents the residual (post-control) impact consequence ratings.

Table 7.31. Underwater sound impact consequence for biological receptors

Receptor	Residual
Plankton	Insignificant
Fish – with swim bladders	Insignificant
Fish – without swim bladders	Insignificant
Cetaceans	Insignificant
Pinnipeds	Insignificant
Avifauna	Insignificant
Crustaceans (e.g., southern rock lobster)	Minor
Molluscs (e.g., scallops)	Minor
Turtles	Insignificant

7.2. INDIRECT IMPACT: Potential Disruption to Fisheries from Underwater Sound

7.2.1. Hazard

The proposed MSS may disrupt the sustainability of commercial and recreational fisheries because of physical, behavioural or physiological responses in fish target species (Carroll *et al.*, 2017).

7.2.2. Potential Environmental Impacts

The potential impacts of underwater sound on commercial and recreational fisheries are:

- Localised and temporary exclusion of fishing operators from fishing grounds, with a consequent potential decrease in fish catch and associated income; and
- Physiological or behavioural changes in target species that results in a lower catch intensity in the short- or long-term, with a consequent potential decrease in associated catch and income.

Commercial fisheries that are known to operate within the underwater sound EMBA are:

Victorian fisheries

- Ocean access;
- Ocean purse seine;
- Inshore trawl;
- Scallop; and
- Southern rock lobster.

Commonwealth fisheries

- Gillnet and shark hook sector (SESS).

Recreational fishers target mostly fin fish species (e.g., snapper, whiting, flathead and salmon, see Section 5.6.4), both from the shore and from boats. Recreational fishing competition organisers have expressed concern regarding the timing and duration of the proposed MSS for their competitions. Potential impacts to these recreational fishing targets are captured under the ‘fin fish’ section following.

7.2.3. Evaluation of Potential Environmental Impacts

Fin Fish

The discussion of underwater sound impacts on fin fish species is relevant to the Victorian Ocean Access (shark, salmon and snapper), Victorian Ocean Purse Seine (sardine, salmon and sprat), Victorian Inshore Trawl (prawn, flathead, shark), the Commonwealth SESS (gillnet and shark hook sector) commercial fisheries and the recreational fishery.

Fish may avoid areas of seismic activity, and fish schools may disperse or change feeding behaviour patterns, resulting in fewer fish being attracted to baited traps or hooks. This can potentially reduce the availability of commercially valuable species or recreationally targeted species. Some studies support the view of many commercial fishers that seismic surveys scare fish away (except for reef-dwelling [i.e., site-attached] fish), but there is minimal information on the time taken for fish to return after the completion of surveys, with overseas studies indicating fish returning within one to five days after the completion of the survey (Parry & Gason, 2006). Other studies investigating sound impacts on fish catch statistics identify catch rates do not change significantly.

McCauley (1994) identified that the nature and extent of behavioural change in fish species will vary according to the species involved, with evidence indicating that for some fish species seismic sound is no more than a nuisance factor. Fisheries and Oceans Canada (2004) reviewed scientific information available on the impacts of MSS on fish and concluded that the ecological significance on fish is expected to be low, except where there may be a dispersion of spawning aggregations or deflections in migration paths, however, the magnitude of effects will be dependent on the biology of the species and the extent of the dispersion or deflection.

Any reduction in spawning or recruitment success may reduce the yield of a species in subsequent years. This can, in turn, contribute to longer-term impacts due to a reduction in spawning stock for the following year. Studies show that effects on fish eggs and larvae populations within survey areas are insignificant, especially when considered with respect to population size and the natural mortality rates for these organisms (McCauley, 1994).

Geoscience Australia examined fisheries catches and catch rates for the potential effects of Bass Strait MSS in a desktop study (GA, 2014). The finfish species studied were school whiting (*Sillago flindersi*), tiger flathead (*Neoplatycephalus richardsoni*), silver warehou (*Seriolella punctata*) and gummy shark (*Mustelus antarcticus*), all of which are expected to occur in the proposed acquisition area. The study concluded that despite attempting novel and relatively sophisticated methods to try to separate the effects of various factors through to effect catch rates, no clear negative (or positive) effects of MSS on fisheries catch rates were detected.

Przeslawski et al (2016b) present the results of a GMEM project undertaken in 2015 (see Section 7.1.4). Assessing fish catch rates was one of several project components, and was monitored using tagged tiger flathead (*Neoplatycephalus richardsoni*), gummy shark (*Mustelus antarcticus*), and swellshark (*Cephaloscyllium laticeps*) released within acoustic arrays in the experimental and control zones. Commercial catch data from 15 species in the region were used to quantify any differences that may have been attributed to the 2015 Geoscience Australian 2D MSS, which was undertaken 25 km south of the proposed acquisition area. The results from this study with regard to catch analysis were:

- Nine out of 15 species indicated significant deviations ($p \leq 0.05$) from their predicted catch rates after the survey, with deviations being gear-specific in species caught across both gear types.
- No species indicated significant before and after deviations in catch across more than one gear type.
- Across all gear types, six species (tiger flathead, goatfish, elephantfish, boarfish, broadnose shark and school shark) indicated increases in catch subsequent to the seismic survey.
- Three species (gummy shark, red gurnard, sawshark) indicated decreases in catch.
- Of these species, most were caught using Danish Seine, which was the more common of the two fishing operation across the area examined (no Danish seine fishing occurs in the proposed acquisition area).

This GMEM study notes that many factors can account for changes in logbook recorded catch rates, such as differences in fishing practices, market forces and environmental effects (e.g., sea surface temperature) that influence the distribution and catchability of species. It also notes that the catchability results support previous work in which the effects of seismic surveys on catch seem to vary among species and gear types.

Carroll et al (2017) also undertook a desktop review of the potential impacts of MSS on fish (and invertebrates). It found that commercial trawl and longline catches of Atlantic cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*) have been shown to fall by 45% and 70%, respectively, five days after MSS in the Barents Sea, which was hypothesized to be the result of fish displaying avoidance behaviour.

Similar reductions were also demonstrated in the hook-and-line fishery for rockfish (*Sebastes* spp.) off the Californian coast, hypothesized to be the result of decreased responsiveness to baited hooks associated with an alarm behavioural response. A companion behavioural study showed that alarm and startle responses were not sustained following the removal of the sound source, suggesting that the effects on fishing may be transitory, primarily occurring during the sound exposure itself.

How May the Fishery be Affected?

In summary, potential impacts to commercial fin fish stock from the proposed MSS are limited to a temporary reduction in fish catch within the proposed acquisition area due to lateral displacement from seismic source operation or deeper depth range for fish species with an affinity for seabed structures.

Impacts to the fishery are minimised because:

- The small survey area and timing means there will be negligible impacts to spawning or recruitment success at the population or fishery level;
- There are no unique or geographically restricted seabed features or fishing target species identified in or around the proposed acquisition area;
- Sharks are not as susceptible to seismic sound because they lack a swim bladder.
- The fishing intensity of the Ocean Purse Seine and SESS (gillnet and hook sector) fishery is widespread throughout Bass Strait and a temporary exclusion from the acquisition area will not present a material loss of catch/income.

Significance to Individual Fishers

The area of the fin fish fisheries overlapped by the proposed acquisition area varies depending on the fishery. For Commonwealth fin fish fisheries, the area of overlap is 0.02% or less (see Table 5.12), while for Victorian fisheries, it is mostly unknown (though only 0.4% for the wrasse fishery, see Table 5.15). There is insufficient catch and financial data for these fisheries available to CarbonNet to allow for a detailed estimate on the impacts to catch and landing value to be made.

On this basis, given the small acquisition area compared with the available fishing area (the entire Victorian coastline for the Victorian fisheries, and Commonwealth waters throughout southeastern Australia for the Commonwealth fisheries), the risk of disrupting the sustainability of the commercial fin fish fishery is negligible, being highly localised and with no lasting effects.

Potential impacts to commercial fishers during the survey period (all of which may result in varying short-term economic impacts depending on how individual fishers operate) include:

- Disruption: inability to fish in the operational area during the survey period;
- Inability to substitute/mitigate: inability to simply fish elsewhere (i.e., substitute) without a risk of lower CPUE;
- Inability to substitute/mitigate (timing can impact price): even if a fisher could substitute by fishing at a different time in the season (e.g., before or after the survey) and achieve the same catch and CPUE, it may be at a time when the beach price is lower; and

- Displacement: disrupted fishers may fish elsewhere, displacing other fishers and resulting in a risk of lower catch rates or lower CPUE for both categories of fisher (which can also threaten the well understood protocols adopted by the fishers in terms of where they usually fish).

Potential impacts to recreational fishers is expected to be negligible given that the proposed MSS will avoid operating during the peak holiday season (when recreational fishing levels are high) and because of the vast shoreline and open ocean available for fishing.

Potential impacts to fishers during the recreational fishing competitions is expected to be negligible given that the proposed MSS will avoid operating during these competitions and that although fish may be scared away during MSS, some studies (e.g., Parry & Gason, 2006) indicate that fish return within one to five days after the completion of the MSS.

Commercial Scallops

As identified in Chapter 4, potential impacts to the commercial scallop catch is a key concern expressed by some fisheries stakeholders, the key stakeholders being the VSFA and SIV. This section provides a commercial scallop (*Pecten fumatus*) fishery-specific discussion of potential impacts.

It is important to note that for context in this discussion:

- The proposed acquisition area intersects only 0.11% of this fishery and the operational area intersects 0.21% of the fishery by area;
- Anecdotal information from some fishing industry organisations claim that scallop beds exist within the proposed acquisition area, but the location of these has not been declared to CarbonNet; and
- The marine environmental assessment commissioned by CarbonNet and undertaken in April 2017 found few areas containing scallops, and these few locations did not have commercial beds of scallops.

Several studies have been undertaken with respect to the effects of MSS sound on fisheries catch data with respect to molluscs including gastropods (abalone, snails) and bivalves (scallops). The following studies are available:

- Przeslawski et al (2016b) (as summarised in Section 7.1.4) found that based on a 2D MSS undertaken in western Bass Strait in April 2015, and using *in situ* monitoring, there were no detectable impacts on the abundance of live scallops, catch of live or dead scallops, or gonad condition.
- The CSIRO and Geoscience Australia (Thomson *et al.*, 2014) examined fisheries catches (10 species of interest) and catch rates for potential effects from 183 seismic surveys undertaken in the Gippsland Basin (Bass Strait). Study species included the commercial scallop (*Pecten fumatus*) and found no clear or consistent relationships between MSS and subsequent fisheries catch rates.
- Harrington et al (2010) studied the short-term effects of seismic surveys on adult commercial scallops (*Pecten fumatus*) within the Bass Strait Central Zone Scallop Fishery between February and June 2010 located in water depths of approximately 70 m. The study aimed to determine the survival and health of adult scallops within impacted (directly below seismic survey transects), semi-impacted (within the seismic survey transect grid) and control (outside of the seismic survey transect grid) strata two months after seismic

surveying. 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. There was also no observable change in the size frequency distribution of scallops in the impacted and semi-impacted strata following seismic surveying. Harrington et al (2010) concluded that no short-term (< 2 months) effects on the survival or health of adult scallops were detected after the seismic survey.

- Parry et al (2002) also found no evidence of a lethal impact of seismic surveying on commercial scallops in Bass Strait. However, this experiment suspended scallops in the water column where they may not be exposed to the same sound or vibration stimuli compared to scallops on the benthos because low frequency seismic waves interact and travel through the sediment and reflect at the sediment/water interface. For example, Walmsley (2007) showed that substratum vibrations resulted in shell closure of cockles. Persistent seabed vibrations, which result in continued shell opening and closure, could potentially result in cessation of filter feeding and decreased health and survival of affected individuals.

The UTAS-FRDC 2014 study (reported by Day et al (2016a), as summarised in Section 7.1.4) indicates that there was no evidence of short-term (< 2 months) impacts on scallop catch rates, but in the long-term (after 120 days), scallop mortality rates increased. This contrasts with the findings of the Przeslawski et al (2016b) study (as noted above). The results indicate that exposure to impulses from an airgun source associated with a MSS may result in the mortality of some scallops as well as some impaired reflexes and immunity response if the seismic source passes in close proximity or directly overhead. Day et al (2016a) also indicated that exposure, particularly repeated exposure, did result in increased mortality compared to unexposed controls.

How the Fishery may be Affected

Catch and effort data is available from VFA only for grids that have information comprised from five or more data sources (the “five fisher rule”). Where fewer than five fishers are active, data is often aggregated across fisheries, making it difficult for CarbonNet to assess potential impacts. The two fishing grid cells overlapped by the proposed acquisition area (noting that the acquisition area extends into a third grid cell [E38] by only several meters and is therefore excluded from analysis herein) were fished by fewer than five fishers from 2010/11 to 2015/16.

Noting that scallop fishers have stated that no scallop fishing has taken place in the proposed acquisition area for the last 7-8 years (to allow for stock replenishment), but that scallop beds may be present, CarbonNet has used historic fishing catch data to assess potential impacts on scallop catch. Commercial scallop catch data from Lakes entrance is provided in DPI (2005) for the years 1970 to 2004. This illustrates the highly variable nature of the scallop fishery. For the years 1998-2003, scallop catch data is available and broken down according to catch and effort grid cells (see Figure 5.35). This figure illustrates that historically, the area to the immediate northeast of the proposed acquisition area had greater catches than other areas along the coast.

Based on Figure 5.35, and taking the upper estimate of catch, the two fishing grid cells intersected by the proposed acquisition area had catches of 133 tonnes (E39) and 265 tonnes (E40) for the 6 years between 1998 and 2003. As the proposed

acquisition area overlaps grid cell E39 by ~50% and grid cell E40 by ~25%, this equates to 66.25 tonnes from each of these two cells over six years (or 11.1 tonnes per year for those six years). This equates to an approximate catch of 22.2 tonnes from the proposed acquisition year for the 6 years from 1998 to 2003 (noting this is an upper estimate based on the coarse data provided in the map). Of the total catch for these years, again based on the upper estimate provided in Figure 5.35, this 22.2 tonnes represents 1.85% of the total average annual catch calculated upon the same basis for those six years. This demonstrates that although the area to the immediate northeast of the proposed acquisition area was an important scallop fishing ground, the Pelican acquisition area represented only a small portion of the total fishery's catch. By extension, if fishing was currently taking place within the proposed acquisition area, it may continue to represent a small percentage of the fishery's catch.

The proposed Pelican 3DMSS is not expected to cause a material reduction in annual fishery catch rates of commercial scallops because:

- Based on a desktop review of many studies, Carroll et al (2017) conclude that the potential effects of seismic pulses on catch rates or abundances of bivalves show no significant differences between sites exposed to seismic operations and those not exposed;
- Presence of commercial beds of *Pecten fumatus* within the proposed acquisition area has not been established (based on CarbonNet's habitat assessment);
- The survey is of a very short duration (a maximum of 27 days, but more likely 13-16 days), representing 4.4 to 7.4% of the duration of the fishing season (which is year-round);
- The proposed acquisition area represents 0.11% of the total Victorian scallop fishery by area and 1.85% based on historical catch rates;
- The potential zone of impact to scallops (see 'Impacts to Scallops' in Section 7.1.4), which are based on conservative sound pressure metrics, is tiny in context of the fishery (at both a local and regional level); and
- Many Victorian scallop fisheries are licensed to fish within the adjoining Commonwealth scallop fishery, meaning that they have alternative areas to fish (assuming that commercially-viable scallop beds are present).

Significance to Individual Fishers

Based on information available to CarbonNet, fewer than five commercial fishers fish in the proposed acquisition area. The proposed Pelican 3DMSS is not expected to cause significant impacts to individual commercial scallop fishers because:

- The presence of commercial beds of *Pecten fumatus* within the proposed acquisition area is yet to be established (based on CarbonNet's video assessment);
- Fewer than five commercial fishers fish in the proposed acquisition area and many Victorian scallop fisheries are licensed to fish within the adjoining Commonwealth scallop fishery, meaning that they have alternative areas to fish;
- The survey is of a very short duration (a maximum of 27 days, more likely 13-16 days), representing 4.4% to 7.4% of the duration of the fishing season (which is 12 months);

- The proposed acquisition area represents 0.11% of the total Victorian scallop fishery by area and 1.85% by historical catch rates;
- There has been no fishing in the area over the last 7-8 years; and
- The potential importance of the proposed acquisition area for future harvesting (and certainly a 2017/18 harvest) is speculative in the absence of a recent scallop fishery stock assessment (the last one was undertaken in 2012).

Potential impacts to commercial fishers during the survey period (all of which may result in varying short-term economic impacts depending on how individual fishers operate) include:

- Disruption: inability to fish in the operational area during the survey period;
- Inability to substitute/mitigate: inability to simply fish elsewhere (i.e., substitute) without a risk of lower CPUE;
- Inability to substitute/mitigate (timing can impact price): even if a fisher could substitute by fishing at a different time in the season (e.g., before or after the survey) and achieve the same catch and CPUE, it may be at a time when the beach price is lower; and
- Displacement: disrupted fishers may fish elsewhere, displacing other fishers and resulting in a risk of lower catch rates or lower CPUE for both categories of fisher (which can also threaten the well understood protocols adopted by the fishers in terms of where they usually fish).

Southern Rock Lobster

As identified in Chapter 4, potential impacts to commercial rock lobster catch is a key concern expressed by the VRLA and SIV. This section provides a commercial southern rock lobster (*Jasus edwardsii*) fishery-specific discussion of potential impacts.

It is important to note that for context in this discussion:

- The proposed acquisition area intersects 0.26% of this fishery and the operational area intersects 0.52% of the fishery by area (both calculations based on the fishery's eastern zone);
- Anecdotal information indicates that only a very small section of reef within the proposed acquisition area is fished for rock lobsters (within Victorian state waters);
- There is a low catch rate for the proposed acquisition area (with catch value representing less than 1% of the annual value of the fishery in the Eastern Zone); and
- The marine environmental survey commissioned by CarbonNet and undertaken in April 2017 found few areas of reef suitable as rock lobster habitat, and in these areas, no rock lobsters were observed (see Section 5.4.1).

Southern rock lobster has been commercially fished prior to seismic surveys commenced in the Bass Strait in the early 1960s. Studies on the effects of 33 seismic surveys undertaken between 1978 and 2003 on the southern rock lobster fishery in the waters off southwest Victoria did not find any impacts to the catch rates of rock lobsters in the weeks and years after the surveys (Parry & Gason, 2006).

A decline in the abundance of southern rock lobster has been extensively documented throughout the entire range off southern Australia, inferred either from the results of stock assessments or from trends in puerulus and catch rates (Linnane *et al.*, 2010). One of the factors for this decline is a high commercial harvest rate (>40% in many years in some areas) (Punt *et al.*, 2012). There is strong evidence for rapid increase in lobster abundance following removal of fishing pressure (e.g., MacDiarmid & Breen, 1993 and Barrett *et al.*, 2009).

In addition to fisheries impacts, recent simultaneous patterns of decline across the Australian range of the southern rock lobster have led various authors (e.g., Linnane *et al.*, 2010 and Punt *et al.*, 2012) to suggest that large-scale environmental influences may be playing a role. As summarised in Punt *et al.* (2012), there are several possible mechanisms by which large-scale environmental change can impact the dynamics of lobster populations including, including the impacts of:

- Temperature on larval survival and growth;
- Changing ocean currents on recruitment due to the lengthy pelagic phase; and
- Upwelling intensity, where extreme cold-water events reduce growth rates of adult lobsters.
- A reduction in kelp habitat driven by climatic changes has also been identified as a potential cause of reduced puerulus settlement in waters off eastern Tasmania (Hinojosa *et al.*, 2014).

Similarly, investigations into sustained below-average puerulus settlement of western rock lobster have concluded that the decline is most likely driven by higher water temperatures at the time of the onset of spawning (October) since the mid-2000s. Statistical analysis shows that most (71%) of the variation in puerulus settlement was explained by the timing of spawning, storm activity during autumn/spring, and offshore water temperatures in February (Caputi *et al.*, 2014).

Day *et al.* (2016a) note that there was no effect from seismic exposure on lobster survival and the nutritional condition of control and exposed lobsters improved considerably during the prolonged (120-365 days) post-exposure period. They conclude that impacts to statocyst morphology, behavioural reflexes and immune response functions in adult lobsters with seismic exposure was relatively minor (see Section 7.1.1), but consequences may be greater for animal fitness in more difficult wild conditions.

Potential consequences of the sub-lethal effects in the Eastern zone (abundance and recruitment)

The two features that are of most importance to determining risks in the Eastern Zone of the Victorian southern rock lobster fishery are abundance and recruitment. While not fully explored in the FRDC study (Day *et al.*, 2016a), reduced mobility and immunity could impact survival of affected lobsters in the wild (and therefore abundance). For example, the study didn't conclude whether the sub-lethal effects observed would reduce an affected lobster's ability to compete for food or avoid predators. The FRDC report did conclude that early stage embryos showed no effect (and were resilient to exposure and that subsequent recruitment should be unaffected). However, it did not assess the effect of seismic exposure on hatched larvae in the water column.

Factors that mitigate against a material impact on larvae (and therefore recruitment) include:

- The short duration of the survey (13 to 16 days) relative to the breeding cycle (up to 90 days);
- The limited extent of key rock lobster habitat in the operational area;
- The avoidance of peak puerulus settlement that occurs between July and September (and possible avoidance of peak larval hatching season in November, depending on exact survey timing);
- The distance from key larval production areas (for example, continuous and expansive rocky reefs further east along the coast and in southwest Victoria); and
- Significant dispersion of larvae by currents and winds prior to the puerulus settling inshore.

Assessment of correlation between MSS and catch

One way to test whether there are population impacts on lobsters is to consult the documented history of annual lobster catches in the region, where seismic surveys have been conducted regularly over recent decades.

Parry and Gason (2006) undertook a statistical analysis of CPUE data collected over nearly 30 years in the Victorian southern rock lobster fishery (in southwest Victoria) that showed no influence of historical 2D and 3D MSS activity. Analyses looked at short-term (weekly) and long-term variations (up to 7 years) in CPUE to determine whether changes were correlated with the MSS. The surveys occurred in water depths ranging from 10 m to 150 m. The study included surveys occurring during the rock lobster spawning period as well as during the rock lobster fishing season and so would have interacted with adult lobsters and larvae in the same way that the proposed Pelican 3DMSS may. This study found no evidence that catch rates were affected in the weeks or years following the surveys, however Day et al (2016a) suggest that catch rates would have had to decrease by around 50% for this study to detect a result. In addition, it is acknowledged that the authors caution that most of MSS occurred in 'deep water' and therefore the statistical power of the analyses of short term (weekly) effects on catch rates from surveys in shallow water depths may provide less statistical certainty than the long-term analyses (the shallower surveys were represented by lower levels of survey effort, lower rock lobster abundance and lower levels of fishing effort). The distinction made by Parry and Gason (2006) between 'deep' and 'shallow' water surveys corresponds with water depths greater than or less than 50 m, so the results are still applicable to the proposed survey. The long-term analyses were less sensitive and so the statistical power of these results was not affected.

Literature suggests this situation applies to species that use broadcast reproductive strategies, releasing eggs or larvae in vast numbers. For example, at a population level, trillions of southern rock lobster larvae hatch in the spring and are widely dispersed as plankton in the Southern Ocean and southern Tasman Sea. The vast disparity between the scale of effect of airgun discharges during a MSS and the trans-ocean dispersal of trillions of lobster larvae strongly indicates a negligible affect at a population level from airgun discharges (McCauley, 1994).

How the Fishery may be Affected

It has been predicted that the proposed Pelican 3DMSS survey will not result in a serious or irreversible impact to the Eastern Zone southern rock lobster population. However, there may be impacts on abundance and recruitment, as well as impacts on lobsters within the operational area (including catchability effects), which could affect the fishing industry.

In total, approximately 3,600 tonnes of Victorian southern rock lobsters are caught each year across 6 fishery zones in the South Australian, Victorian and Tasmanian fisheries.

There were 25 active southern rock lobster licenses for the Eastern Zone in 2014/15, with only six fishers active from 2007 to 2016. The catch is caught in baited pots, and there is a limit on the number of pots that may be used as well as a seasonal quota. That quota is divided into transferrable units and allocated to the licensed fishers. Fishers report catch and effort data to the VFA using a grid system to record location. Two fishing grid cells intersect the proposed acquisition area (E39 and E40) noting that the acquisition area extends into grid cells E38 by only several meters and is therefore excluded from analysis herein.

Catch and effort data is available from the VFA only for grids that have information comprised from five or more data sources (the “five fisher rule”). The two affected fishing grid cells were fished by fewer than five fishers from 2011/12 to 2015/16. This makes it nearly impossible to accurately estimate the mean annual catch for these fishing grids. However, the following coarse analysis of catch and value for the proposed acquisition area is possible based on DEDJTR (2016) and DPI (2016) data reports:

- The catches for the five years from 2011/12 to 2015/16 in the eastern zone was 273 tonnes (average 54.6 tonnes/year);
- There are 448 VFA catch and effort grid cells in the southern rock lobster eastern zone; and
- The proposed acquisition area intersects two of these grid cells (covering less than 50% of both cells combined, or 1 of the 448 catch and effort grid cells in total). This represents 0.26% of this fishery by area and 0.12 tonnes/year of catch (both calculations based on the fishery’s eastern zone).

Impacts to Catchability

In relation to catchability, the primary physiological response detected in the Day et al (2016a;b) study that points to a loss of function in the exposed lobsters that may translate to reduced mobility or sensory ability (and thus catchability) is damage to the statocyst. Impairment to spatial orientation ability due to statocyst damage may reduce the ability of a southern rock lobster to navigate to and enter a baited trap. A lobster’s ability to locate food is also a factor.

Assessments of the catchability of the southern rock lobster population with impaired statocysts within the CPSR have been undertaken by Ziegler et al (2002a;b) by comparing catch rates obtained in the trapping surveys to the density of lobsters on the reef determined through underwater observations. Catch rates of males and females and the sex ratio of trapped lobsters was found to vary strongly with season, implying that catchability varies seasonally and with sex. Catchability generally increased with size, with larger lobsters over-represented in the catch. No indication of low or impaired catch rates were presented in these studies and suggest that there

is no highly significant effect on catchability due to statocyst damage. However the methods used preclude a direct comparison with catch rates reported by commercial fishers in adjacent areas.

Chemosensory systems have been identified as centrally involved to the feeding behaviour of rock lobsters (Derby and Atema, 1981; Derby *et al.*, 2001). Whilst the FRDC study did not directly assess chemosensory systems, no change in nutritional status of adult lobsters was observed that could be attributed to seismic exposure. The nutritional condition of all lobsters improved considerably during the prolonged period post-exposure period (120-365 days). This finding suggests that the lobsters' chemoreceptory facilities that would influence the lobsters' ability to locate food (e.g., bait within traps) were not impaired.

Significance to Individual Fishers

Based on the information available to CarbonNet, fewer than five commercial fishers fish in the acquisition area. Anecdotal information suggests only one rock lobster fisher occasionally works in the area, with no rock lobster fishers having made themselves known to CarbonNet during the stakeholder consultation process.

The proposed Pelican 3DMSS is not expected to cause significant financial impacts to this individual commercial rock lobster fisher (or multiple fishers) because:

- Based on CarbonNet's marine habitat assessment and LiDAR mapping, there is limited area of rocky reef in the proposed acquisition area that is suitable for commercial rock lobster fishing, and on its own is therefore not likely to represent a significant fishing ground for individual fishers;
- The rocky reef present within the proposed acquisition area is not limited to this locality – it is present in patches along the Ninety Mile Beach (see Section 5.1.2). As such, this fisher (or fishers) has access to much larger fishing grounds, meaning that there are alternative areas to fish;
- The survey is of a very short duration (a maximum of 27 days, but more likely 13-16 days), representing 8% to 13.8% of the duration of the fishing season (which is 6.5 months of the year); and
- The proposed acquisition area represents 0.26% of the eastern zone of the southern rock lobster fishery.

Potential impacts to fishers during the survey period (all of which may result in varying short-term economic impacts depending on how individual fishers operate) include:

- Disruption: inability to fish in the operational area during the survey period;
- Inability to substitute/mitigate: inability to simply fish elsewhere (i.e., substitute) without a risk of lower CPUE;
- Inability to substitute/mitigate (timing can impact price): even if a fisher could substitute by fishing at a different time in the season (e.g., before or after the survey) and achieve the same catch and CPUE, it may be at a time when the beach price is lower; and
- Displacement: disrupted fishers may fish elsewhere, displacing other fishers and resulting in a risk of lower catch rates or lower CPUE for both categories of fisher (which can also threaten the well understood protocols adopted by the fishers in terms of where they usually fish).

In summary, on the basis of the above catch information and recent studies undertaken by Day et al (2016a;b) into the impacts of MSS on southern rock lobsters, there will be no significant effects to catch rates in the short- or long-term and therefore a low risk of detrimentally affecting the sustainability of the southern rock lobster fishery.

7.2.4. Control Measures & Impact Consequence

The following control measures will be implemented to minimise the impacts of underwater sound on commercial fisheries:

- Advice to AMSA and Transport Safety Victoria is provided several weeks prior to initial mobilisation to the survey location and prior to final demobilisation from location.
- The Vessel Master and crew are appropriately qualified in accordance with the:
 - *Marine Safety (Domestic Commercial Vessel) National Law Act 2012* Section 48 (Issue certificate of operation) for a domestic commercial vessel; or
 - If a regulated Australian vessel, in accordance with AMSA Marine Orders Part 3 (Seagoing qualifications) (e.g., International Convention of Standards of Training, Certification and Watch keeping for Seafarers [STCW95], to operate radio equipment in order to minimise the chance of collisions (as appropriate).
- A notification is issued to fishery stakeholders who operate in the acquisition area at least four weeks prior to the survey commencing.
- Notifications are in place at local towns (i.e., Golden Beach, Paradise Beach and Seaspray) for at least three weeks prior to and during the MSS to advise of the survey activities.
- Navigation, identification and communication equipment is functional and in use in accordance with AMSA Marine Order Part 30 (Prevention of collisions) or National Standard for Commercial Vessel 2015 (as appropriate).
- In the event that CarbonNet is made aware of the potential for another survey/s to take place in the same area at the same time as this survey, at least a 40 km (21 nm) separation will be maintained between active sources to ensure sound from one source doesn't interfere with sound from the other and to reduce the possibility of cumulative sound impacts.
- CarbonNet has modified its operating window to exclude November and December (in addition to January) so as to avoid overlapping with the most important period of the year for spawning and larval dispersal of many fish of commercial and recreational fishing importance.
- A marine environmental assessment is undertaken pre- and post-MSS in order to determine whether immediate mass mortality of commercial scallops or southern rock lobsters takes place during the MSS.
- The underwater sound validation study is undertaken during the MSS in order to validate the STLM results and determine whether the effects of MSS on benthic invertebrate remain within the 1,220 m radius zone.

Table 7.32 presents the residual (post-control) impact consequence ratings.

Table 7.32. Impact consequence for effects of underwater sound on commercial and recreational fisheries (using environmental and financial definitions of consequence)

Fishery	Residual
Scallop (Vic)*	Minor
Rock lobster (Vic)*	Minor
Ocean access (Vic)	Insignificant
Ocean purse seine (Vic)	Insignificant
Inshore trawl (Vic)	Insignificant
Southern squid jig (Cth)	Insignificant
Gillnet & shark hook (Cth)	Minor

7.3. IMPACT: Atmospheric Emissions

7.3.1. Hazard

The following activity will generate atmospheric emissions:

- Combustion of marine diesel from the vessel engines, generators and fixed and mobile deck equipment during the survey.

7.3.2. Known and Potential Environmental Impacts

The known and potential environmental impacts of atmospheric emissions are:

- Localised and temporary decrease in air quality due to gaseous emissions and particulates from diesel combustion; and
- Incremental build-up of GHG in the atmosphere (influencing climate change).

7.3.3. Evaluation of Environmental Impacts

The combustion of diesel fuel can create continuous or discontinuous plumes of particulate matter (soot or black smoke) and the emission of non-GHG, such as sulphur oxides (SO_x) and nitrous oxides (NO_x). The inhalation of particulate matter may affect the respiratory systems of fauna. In the proposed acquisition area, this is limited to seabirds overflying the vessels.

Particulate matter released from the source and support vessels is not likely to impact on the health or amenity of the nearest human coastal settlements (e.g., Golden Beach and Paradise Beach), as offshore winds will rapidly disperse and dilute particulate matter. This rapid dispersion and dilution will also ensure that seabirds are not exposed to concentrated plumes of particulate matter from vessel exhaust points.

The use of fuel to power engines, generators and any mobile/fixed plant will result in gaseous emissions of GHG such as carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). While these emissions add to the GHG load in the atmosphere, which adds to global warming potential, they are relatively small on a global scale, representing an insignificant contribution to overall GHG emissions. The activity is similar to other industrial activities contributing to the accumulation of GHG in the atmosphere.

7.3.4. Control Measures & Impact Consequence

The following control measures will be implemented to minimise the impacts of atmospheric emissions:

- Only low-sulphur (<3.5% m/m) marine-grade diesel will be used in order to minimise SOx emissions.
- All combustion equipment is maintained in accordance with the PMS (or equivalent).
- Vessels with gross tonnage >400 tonnes possess equipment, systems, fittings, arrangements and materials that comply with the applicable requirements of MARPOL Annex VI.
- Vessels >400 gross tonnes and involved in an international voyage implement their Ship Energy Efficiency Management Plan (SEEMP) to monitor and reduce air emissions.
- Vessels >400 gross tonnes must ensure that firefighting and refrigeration systems are managed to minimise Ozone Depleting Substances (ODS).
- Only a MARPOL VI-approved incinerator is used to incinerate solid combustible waste (food waste, paper, cardboard, rags, plastics).
- Incineration is only conducted when the vessel is >12 nm from the shore.
- Oil and other noxious liquid substances will not be incinerated.
- Fuel use will be measured, recorded and reported for abnormal consumption, and in the event of abnormal fuel use, corrective action is taken to minimise air pollution.

The residual (post-control) impact consequence is rated as 'insignificant.'

7.4. IMPACT: Light Emissions

7.4.1. Hazard

Light emissions will occur from the source and support vessels at all times. The following activities will result in artificial lighting:

- Vessel navigation lighting will be maintained while vessels are on location for maritime safety purposes and deck lighting for the safety of personnel working on deck.

7.4.2. Known and Potential Environmental Impacts

The known and potential environmental impacts of artificial lighting are:

- Localised light glow may act as an attractant to light-sensitive species (e.g., seabirds, squid, zooplankton), in turn affecting predator-prey dynamics (due to attraction to or disorientation from light).

Light-sensitive receptors that may occur within the area affected by light glow, either as residents or migrants, are:

- Plankton;
- Fish (e.g., squid); and
- Seabirds.

7.4.3. Evaluation of Environmental Impacts

Seabirds may be attracted to the vessels at night due to the light glow. Bright lighting can disorientate birds, thereby increasing the likelihood of seabird injury or mortality through collision with infrastructure, or mortality from starvation due to disrupted foraging at sea (Wiese *et al.*, 2001 in DSEWPC, 2011).

Studies conducted between 1992 and 2002 in the North Sea confirmed that artificial light was the reason that birds were attracted to and accumulated around illuminated offshore infrastructure (Marquenie *et al.*, 2008) and that lighting can attract birds from large catchment areas (Wiese *et al.*, 2001). The light may provide enhanced capability for seabirds to forage at night.

Fish and zooplankton may be directly or indirectly attracted to lights. The concentration of organisms attracted to light results in an increase in food source for predatory species and marine predators are known to aggregate at the edges of artificial light halos. This could potentially lead to increased predation rates compared to unlit areas.

7.4.4. Control Measures & Impact Consequence

The following control measures will be implemented to minimise the impacts of light emissions:

- External vessel lighting is managed in accordance with AMSA Marine Orders Part 30 (Prevention of Collisions) and AMSA Marine Orders Part 59 (Offshore Support Vessel Operations).

The residual (post-control) impact consequence is rated as 'insignificant.'

7.5. IMPACT: Discharge of Sewage and Grey Water

7.5.1. Hazard

The use of ablution, laundry and galley facilities by vessel crews will result in the discharge of sewage and grey water. While the number of personnel onboard the vessel/s at any one point in time is currently unknown, this activity will result in the discharge of several hundred litres of treated sewage and greywater each day.

7.5.2. Known and Potential Environmental Impacts

The known and potential environmental impact of treated sewage and grey water discharges is:

- Temporary and localised reduction in surface water quality around the vessels.

The EMBA for sewage and grey water discharges associated with vessel activities is likely to be the top 10 m of the water column and a 50 m radius from the discharge point. This is based on modelling of continuous wastewater discharges (including treated sewage and greywater) undertaken by Woodside for its Torosa South-1 drilling program (in the Scott Reef complex), which found:

- Rapid horizontal dispersion of discharges occurs due to wind-driven surface water currents;
- Vertical discharge is limited to about the top 10 m of the water column due to the neutrally buoyant nature of the discharge; and
- A concentration of a component within the discharge stream is reduced to 1% of its original concentration at no less than 50 m from the discharge point under any condition (Woodside, 2008).

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Plankton;
- Pelagic fish; and
- Seabirds.

7.5.3. Evaluation of Environmental Impacts

Sewage will be treated through a sewage treatment plant (STP) to a tertiary level, so there are no potential impacts relating to the release of pathogens in untreated sewage. Nutrients in sewage, such as phosphorus and nitrogen, may contribute to eutrophication of receiving waters (although usually only still, calm, inland waters and not offshore waters), causing algal blooms, which can degrade aquatic habitats by reducing light levels and producing certain toxins, some of which are harmful to marine life and humans.

Grey water (used water from the galley, dishwashers, showers, hand basins and laundry) can contain a wide variety of pollutant substances at different strengths, including oil and some organic compounds, hydrocarbons, detergents and grease, metals, suspended solids, chemical nutrients, food waste, coliform bacteria and some medical waste. Grey water is also treated through the STP, so pollutants will be largely removed from the discharge stream.

The effects of sewage and sullage discharges on the water quality at Scott Reef were monitored for a drill rig operating near the edge of the deep-water lagoon area at South Reef. Monitoring at stations 50, 100 and 200 m downstream of the rig and at five different water depths confirmed that the discharges were rapidly diluted in the upper

10 m water layer and no elevations in water quality monitoring parameters (e.g., total nitrogen, total phosphorous and selected metals) were recorded above background levels at any station (Woodside, 2011). Conditions associated with this example at Scott Reef are considered conservative given the high numbers of personnel onboard a drill rig compared with seismic survey vessels, and the environment much less dispersive than vessels that are in constant movement in Bass Strait.

Discharges of treated sewage and grey water will be rapidly diluted in the surface layers of the water column and dispersed by currents. The biological oxygen demand (BOD) of the treated effluent is unlikely to lead to oxygen depletion of the receiving waters (Black *et al.*, 1994), as it will be treated prior to release. On release, surface water currents will assist with oxygenation of the discharge.

For the following reasons, the impact treated sewage discharges to the marine environment will have very low consequences to marine life:

- Low and intermittent discharge volumes;
- Treatment of the waste stream prior to discharge;
- High dilution and dispersal factor in open waters;
- Localised area of impact; and
- High biodegradability and low persistence of the waste.

7.5.4. Control Measures & Impact Consequence

The following control measures will be implemented to minimise the impacts of sewage and grey water discharges:

- Where sewage is treated in a STP, the STP meets MARPOL standards.
- The STP is maintained in accordance with the vessel's PMS.
- Sewage is comminuted, disinfected and discharged when:

- Vessel is >3 nm from nearest land.
- Sewage originating in holding tanks is discharged at a moderate rate (in accordance with Regulation 11 of MARPOL Annex IV, as defined by Marine Order 96) while the vessel is proceeding en-route at a speed not less than 4 knots.
- In the event of a STP malfunction, untreated sewage and grey water is only discharged when the vessel is greater than 12 nm from shore in accordance with Regulation 11 of MARPOL Annex IV (enacted by AMSA Marine Orders Part 96, Sewage).

The residual (post-control) impact consequence is rated as 'insignificant.'

7.6. IMPACT: Discharge of Cooling and Brine Water

7.6.1. Hazard

Seawater is used as a heat exchange medium for cooling machinery engines on vessels. Brine is created through the vessel desalination processes for potable water generation.

Seawater is used as a heat exchange medium for cooling machinery engines and other equipment. Seawater is drawn up from the ocean, where it is de-oxygenated and sterilised by electrolysis (by release of chlorine from the salt solution) and then circulated as coolant for various equipment through the heat exchangers (in the process transferring heat from the machinery), and is then discharged to the ocean at depth (not at surface). Upon discharge, it will be warmer than the ambient water temperature and may contain low concentrations of residual biocide and scale inhibitors if they are used to control biofouling and scale formation.

The maximum cooling water discharge rate for the vessels that may be used is unknown. Also unknown is the temperature at which the heat exchangers are designed to discharge the cooling water at (generally several degrees Celcius above ambient sea temperature).

Brine water (hypersaline water) is created through the desalination process that creates freshwater for drinking, showers, cooking etc. This is achieved through reverse osmosis (RO) or distillation resulting in the discharge of seawater with a slightly elevated salinity (~10-15% higher than seawater). The freshwater produced is then stored in tanks on board. Upon discharge, the concentration of the brine is (based on other modern vessels) likely to range from 44-61 ppm, which is 9-26 ppm higher than seawater salt concentration (35 ppm). Brine concentration is dependent on throughput and plant efficiency.

7.6.2. Known and Potential Environmental Impacts

The known and potential environmental impact of cooling water and brine discharges are:

- Temporary and localised increase in sea water temperature, causing thermal stress to marine biota;
- Temporary and localised increase in sea surface salinity, potentially causing harm to fauna unable to tolerate higher salinity; and
- Potential toxicity impacts to marine fauna from residual biocide and scale inhibitors.

The EMBA for cooling water and brine discharges associated with vessel activities is likely to be the top 10 m of the water column and a 100 m radius from the discharge point. This is based on modelling of continuous wastewater discharges undertaken by Woodside for its Torosa South-1 drilling program (in the Scott Reef complex), which found that discharge water temperature decreases quickly as it mixes with the receiving waters, with the discharge water temperature being less than 1°C above background levels within 100 m (horizontally) of the discharge point, and will be within background levels within 10 m vertically (Woodside, 2008).

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Plankton;
- Pelagic fish;
- Cetaceans;
- Pinnipeds; and
- Avifauna.

7.6.3. Evaluation of Environmental Impacts

Once in the water column, cooling water will remain in the surface layer, where turbulent mixing and heat transfer with surrounding waters will occur. Prior to reaching background temperatures, the impact of increased seawater temperatures down current of the discharge may result in changes to the physiological processes of marine organisms, such as attraction or avoidance behaviour, stress or potential mortality.

Modelling of continuous waste water discharges (including cooling water) undertaken by Woodside for its Torosa South-1 drilling program in the Scott Reef complex found that discharge water temperature decreases quickly as it mixes with the receiving waters, with the discharge water temperature being less than 1°C above background levels within 100 m (horizontally) of the discharge point, and will be within background levels within 10 m vertically (Woodside, 2008). As such, impacts to most receptors are expected to be negligible even within this zone.

Brine water will sink through the water column where it will be rapidly mixed with receiving waters, and dispersed by ocean currents. Walker and MacComb (1990) found that most marine species are able to tolerate short-term fluctuations in water salinity in the order of 20-30‰, and it is expected that most pelagic species passing through a denser saline plume would not suffer adverse impacts. As such, impacts to most receptors are expected to be negligible.

The scale inhibitors and biocides are inherently safe at the low dosages used, as they are usually 'consumed' in the inhibition process, ensuring there is little or no residual chemical concentration remaining upon discharge.

7.6.4. Control Measures & Impact Consequence

The following control measures will be implemented to minimise the impacts of cooling and brine water discharges:

- Engines and associated equipment that require cooling by water will be maintained in accordance with the vessel PMS so that they are operating within accepted parameters.

- The vessel contractor ensures that only low-toxicity biocides and scale inhibitors (e.g., ONCS 'gold'/'Silver' [CHARM] or 'D'/'E' [non-CHARM]) are used in the cooling and brine water systems.

The residual (post-control) impact consequence is rated as 'insignificant.'

7.7. IMPACT: Discharge of Putrescible Waste

7.7.1. Hazard

The generation of food waste from the vessel galleys will result in the discharge of macerated putrescible waste in Commonwealth waters.

It is expected that the average volume of putrescible waste discharged overboard from each vessel will vary depending on the number of Persons on Board (POB) and the types of meals prepared, but would be in the order up to 10-20 kg/day (spread out over each meal service).

7.7.2. Known and Potential Environmental Impacts

The known and potential environmental impacts of putrescible waste discharge are:

- Temporary and localised increase in the nutrient content of surface waters surrounding the discharge point; and
- An associated increase in scavenging behaviour of marine fauna and seabirds.

The EMBA for putrescible waste discharges is likely to be the top 10 m of the water column and a 100 m radius from the discharge point.

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Plankton;
- Pelagic fish;
- Cetaceans;
- Pinnipeds; and
- Avifauna.

7.7.3. Evaluation of Environmental Impacts

The overboard discharge of macerated food wastes has the result of creating a localised and temporary increase in the nutrient load of the surface waters. This may in turn act as a food source for scavenging marine fauna or seabirds, whose numbers may temporarily increase as a result. However, the rapid consumption of this food waste by scavenging fauna, and its physical and microbial breakdown, ensures that the impacts of putrescible waste discharges are insignificant.

7.7.4. Control Measures & Impact Consequence

The following control measures will be implemented to minimise the impacts of putrescible waste discharges:

- A Garbage Management Plan is in place (for vessels >100 gross tonnes or certified to carry 15 persons or more) that sets out the procedures for minimising, collecting, storing, processing and discharging garbage.

- A food macerator is on board, functional, in use and set to macerate to ≤ 25 mm.
- Macerated putrescible waste is only discharged overboard when the vessel is greater than 3 nm from the coastline.
- Un-macerated putrescible waste is only discharged overboard when the vessel is greater than 12 nm from the coastline.
- Non-putrescible galley waste is returned to shore for disposal.

The residual (post-control) impact consequence is rated as 'insignificant.'

7.8. IMPACT: Discharge of Bilge Water and Deck Drainage

7.8.1. Hazard

Bilge tanks receive fluids from closed deck drainage and machinery spaces that may contain contaminants such as oil, detergents, solvents, chemicals and solid waste. An oily water separator (OWS) then treats this water prior to discharge overboard in order to meet the MARPOL requirement that no greater than 15 ppm oil-in-water (OIW) is discharged overboard. The volume of these discharges is small and intermittent (as required, based on bilge tank storage levels).

Decks that are not banded and drain directly to the sea may lead to the discharge of contaminated water, caused by ocean spray and rain ('green water') or deck washing activities capturing trace quantities of contaminants such as oil, grease and detergents, or a chemical or hydrocarbon spill or leak washed overboard.

7.8.2. Known and Potential Environmental Impacts

The known and potential environmental impacts of the discharge of bilge water and deck drainage are:

- Temporary and localised reduction of surface water quality around the discharge point; and
- Acute toxicity to marine fauna through ingestion of heavily contaminated water (in the event of malfunction of the OWS or an uncontrolled spill emanating from an open drainage area).

7.8.3. EMBA

The EMBA for bilge water discharges is likely to be the top 10 m of the water column and a 100 m radius from the discharge point.

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Plankton;
- Pelagic fish;
- Cetaceans;
- Pinnipeds; and
- Avifauna.

7.8.4. Evaluation of Environmental Impacts

Small volumes and low concentrations of oily water (<15 ppm) from bilge discharges and traces of chemicals or hydrocarbons discharged to the ocean through open deck drainage may temporarily reduce water quality.

These discharges will be rapidly diluted, dispersed and biodegraded to undetectable levels and will have negligible impacts to plankton and pelagic fish.

The small volumes and low concentrations of oily water from bilge discharges may temporarily reduce water quality. In the event the OWS malfunctions and discharges off-specification water, these impacts may occur, though this is only likely in a highly localised area (meaning that few individuals would be exposed).

7.8.5. Control Measures & Impact Consequence

The following control measures will be implemented to minimise the impacts of bilge water and deck drainage discharges:

- For vessels greater than 400 gross tonnes, all bilge water passes through a MARPOL-compliant OWS set to limit OIW to <15 ppm prior to overboard discharge.
- The OWS is maintained in accordance with the vessel PMS.
- The OWS is calibrated in accordance with the PMS to ensure the 15 ppm OIW limit is met.
- The residual oil from the OWS is pumped to tanks and disposed of onshore.
- Deck cleaning detergents are biodegradable.
- Hydrocarbon and chemical storage areas (process areas) are bunded and drain to the bilge tank (or equivalent).
- Portable bunds and/or drip trays are used to collect spills or leaks from equipment that is not contained within a permanently bunded area (non-process areas).
- The cable deck, cable storage and under-streamer reel areas are contained within a bund area (or bunded deck).
- Bunds (or drip trays) are to be emptied into a holding tank where the cable oil can be stored for re-use or appropriate disposal.
- Cable sections that are being drained, filled or flushed with cable oil are contained within the bunded area.
- Hoses and associated tools for pumping and filling cable sections will be kept in good operational condition and regularly checked for leaks.
- A cable oil filling procedure will be followed, or at a minimum ensure an operator is present at all times while cable oil is being pumped into a section, in order to ensure prompt shut down in the event of a spill.
- The vessel crew is competent in spill response and has appropriate response resources in order to prevent or minimise hydrocarbon or chemical spills discharging overboard.
- Spill response kits (fully stocked) and scupper plugs or equivalent drainage control measures are readily available to the deck crew and used in the event of a spill to deck to prevent or minimise discharge overboard.
- The vessel-specific Shipboard Marine Pollution Emergency Plan (SMPEP) is implemented in the event of a large spill of hydrocarbons or chemicals overboard.

The residual (post-control) impact consequence is rated as 'insignificant.'

7.9. RISK: Underwater Sound Interaction with Swimmers and Divers

7.9.1. Hazard

There is the potential that the seismic pulses will be audible to humans engaged in swimming or diving activities below the water surface.

The proposed acquisition area lies adjacent to the Gippsland shoreline. Nearshore areas may be used for recreational swimming (mainly in the summer months) and may be utilised for commercial and recreational diving (e.g., southern rock lobster fishing).

There are no recorded shipwrecks in the proposed operational area (see Section 5.5.2), so diving (if undertaken) is likely to be restricted to the nearshore reefs given the absence of other notable seabed features.

7.9.2. Potential Environmental Risks

Physiological risks

Three main physiological symptoms associated with high-level low-frequency sound sources have been identified in humans (NATO, n.d.):

- The first involves the Pacinian corpuscle, a sensor of the nervous system that is distributed throughout the epidermis and provides for vibrotactile sensitivity. The frequency response of the Pacinian corpuscles peaks at about 250 Hz, the most annoying frequency in divers' complaints of tingling and numbness.
- The second effect involves acoustically-forced vibrations of gas pockets in the gastrointestinal tract, which may be responsible for complaints of abdominal discomfort.
- The third major effect is one involving TTS in hearing caused by the high levels of sound.

Social risks

During the summer especially, the coastline adjacent to the proposed survey area is an important tourism destination (see Section 5.6.5). The STLM results indicate that restrictions on swimming and diving will be required to protect people from harm at certain times during the survey.

Pre-survey consultation and coordination with relevant community groups, government agencies and the wider regional community will minimise health risks to swimmers and economic effects associated with a temporary restriction on swimming and diving in the area, such as the temporary loss of tourists from the area.

Thresholds adopted by STLM

The following information is sourced from the JASCO STLM report (McPherson *et al.*, 2017).

The human ear under water is about 20 dB less sensitive than in air at low frequencies (20 Hz), increasing to 40 dB at mid-frequencies (< 1 kHz), and increasing to 70–80 dB at higher frequencies.

Divers wearing a neoprene hood have even higher hearing thresholds above 500 Hz due to sound absorption by the hood material at high frequencies (Parvin, 1998). Fothergill et al (2000, 2001) exposed divers to pure tones of constant frequency as well as sweeps and asked divers to rate the sound they heard on a severity scale. The auditory threshold of hearing under water was lowest at 1 kHz (SPL of 70 dB re 1 μ Pa) and rose for lower and higher frequencies to about 120 dB re 1 μ Pa at 20 Hz and at 20 kHz (Parvin, 1998). For frequencies between 100 and 500 Hz, at a received SPL of 130 dB re 1 μ Pa, divers and swimmers were able to detect body vibration (Fothergill *et al.*, 2001). None of the divers tested rated levels of 140 dB re 1 μ Pa as “very severe”; however, at 157 dB re 1 μ Pa, sound was rated as “very severe” 19% of the time. No physiological damage was seen at the highest levels tested: 160 dB re 1 μ Pa (Fothergill *et al.*, 2001). As a result of such controlled diver exposure experiments, the following recreational diver exposure criteria were suggested:

- For frequencies between 100 and 500 Hz, the maximum SPL should be 145 dB re 1 μ Pa over a maximum continuous exposure of 100 seconds or with a maximum duty cycle of 20% and a maximum daily cumulative total of 3 hours (Pestorius *et al.*, 2009).
- For frequencies between 500 and 2,500 Hz, an increasing number of divers rated the sound as “very severe” at received levels above 155 dB re 1 μ Pa. The tolerance limit for bareheaded divers and swimmers was between 167 and 185 dB re 1 μ Pa, with divers exhibiting dizziness and disorientation.

Table 7.33 summarises the biological effects of underwater sound as reported by Parvin (2005).

A safety criterion of 155 dB re 1 μ Pa for frequencies between 500 and 2,500 Hz was therefore suggested (Parvin *et al.*, 2002) and has been adopted for this project. This is supported by a literature review undertaken by Ainslie (2008), which suggests that a safety criterion of 155 dB re 1 μ Pa for frequencies between 500 and 2,500 Hz is appropriate for non-military or non-alerted divers.

It is important to note that the 155 dB re re 1 μ Pa SPL criterion applied in the STLM is not one that implies the onset of injury to humans. Exposure studies related to divers have typically focused on military sonar exposure, with little information on seismic surveys. A precautionary safety criterion for divers for exposure to low frequency active sonar with signals between 500 and 2,500 Hz of 155 dB re 1 μ Pa (SPL) is commonly applied (including for shipping and port operations and international dive sites). This level is clearly audible above diver self-noise (breathing), but has not been shown to cause any physical injury. Because the majority of energy from an airgun array is below 500 Hz, and to add a further level of precaution, the safety criterion is assessed over the entire modelled frequency range (5 Hz to 25 kHz).

Table 7.33 Biological effects of underwater sound

SPL dB re 1uPa	Effect (500 to 2,500 Hz)
100 – 500 Hz (low frequency)	
170+	Tolerance limit for divers and swimmers. Sound causes lung and body vibration.
148-157	The loudness and vibration levels become increasingly aversive. Some divers will contemplate aborting an open water dive.
140-148	A small number of divers rate the sound as “very severe”.
136-140	The sound is clearly audible. The majority of divers tolerate the sound well with only “slight” aversion.
130	Divers and swimmers able to detect body vibration.
80-100	Auditory thresholds.
500 to 2,500 Hz	
190+	Hooded diver tolerance limit.
167-185	Tolerance limit for bareheaded divers and swimmers. Sound causes dizziness and disorientation. Divers in suit and hood are able to tolerate the sound well.
155-166	Divers tolerate these sounds well, although an increasing number of bareheaded divers indicate a ‘severe’ aversion rating.
140-154	Sound is clearly audible to divers. Sound is tolerate well with only slight aversion.
100-140	Divers hear underwater sound, but it is masked by exhaust bubble sound.
80	Hearing threshold for hooded divers.
65	Hearing threshold for barehead divers.

Source: Parvin (2005).

STLM results

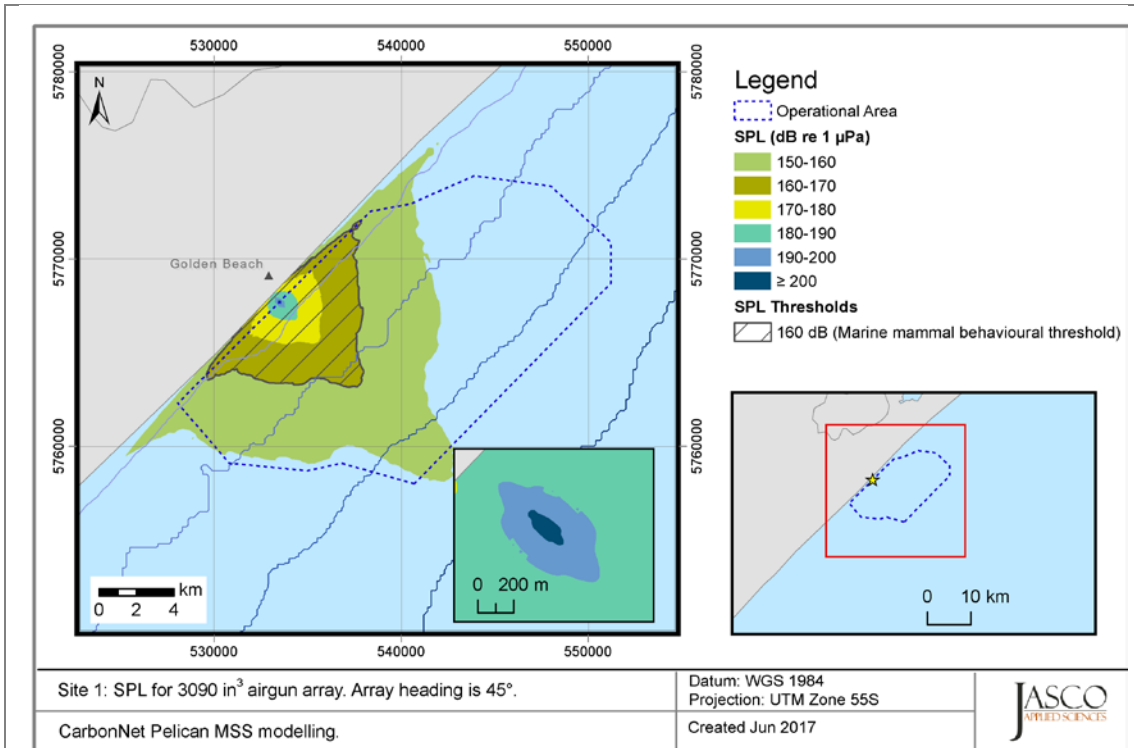
Table 7.34 presents the per-pulse results at the underwater sound modelling locations, showing estimated ranges for the per-pulse effects criterion for divers. The modelling results indicate that the R_{max} ranges for distances to reach threshold range from a low of 8.1 km (site 1, shallowest water) to 12.3 km (site 3, mid-depth).

Table 7.34. Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances from the source array to modelled maximum-over-depth diver safety criterion of SPL 155 dB re 1µPa

Site 1		Site 2		Site 3		Site 4		Site 5	
R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)
8.8	7.3	9.1	7.2	12.3	9.0	11.5	8.7	9.9	8.1

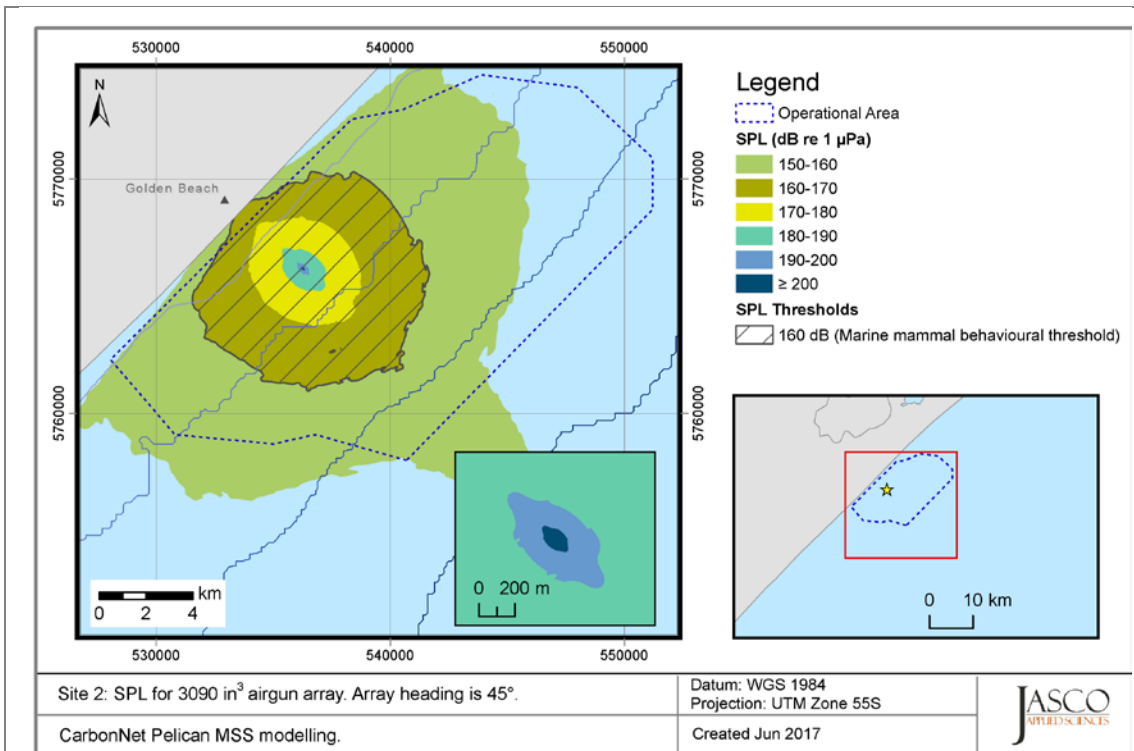
Cells highlighted in red indicate maximum predicted extent of sound.

Figure 7.9 to Figure 7.13 illustrate these results.



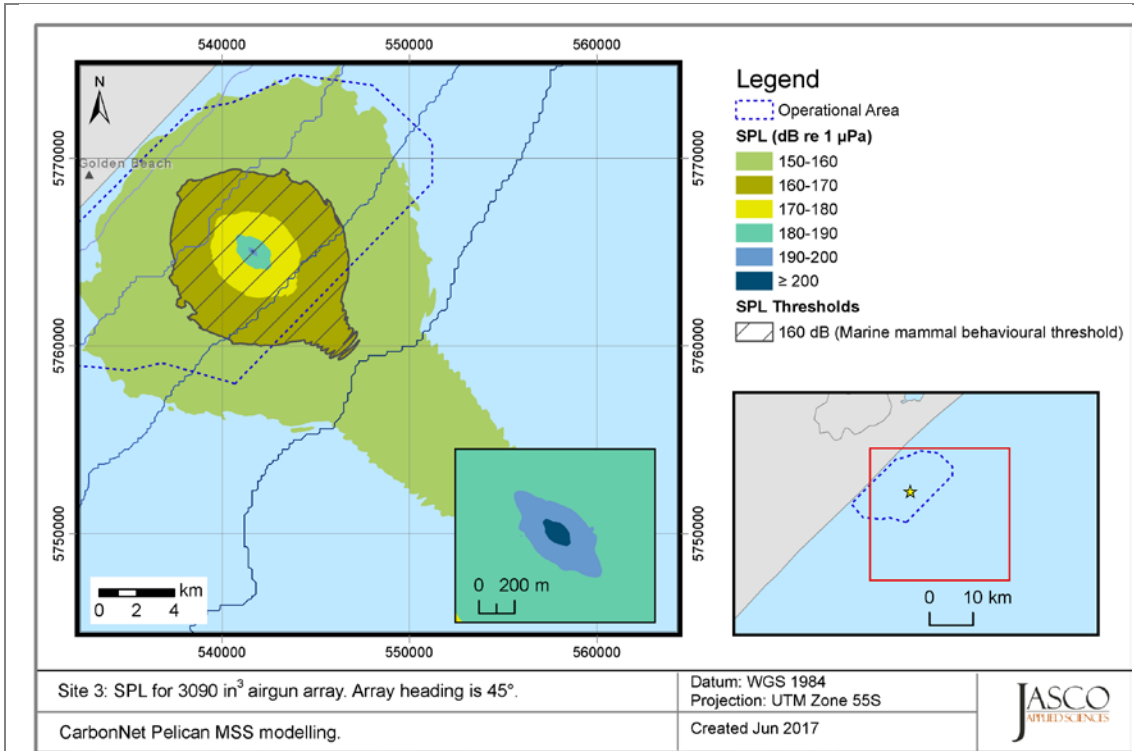
Source: McPherson (2017).

Figure 7.9. Sound level contour map showing maximum-over-depth per-pulse SPL results at site 1 (representative of the shallowest water location)



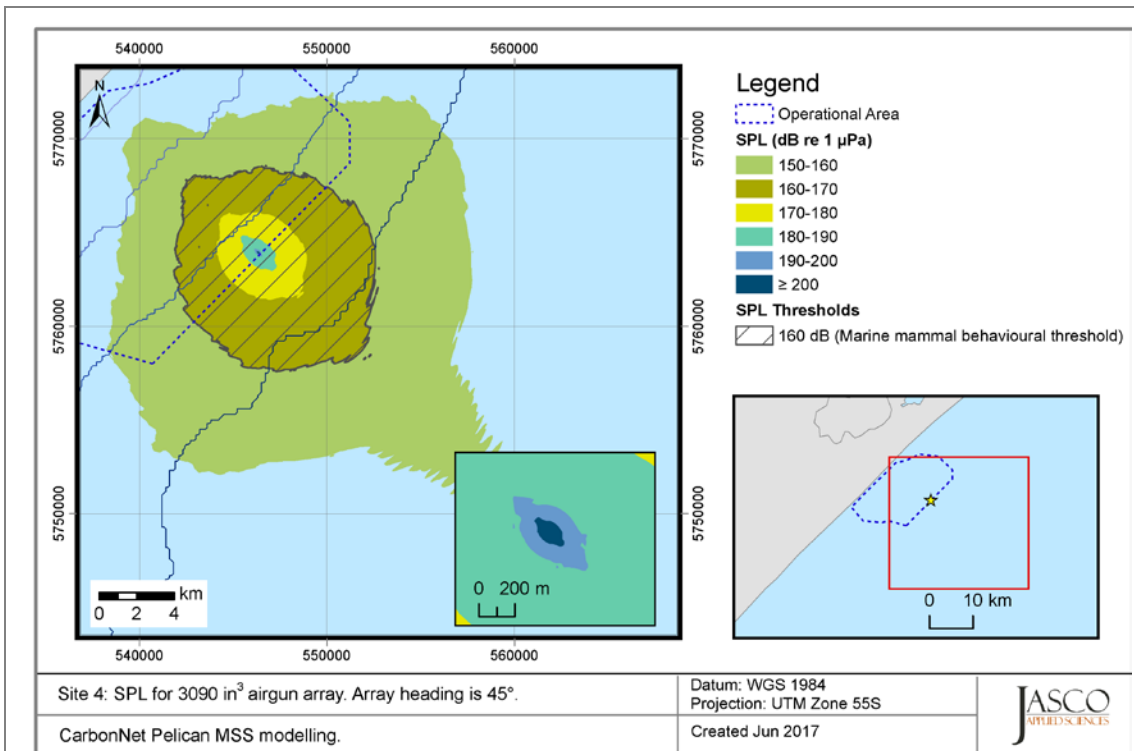
Source: McPherson (2017).

Figure 7.10. Sound level contour map showing maximum-over-depth per-pulse SPL results at site 2



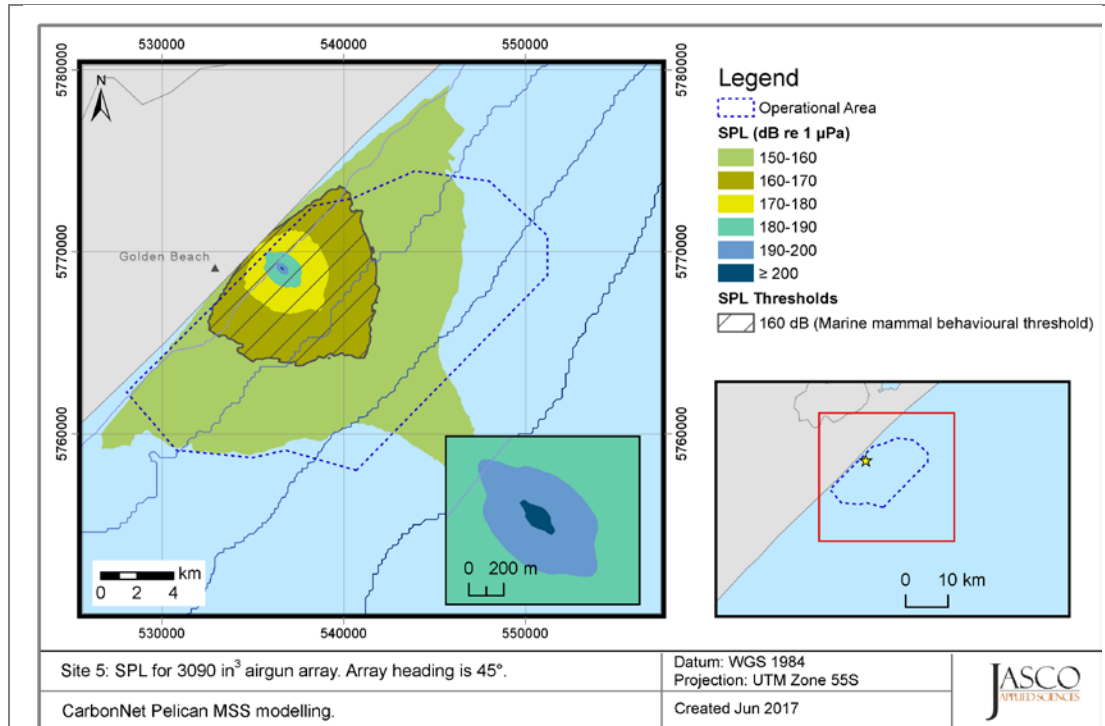
Source: McPherson (2017).

Figure 7.11. Sound level contour map showing maximum-over-depth per-pulse SPL results at site 3



Source: McPherson (2017).

Figure 7.12. Sound level contour map showing maximum-over-depth per-pulse SPL results at site 4 (representative of the deepest water)



Source: McPherson (2017).

Figure 7.13. Sound level contour map showing maximum-over-depth per-pulse SPL results at site 5

7.9.3. Evaluation of Environmental Risks

Physiological Risks

Limited research has been undertaken into the impacts of underwater low frequency sound on humans. Available studies have concentrated on frequency bands 100 to 500 Hz (as most seismic survey energy is produced at frequencies below 500 Hz) and 500 to 2,500 Hz. Table 7.33 details the bio-effects of low frequency sound (100 to 500 Hz) based on available research (Parvin, 2005).

DMAC (2011) reports that the intensity of the sound experienced by a diver is dependent on the power of the seismic airgun array and the distance between the diver and the seismic airgun, but other factors may have important effects. These factors include the:

- Water depth at which the seismic activity takes place;
- Presence of thermoclines (layering due to changes in temperature);
- Depth of the diver versus the depth of the thermocline;
- Bottom conditions;
- Salinity; and
- Sea state.

The multiple factors involved make it difficult to determine a safe or tolerable distance between seismic survey activities and diving, particularly in shallow water (DMAC, 2011).

Social Risks

Noting that Parks Victoria have signage in place advising the public that Golden Beach and the Ninety Mile Beach are not suitable for swimming and directing them to the patrolled beach at Seaspray, if people are advised against swimming or diving in the area as a result of the MSS (albeit for a very short duration), this should not result in additional inconvenience or a reduced visitor experience given the signed warnings currently in place.

Table 7.35 presents the length of shoreline intersected by and the distances from the sound isopleths for each of the STLM modelling sites, with the first two columns being the band within with the 150-160 SPL dB re 1 μ Pa safety criterion falls. This presents the length of coastline in which it is recommended that swimmers and divers are advised not to enter while the survey vessel is acquiring and close to shore. The length of coastline affected moves with the vessel.

The length of shoreline affected by sound levels greater than 170 dB re 1 μ Pa (representing the human tolerance limit, as outlined in Table 7.33) is restricted to a shoreline length of 375 m, and only from site 1. The distances from the shoreline for sound levels greater than 170 dB re 1 μ Pa for the other modelling sites are generally those that are too far for most swimmers to venture into. As a precautionary measure, people may need to be excluded from swimming and diving close to the shore by a beach patrol when the survey vessel is acquiring data in the western half of the acquisition area.

There will be periods during line turns (that may last for up to 90 minutes each) when there may be no restrictions on swimming or diving activity because the sound source is either not in acquisition mode or is in low-power ramp up mode.

Table 7.35. Length of shoreline intersected by the sound isopleths (SPL dB re 1 µPa) and distance of sound isopleths from the shoreline

Modelling site	150 dB contour*		160 dB contour*		170 dB contour		180 dB contour		190 dB contour		200 dB contour	
	L	D	L	D	L	D	L	D	L	D	L	D
1	3,000 m	N/A	1,250 m	N/A	375 m	N/A	0	110 m	0	440 m	0	675 m
2	1,450 m	N/A	0	700 m	0	1,200 m	0	2,700 m	0	3,500 m	0	3,800 m
3	0	1,700 m	0	1,000 m	0	5,900 m	0	7,200 m	0	8,000 m	0	8,300 m
4	0	800 m	0	600 m	0	9,900 m	0	11,300 m	0	12,300 m	0	12,500 m
5	3,000 m	N/A	750 m	N/A	0	150 m	0	780 m	0	1,500 m	0	1,900 m
6	2,250 m	N/A	600 m	N/A	0	145 m	0	650 m	0	1,400 m	0	1,600 m

L = length of shore intersected (in metres).

D = distance from shore (in metres).

N/A = not applicable because of intersection with the shoreline.

* Contour bands relevant to the 155 dB re 1 µPa safety criterion.

The absence of shipwrecks within the operational area and immediate surrounds, and the absence of notable reefs (along with the absence of dive shops in towns adjacent to the survey area, such as Golden Beach and Seaspray) suggest that diving is unlikely to be a popular recreational (or commercial) pursuit in the operational area. As such, impacts to divers from the proposed survey are likely to be negligible.

7.9.4. Control Measures & Risk Assessment

The following control measures will be implemented to minimise the risk of underwater sound to swimmers and divers:

- The MSS will not take place during the Christmas holiday period (24th December 2017 through to the Australia Day long weekend, ending 28th January 2018) so as to minimise interactions with holidaymakers.
- CarbonNet has consulted and will continue to consult with identified local recreational groups and diving stakeholders so that awareness of hazards to swimmers and divers from the survey are widely known and understood.
- Before and during the survey, swimmers and divers will be advised that it is recommended that no swimming or diving in beaches adjacent to the survey vessel takes place for the duration of the survey. This will be undertaken by:
 - Advertising in local media advising of the MSS timing and recommending that swimming and diving do not take place adjacent to the vessel at the time of the survey.
 - Providing notifications at local towns (i.e., Golden Beach, Paradise Beach, Seaspray) immediately prior to and during the MSS to advise of the survey activity.
 - Roving project personnel patrolling the beaches adjacent to the survey will recommend that people don't swim or dive adjacent to the survey vessel during seismic acquisition.
 - Support Vessel Masters will monitor for 'diver below' flags (a white and blue flag, or red flag with white diagonal stripe) in the operational area and liaise with any commercial or recreational vessels in the area to advise them to leave the operational area.
 - CarbonNet has emergency management procedures.

In order to rate the likelihood and consequence of physiological impacts to swimmers and divers from the Pelican 3DMSS, CarbonNet took into consideration:

- Existing data about the use of the shoreline adjacent to the survey area;
- Consultation with the managers of shoreline assets;
- The results of the STLM commissioned by CarbonNet;
- Advice from underwater sound modelling experts;
- Feedback received through stakeholder consultation (specifically regarding avoidance of key holiday times);
- A review of recent scientific papers and studies; and
- The reduced sound source now specified for the survey vessel operator.

Table 7.36 presents the residual risk assessment for the underwater sound interaction with swimmers and divers.

Table 7.36. Residual risk assessment for underwater sound interaction with swimmers and divers (using safety definitions of consequence)

Likelihood	Consequence	Risk rating
Rare	Minor	Low

7.10. RISK: Seabed Disturbance

7.10.1. Hazard

Activities that may result in seabed disturbance include:

- Streamer drag;
- Vessel grounding (in shallow waters);
- Vessel thruster/propeller wash (in shallow waters);
- Dropped objects (including streamers);
- Vessel anchoring (in emergency situations only); and
- Deployment and retrieval of loggers at the seabed (for sound validation, see Section 2.7.2).

7.10.2. Potential Environmental Risks

The potential environmental risks of seabed disturbance are:

- Localised turbidity of the water column at the seabed;
- Damage to reef structures; and
- Displacement of a small area of seabed habitat by dropped object (if not recovered).

These impacts may result in temporary disturbance, displacement or smothering of benthic habitats and fauna.

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Plankton;
- Benthic fauna;
- Benthic habitat (sand and reef substrates); and
- Pelagic fish.

7.10.3. Evaluation of Environmental Risks

Turbidity may occur when seabed sediments are stirred up, and may result from anchor deployment and deployment/retrieval of sound logger bottom plate assembly, weights and ground line, and in the shallowest waters of the proposed operational area (when there is the smallest clearance between the bottom of the vessels and the seabed), thruster or propeller wash, streamer drag or vessel grounding may also result in turbidity.

Any turbidity created is likely to be within the limits of natural variability when considering the turbidity created by tides and crashing waves in the nearshore environment. This turbidity would temporarily inhibit light penetration into the water column, but given its temporary nature would be unlikely to inhibit any macroalgae growth. Benthic fauna living in sediment (endobenthos) or on sediment (epibenthos) may be temporarily displaced by this turbidity.

The rocky reefs present in discontinuous patches in the proposed acquisition area (as described in Section 5.1.3 and Section 5.4.1) may be damaged through streamer drag, dropped objects, emergency anchoring or vessel grounding. Sound loggers will not be deployed on rocky reef. As the discontinuous reef outcrops are no higher than 1.5 m from the surrounding seabed, and the shallowest point of the proposed acquisition area is 15 m and the streamers will be towed at 5 m (\pm 1 m) below sea level, there will be a vertical separation of between 7.5 and 10 m between the streamers and the reef outcrops. This vertical separation makes it highly unlikely that there will be damaged through streamer drag.

Physical contact with the reef (e.g., streamer drag dislodging macroalgae and sponges) may result in some damage to the reef structure, but any loss of habitat and displacement of associated fauna is likely to be temporary, with individuals rapidly recolonising bare and exposed damaged areas.

Dropped objects would have the impact of smothering benthic habitat and fauna. Impacts from the loss of equipment overboard (assuming no buoyancy) would be the localised and temporary loss of a small area of benthic habitat. If the equipment lost overboard is solid and not recovered, it is likely to provide additional suitable substrate for benthic flora and fauna to colonise (much like subsea infrastructure, such as pipelines and wellheads provide).

7.10.4. Control Measures & Risk Assessment

The following control measures will be implemented to minimise the risk of seabed disturbance:

- The survey and support vessels will only anchor in emergency conditions (e.g., loss of propulsion power).
- Detailed bathymetric mapping will be acquired and used in survey planning to ensure that seabed obstacles are identified and accommodated in the final survey design.
- Only source and support vessels suitable for work in shallow waters (e.g., fitted with depth sounders) will be contracted.
- Vessel Masters use bathymetric mapping and GPS to avoid seabed obstacles and monitor vessel and source equipment clearances via depth sounders to ensure there is clearance at all times between the vessel and the seabed.
- The vessel crew will adjust the depth of the streamers (using the streamer depth controllers, or 'birds') to keep the streamers clear of the seabed. Depths will be monitored by the crew during acquisition and on line changes, with minimum clearances taken into account prevailing currents and weather conditions.
- The seismic crew deploy the seismic source and streamers in accordance with the contractor's approved procedures for operating in shallow waters.
- Streamers are fitted with streamer retrieval devices (SRD) that inflate when the SRD reaches a maximum depth. The tail of each streamer has an RGPS tailbuoy. If a streamer is lost then the RGPS position of the tailbuoy combined with the visual presence of the SRDs would be used to locate and retrieve it. The sources are all suspended from floats and each float will be fitted with an RGPS unit.
- The vessel contractor's Matrix of Permitted Operations (MOPO) (or equivalent, which sets limits for certain activities dependant on weather conditions) will be used to guide the deployment of streamer and source equipment so that damage to (and potential loss of) equipment caused by rough seas is avoided.

- Large bulky items are securely fastened to or stored on the deck to prevent loss to sea.
- The crane handling and transfer procedure is in place and implemented by crane operators (and others, such as dogmen) to prevent dropped objects.
- The crane operators are trained to be competent in the handling and transfer procedure to prevent dropped objects.
- Visual inspection of lifting gear is undertaken every quarter by a qualified competent person (e.g., maritime officer) and lifting gear is tested regularly in line with the vessel PMS.
- Qualified and experienced divers are engaged to recover dropped or snagged equipment if they represent a significant navigation hazard and cannot be easily recovered by other means.
- The base plate and/or weight/s used to keep the underwater sound loggers on site during the MSS will not be placed over mapped sensitive habitat, such as sponge gardens or reef.

Table 7.37 presents the residual risk assessment for underwater sound.

Table 7.37. Residual risk assessment for seabed disturbance

Likelihood	Consequence	Risk rating
Rare	Minor	Low

7.11. RISK: Accidental Overboard Release of Hazardous and Non-hazardous Waste

7.11.1. Hazard

The handling and storage of materials and waste on board a vessel has the potential for accidental overboard disposal of hazardous and non-hazardous materials and waste.

In the normal course of operations, solid and liquid hazardous and non-hazardous materials and wastes will be stored on the vessel until it is disposed of via port facilities for disposal at licensed onshore facilities. However, accidental releases to sea are a possibility, especially in rough ocean conditions when items may roll off or be blown off the deck.

7.11.2. Potential Environmental Risks

The potential risks of the release or accidental disposal of hazardous and non-hazardous materials and waste to the ocean are:

- Marine pollution (litter and a temporary and localised reduction in water quality);
- Injury and entanglement of individual animals (such as seabirds and seals); and
- Localised (and normally temporary) smothering or pollution of benthic habitats.

Receptors that may occur within the EMBA by waste discharges, either as residents or migrants, are:

- Plankton;
- Benthic fauna;
- Benthic habitat (sand and reef substrates);
- Pelagic fish;
- Cetaceans;
- Pinnipeds; and
- Avifauna.

7.11.3. Evaluation of Environmental Risks

Hazardous materials and wastes released to the sea cause pollution and contamination, with either direct or indirect effects on marine organisms. For example, chemical or hydrocarbon spills can (depending on the volume released) impact on marine life from plankton to pelagic fish communities, causing physiological damage through ingestion or absorption through the skin. Impacts from an accidental release would be limited to the immediate area surrounding the release, prior to the dilution of the chemical with the surrounding seawater. In an open ocean environment such as Bass Strait, it is expected that any minor release would be rapidly diluted and dispersed, and thus temporary and localised.

Solid hazardous materials, such as paint cans containing paint residue, batteries and so forth, would settle on the seabed if dropped overboard. Over time, this may result in the leaching of hazardous materials to the seabed, which is likely to result in a small area of substrate becoming toxic and unsuitable for colonisation by benthic fauna. The benthic habitats of the area are broadly similar to those elsewhere in the region (e.g., extensive sandy plains), so impacts to very localised areas of seabed will not result in the long-term loss of benthic habitat or species diversity or abundance.

Discharged overboard, non-hazardous wastes can cause smothering of benthic habitats as well as injury or death to marine fauna or seabirds through ingestion or entanglement (e.g., plastics caught around the necks of seals or ingested by seabirds and fish). For example, the TSSC (2015) reports that there have been 104 records of cetaceans in Australian waters impacted by plastic debris through entanglement or ingestion since 1998 (humpback whales being the main species).

7.11.4. Control Measures & Risk Assessment

The following control measures will be implemented to minimise the risk of accidental overboard disposal of hazardous and non-hazardous materials and waste:

- The controls listed below are in addition to those for 'seabed disturbance' provided in Section 7.10.4.
- Vessels >100 gross tonnes or certified to carry more than 15 people vessel will possess a Garbage Management Plan (GMP).
- Waste is stored, handled and disposed of in accordance with the GMP.
- Vessel crew and visitors are inducted into waste management procedures to ensure they understand how to implement the GMP.
- Wind-blown or solid waste overboard is recovered if reasonably practicable.

Table 7.38 presents the residual risk assessment for accidental overboard disposal of hazardous and non-hazardous materials and waste.

Table 7.38. Residual risk assessment for accidental overboard disposal of hazardous and non-hazardous materials and waste

Likelihood	Consequence	Risk rating
Rare	Minor	Low

7.12. RISK: Introduction of Invasive Marine Species

7.12.1. Hazard

The following activities have the potential to result in the introduction of IMS in the operational area:

- Discharge of vessel ballast water containing foreign species; and
- Translocation of foreign species through biofouling of the vessel hull, niches (e.g., sea chests, bilges, strainers) or in-water equipment (seismic source arrays and streamers).

The DAWR Biosecurity Department (formerly AQIS) indicates that ballast water is responsible for 20-30% of all marine pest incursions into Australian waters (DAWR, 2015). The DAWR declares that all saltwater from ports or coastal waters outside Australia's territorial seas presents a high risk of introducing foreign marine pests into Australia (AQIS, 2011).

Biofouling is the accumulation of aquatic microorganisms, algae, plants and animals on vessel hulls and submerged surfaces. More than 250 non-indigenous marine species have established in Australian waters, with research indicating that biofouling has been responsible for more foreign marine introductions than ballast water (DAWR, 2015).

7.12.2. Potential Environmental Risks

The potential risks of IMS introduction (assuming their survival, colonisation and spread) include:

- Reduction in native marine species diversity and abundance;
- Displacement of native marine species;
- Socio-economic impacts on commercial fisheries; and
- Changes to conservation values of protected areas.

Receptors most at risk from the introduction of IMS, either as residents or migrants, are:

- Benthic fauna (because of their limited ability to move to other suitable areas);
- Benthic habitat; and
- Pelagic fish.

7.12.3. Evaluation of Environmental Risks

Successful IMS invasion requires the following three steps:

1. Colonisation and establishment of the marine pest on a vector (e.g., vessel hull) in a donor region (e.g., home port).
2. Survival of the settled marine species on the vector during the voyage from the donor to the recipient region (e.g., project area).
3. Colonisation (e.g., dislodgement or reproduction) of the marine species in the recipient region, followed by successful establishment of a viable new local population.

At this point, the IMS is likely to have little or no natural competition or predation, thus potentially outcompeting native species for food or space, preying on native species or changing the nature of the environment.

Marine pest species can also deplete fishing grounds and aquaculture stock, with between 10% and 40% of Australia's fishing industry being potentially vulnerable to marine pest incursion (AMSA, n.d). For example, the introduction of the Northern Pacific seastar (*Asterias amurensis*) in Victorian and Tasmanian waters was linked to a decline in scallop fisheries.

The CoA (2009) states that the operational and maintenance needs of immersible seismic survey equipment means that they do not typically pose a threat for biofouling accumulation and translocation, though biofouling can be present in streamer joints and the gaps of collar joints.

7.12.4. Control Measures & Risk Assessment

The following control measures will be implemented to minimise the risk of introduction of IMS:

- CarbonNet undertakes a vessel contractor pre-qualification to ensure vessel biofouling controls meet these EP requirements. For vessels <500 gross tonnes and/or <50 m in length, CarbonNet will use the IMCA Marine Inspection for Small Workboats Inspection Template (IMCA, 2016) as part of the pre-qualification process.
- Vessels are managed in accordance with the National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (AQIS, 2009). This means:
 - Conducting in-water inspection by divers or inspection in drydock if deemed necessary.
 - Biofouling risk will be assessed, with cleaning of hull and internal seawater systems undertaken if deemed necessary.
 - Anti-fouling coating status taken into account, with antifouling renewal undertaken if deemed necessary.
- Any vessel >400 gross tonnes carries a current International Anti-fouling System (IAFS) Certificate and is compliant with and Marine Order Part 98 (Anti-fouling Systems).
- International vessels have fulfilled the requirements of the Australian Ballast Water Management Requirements (DAWR, 2016, v6) if they have mobilised from outside of Australian waters.
- Vessels only discharge low-risk domestic ballast water into Victorian state waters (on entry to a Victorian port and throughout the survey) in accordance with:
 - The Victorian Environment Protection (Ships Ballast Water) Regulations 2008.

- EPA Protocol for Environmental Management: Domestic Ballast Water Management in Victorian Waters (Publication 949.7, 2017).
- Risk assessment undertaken and submitted by the Vessel Master prior to entering Victorian state waters (<https://management.marinepests.gov.au/bw/>).
- Non-compliant discharges of domestic ballast water are reported to the EPA Victoria immediately.
- Suspected or known introductions of IMS will be reported to the DELWP immediately.
- In-water survey equipment will be cleaned (e.g., fouling is removed from streamer joints, collar joints, etc) prior to initial use in the proposed operational area.

Table 7.39 presents the residual risk assessment for the introduction of IMS.

Table 7.39. Residual risk assessment for the introduction of IMS

Likelihood	Consequence	Risk rating
Rare	Moderate	Low

7.13. RISK: Displacement of or Interference with Third-party Vessels

7.13.1. Hazard

The physical presence of the survey and support vessels and the survey streamers will result in the enforcement of an exclusion zone for the duration of the proposed survey for third-party vessel operators, such as commercial and recreational fishing vessels and merchant vessels.

7.13.2. Known and Potential Environmental Impacts

The known and potential impacts of the displacement of or interference with third-party vessels are:

- Diversion from navigation paths (leading to increased travel times and fuel usage/costs).
- Vessel damage (resulting in financial loss).
- Damage to or loss of fishing equipment and/or loss of commercial fish catches (resulting in financial loss).

Receptors most at risk are:

- Commercial and recreational fishing vessels;
- Commercial fishing equipment (e.g., trawl nets, lobster pots); and
- Merchant vessels.

7.13.3. Evaluation of Environmental Risks

The presence of the survey vessel (with trailing equipment) (and to a lesser extent, the support vessels) will temporarily exclude other users of the marine environment in order to protect the source and streamer equipment. Given that 84% of the proposed operational area occurs within the Bass Strait Area to be Avoided (see

Section 5.6.1), combined with the shallow waters of the proposed operational area, it is not expected that the survey and support vessels will encounter merchant vessels. In the unlikely scenario that they did encounter merchant vessels, the inability of the survey vessel to take sudden evasive action with streamers trailing means that the support vessels would engage the merchant vessel to change course. This may result in a negligible increase in travel time and fuel cost for merchant vessels, but in the context of an entire journey, this is not considered significant.

The consequence of displacing other users, such as commercial and/or recreational fishers, is considered negligible given the very sparse use of the area by fishers.

In the event of a vessel-to-vessel collision, health and safety impacts are more likely than environmental impacts. Should the force of a collision be enough to breach a vessel hull (which is unlikely due to the low speed of the source vessel and the low speed or stationary nature of the support vessels), a diesel spill may eventuate (this is addressed in Section 7.16).

Commercial (and recreational) fishing vessels will be excluded from operating within the survey area for the duration of the survey so as to protect the safety of third-party personnel (while also avoiding damage to the trailing survey streamers). Interactions between the survey and support vessels and third-party vessels is likely to be minimal, mostly because of the slow moving and stationary nature of the source vessel, its high visibility (due to size) and ease of manoeuvrability of the support vessels to avoid a collision. Due to this visibility, it is also unlikely that fishing gear (such as lobster pots or trawl nets) would be damaged, as fishing vessels would detour around the vessel/s once communication between the vessels is made.

In the event that third-party vessels breach the safety exclusion maintained by the support vessels, there is potential for fishing gear to become entangled in the survey streamers, resulting in damage or loss. In addition to the cost of repairing or replacing this equipment, it could also result in the loss of income from caught fish during that fishing expedition.

Given the short duration of the proposed survey and the low fishing intensity in the proposed operational area, the risk of interference with third-party vessels is negligible.

7.13.4. Control Measures & Risk Assessment

The following control measures will be implemented to minimise the risk of displacement of or interference with third-party vessels:

- CarbonNet has undertaken thorough pre-survey consultation with fishing stakeholders to ensure that commercial fishers are aware of the survey operations, timing and safety exclusion zone requirements.
- The AHO and TSV will be notified of survey activities at least a month prior to survey commencement to enable the promulgation of Notice to Mariners and AusCoast navigational warnings.
- The survey and support vessels are readily identifiable to third-party vessels.
- Visual and radar watch is maintained on the bridge of the source and support vessels at all times.
- The Vessel Master and deck officers have a valid SCTW certificate in accordance with AMSA Marine Order 70 (seafarer certification) (or equivalent) to operate radio equipment to warn of potential third party spatial

- conflicts (e.g. International Convention on Standards of Training, Certification and Watch-keeping for Sea-farers [STCW95], GDMSS proficiency).
- Prior to the survey commencing, CarbonNet will obtain approval from VFA to remove and relocate lobster pots or other fishing equipment that may be in the path of the survey vessel.
 - Prior to the survey commencing, CarbonNet will agree a protocol with lobster fishers (or representatives) for the removal and return of lobster pots during the MSS.
 - The Masters of the support vessels will remain alert for lobster pot buoys and notify the Master of the source vessel if they are sighted, so that they can be removed and returned at the earliest opportunity.
 - The Vessel Masters issue warnings (e.g., radio warning, flares, lights/horns) to third-party vessels approaching the safety exclusion zone in order to prevent a collision with the vessels or equipment.
 - Constant communication between the survey vessel and support vessels is maintained to ensure that the support vessels are patrolling the safety exclusion zone (defined as a 6 nm [11 km] radius around the survey vessel and streamers) at all times.
 - The tailbuoys on the seismic streamers will have flashing lights and radar reflectors so they are visible to other marine users.
 - The survey vessel(s) will display the appropriate lights and day shapes for a vessel with restricted ability to manoeuvre during survey operations.
 - One of the support vessels will remain in close proximity to the survey vessel (generally one ahead of the survey vessel and one astern of the tail buoys) at all times and will intercept approaching vessels that have not heeded radio advice about avoiding the safety exclusion zone.
 - CarbonNet will apply to NOPSEMA to enter and work within the Bass Strait 'Area to be Avoided' if the survey vessel is >200 gross tonnes.
 - The Vessel Master will sound the general alarm, manoeuvre the vessel to minimise the effects of the collision and implement all other measures as outlined in the vessel or structure collision procedure (or equivalent).
 - Vessel collisions will be reported to AMSA (for Commonwealth waters) or TSV (Victorian state waters) if that collision has or is likely to affect the safety, operation or seaworthiness of the vessel or involves serious injury to personnel.

Table 7.40 presents the residual risk assessment for the risk of displacement of or interference with third-party vessels.

Table 7.40. Residual risk assessment for the risk of displacement of or interference with third-party vessels

	Likelihood	Consequence	Risk rating
Displacement	Rare	Insignificant	Low
Interference	Rare	Moderate	Low

7.14. RISK: Damage to Marine Infrastructure

7.14.1. Hazard

Marine infrastructure known to occur in the proposed operational area are three subsea oil and gas pipelines (see Section 5.6.6 and Figure 5.52) and five P&A wells

(there are no wellheads associated with these). The presence of the survey and support vessels in shallow waters may result in contact with, and damage to the subsea pipelines if:

- Freeboard (clearance between the infrastructure and the bottom of the vessel hulls) is insufficient;
- The seismic streamers drag across the pipelines; or
- Pulses or peak particle velocities created by the seismic acquisition are greater than the tolerances of those pipelines.

7.14.2. Potential Risks

The potential risks of damage to the subsea pipelines are:

- Loss of pipeline integrity (due to pipeline movement or reduction in wall thickness), which would be unlikely to lead to a loss of hydrocarbons.
- Disruption to commercial petroleum production activities (i.e., temporary suspension of production from any of the Barracouta, Bream, Seahorse or Tarwhine wells).
- Oil or gas leak.

Receptors most at risk within this EMBA are:

- The pipeline infrastructure itself; and
- The source and support vessels.

7.14.3. Evaluation of Risks

CarbonNet commissioned RPS to undertake a technical review of the potential effects of the proposed MSS on pipelines. The following discussion presents these results (RPS, 2017).

Peak particle velocity (PPV) levels in the water at a point 5 cm above the seafloor have been estimated based on interpolation of the particle motion modelling results presented in the initial JASCO underwater STLM report (McPherson *et al.*, 2017). These results have been used to estimate the PPV vibration level in the seafloor at each pipeline location taking into account the change in acoustic impedance between sea water and the seafloor and the burial depth of the pipeline.

The *Code of practice for noise and vibration control on construction and open sites* (BS 5228-2:2009+A1:2014) provides indicative criteria for maximum PPV levels for buried services. The standard recommends maximum PPV for intermittent or transient vibrations of 30 mm/s. The standard goes on to note that “Even a PPV of 30 mm/s gives rise to a dynamic stress which is equivalent to approximately 5% only of the allowable working stress in typical concrete and even less in iron or steel.” Accordingly, it is considered that tolerances for the buried pipelines in this study are likely to be significantly higher than the 30 mm/s PPV recommended as a ‘catch all’ for buried services in the standard, with allowable stresses likely to be more than 20 times higher.

Based on the 30 mm/s criteria leading only to 5% allowable stress for concrete, and taking into account the even higher tolerances for steel pipelines, it is considered unlikely that the PPV levels resulting from this MSS would lead to excessive stress levels in the pipelines.

The Esso 3D survey that took place over these same pipelines in 2001, using an airgun array volume of 3,542 cui (higher than that proposed by CarbonNet and higher than the figure used for the PPV modelling) with an operating pressure of 2,000 psi, with the two airgun arrays towed at a depth of 6 m below the sea surface. It is likely that PPV levels would have been of a similar magnitude to those proposed in this survey and did not result in pipeline failure. This provides empirical evidence that MSS undertaken in the past have not led to pipeline failure.

The results of this assessment indicate that it is unlikely that the proposed Pelican 3DMSS will result in damage to EARPL's pipelines (and therefore a hydrocarbon release from the pipelines is not credible).

7.14.4. Control Measures & Risk Assessment

The following control measures will be implemented to minimise the risk of damage to marine infrastructure:

- CarbonNet has undertaken thorough pre-survey consultation with EARPL, as the operator of the subsea pipelines, to understand the implications of SIMOPs.
- The source array will not be activated directly over EARPL's pipelines and the sound volume will be reduced in close proximity to pipelines to avoid exceeding maximum PPV levels over pipelines in accordance with the Code of practice for noise and vibration control on construction and open sites (BS 5228-2:2009+A1:2014).
- CarbonNet will ensure that the survey contractor has the subsea pipelines marked in the vessels' navigation displays that enables decisions to be made regarding real-time access over the pipelines (with regard to tides, freeboard and survey streamer positioning within the water column).
- The survey contractor will track tide movements and predictions using the BoM (Victorian Tide Charts) predictions for the Barracouta platform (and other sources as relevant) that enables real-time decisions to be made regarding working within the shallower parts of the acquisition area.
- CarbonNet and EARPL will undertake a joint SIMOPs workshop prior to the survey commencing to ensure that all hazards to both parties are understood and communicated between the parties.
- CarbonNet will advise EARPL of the survey commencement date and maintain ongoing communications during survey operations.
- The CarbonNet Project Director, or delegate, reports damage to EARPL as soon as possible after becoming aware of an incident of pipeline damage.
- The CarbonNet Project Director, or delegate, reports damage to NOPSEMA and ERR within 2 hours of becoming aware of the incident.

Table 7.41 presents the residual risk assessment for damage to marine infrastructure.

Table 7.41. Residual risk assessment for the risk of damage to marine infrastructure

	Likelihood	Consequence	Risk rating
Damage to pipelines	Rare	Major	Low
Damage to vessels	Rare	Moderate	Low

7.15. RISK: Vessel Strike or Entanglement with Megafauna

7.15.1. Hazard

The movement of the survey and support vessels throughout the operational area, together with the presence of seismic streamers, has the potential to result in collision or entanglement with megafauna, this being cetaceans and pinnipeds.

7.15.2. Potential Environmental Risks

The known and potential impacts of vessel strike or entanglement with towed streamers to cetaceans and pinnipeds are:

- Injury; and
- Death.

7.15.3. Evaluation of Environmental Risks

Cetaceans and pinnipeds are naturally inquisitive marine mammals that are often attracted to offshore vessels, and dolphins commonly 'bow ride' with offshore vessels. The reaction of whales to the approach of a vessel is quite variable. Some species remain motionless when in the vicinity of a vessel while others are known to be curious and often approach ships that have stopped or are slow moving, although they generally do not approach, and sometimes avoid, faster moving ships (Richardson *et al.*, 1995).

Collisions between vessels and cetaceans occur more frequently where high vessel traffic and cetacean habitat coincide (WDCS, 2006). There have been recorded instances of cetacean deaths in Australian waters (e.g., a Bryde's whale in Bass Strait in 1992) (WDCS, 2006), though the data indicates this is more likely to be associated with container ships and fast ferries. Some cetacean species, such as humpback whales, can detect and change course to avoid a vessel (WDCS, 2006).

The DoE (2015b) reports that there were two blue whale strandings in Victoria in the Bonney Upwelling with suspected ship strike injuries visible. When the vessels are stationary or slow moving, the risk of collision with cetaceans is extremely low, as the vessel sizes and underwater noise 'footprint' will alert cetaceans to its presence and thus illicit avoidance. Laist *et al* (2001) identifies that larger vessels moving in excess of 10 knots may cause fatal or severe injuries to cetaceans with the most severe injuries caused by vessels travelling faster than 14 knots.

The DSEWPC (2012b) notes that entanglement in nets and lines to whales often cause physical damage to skin and blubber. These wounds can then expose the animal to infection. Entanglement can also result in amputation (e.g., of a flipper or tail fluke), and death over a prolonged period.

The survey vessel will be travelling at a maximum of about 4.5 knots (8.3 km/hr) while acquiring seismic data (with the support vessels generally travelling at a similar speed or remaining stationary for long periods), thus minimising the risk of injury to megafauna. Combined with the low likelihood of presence of southern right whales and humpback whales in and around the operational area during the proposed survey period, and the lack of a defined migration route for pygmy blue whales in the Gippsland region, it is unlikely that vessel strike or streamer entanglement with threatened whales will occur.

The Australian and New Zealand fur-seals are highly agile species that haul themselves onto rocks and oil and gas platform structures (jackets). As such, it is likely that they will be able to avoid seismic streamers and are unlikely to become entangled within them (especially with horizontal separation between the streamers being about 50 m).

7.15.4. Control Measures & Risk Assessment

The following control measures will be implemented to minimise the risk of megafauna vessel strike and streamer entanglement:

- The Australian Guidelines for Whale and Dolphin Watching (DEWHA, 2005) for sea-faring activities will be implemented, which means:
 - Caution zone (300 m either side of whales and 150 m either side of dolphins) – vessels must operate at no wake speed in this zone.
 - No approach zone (100 m either side of whales and 50 m either side of dolphins) – vessels should not enter this zone and should not wait in front of the direction of travel or an animal or pod/group.
 - Do not encourage bow riding.
 - If animals are bow riding, do not change course or speed suddenly.
 - If there is a need to stop, reduce speed gradually.
- Vessel crew has completed an environmental induction covering the above-listed requirements for vessel and megafauna interactions.
- Vessel strike causing injury to or death of a cetacean is reported to the DoEE via the online National Ship Strike Database within 72 hours of the incident.
- Entanglement of megafauna in survey streamers is reported to the Whale and Dolphin Emergency Hotline as soon as possible. No attempts to disentangle megafauna should be made by project personnel.

Table 7.42 presents the risk assessment for megafauna vessel strike and streamer entanglement.

Table 7.42. Risk assessment for megafauna vessel strike and streamer entanglement

	Likelihood	Consequence	Risk rating
Individual animal	Unlikely	Insignificant	Low
Population level	Rare	Minor	Low

7.16. RISK: Diesel Spill

7.16.1. Hazard

The survey and support vessels carry large inventories of marine diesel oil (MDO). These are spread out over numerous tanks on each vessel. The following events may result in the loss of part of the inventory of one or more fuel tanks:

- A vessel-to-vessel collision (e.g., third-party vessel with either the source or support vessels); or

- Vessel grounding (e.g., in shallow waters);

Given the close proximity to ports, it is not planned to undertake refuelling on location, so refuelling spills have not been considered or modelled.

Dispersion into the sea by the action of wind and waves can result in 25 to 50% of the loss of hydrocarbons from surface slicks and dissolution (solubility of hydrocarbons) can account for 1-10% loss from the surface. The majority of the MDO evaporates quickly; for this study, there is an evaporation rate between 29% in 15 knot winds and 42% in 5 knot winds, as shown in Figure 7.14. When spilled on water, MDO spreads very quickly to a thin film and have low viscosities that can result in hydrocarbons becoming physically dispersed as fine droplets into the water column when winds exceed 10 knots.

In open water, diesel oil spills are so rapidly diluted that fish kills are rarely observed (this is more likely in confined, shallow waters).

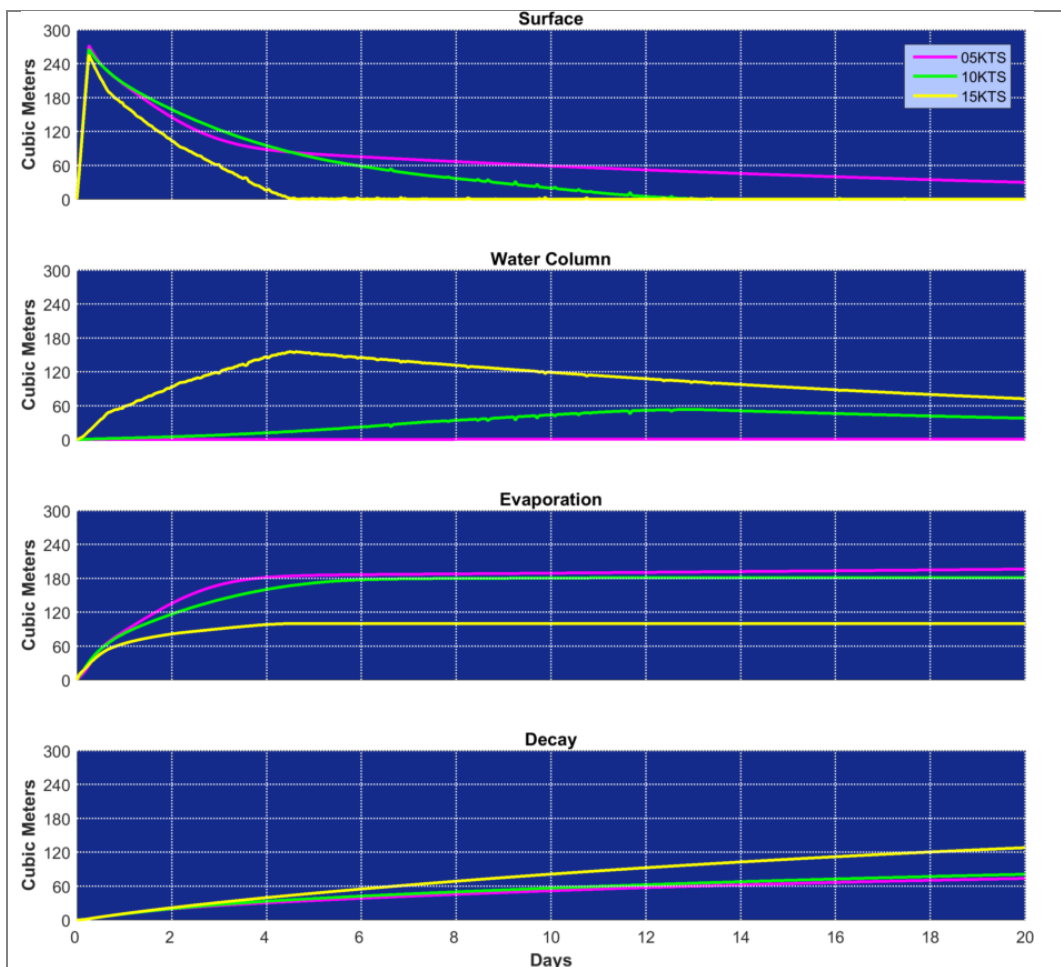


Table 7.14. Weathering and fates graph, as a function of volume, under 5, 10 and 15 knot static wind conditions, based on a 306 m³ surface release of MDO over 6 hours (tracked over 20 days)

MDO spill modelling

CarbonNet commissioned RPS-APASA to undertake oil spill trajectory modelling (OSTM) specific to the location and design of the proposed Pelican 3DMSS (RPS-APASA, 2016). This involved modelling the loss of 306 m³ of MDO over 6 hrs (51 m³/hr) for the September to April period, using an amalgamation of 100 spill release sites within the proposed operational area and five years of wind and current data inputs (2011 to 2015 inclusive).

MDO characteristics

For the sake of conservativeness, MDO has been used for this OSTM, as this is a heavier product than marine gas oil. The physical characteristics of the MDO are provided in Table 7.43.

Table 7.43. Physical characteristics of the MDO

Oil property	MDO
Density (kg/m ³)	829.1 @ 15°C
API	37.6
Dynamic viscosity (cP)	4.0 @ 25°C
Pour point (°C)	-14
Oil property category (ITOPF)	Group II
Oil persistence classification	Light persistent oil (5%)

Spill Location

For this assessment, 100 release sites spaced approximately 1-2 km apart within and around the perimeter of the operational area were selected, with one simulation run from each point. This removes any bias in selecting a single spill location.

Spill Volume

AMSA's Technical Guidelines for preparing Contingency Plans for Marine and Coastal Facilities (AMSA, 2015, pg 24) indicates that an appropriate spill size for a vessel collision (a non-oil tanker) should be based on the volume of the largest tank, while the volume for a non-major grounding should be based on the total fuel volume of one tank. CarbonNet has used this guidance in determining the volume to be modelled for this study.

While the exact volume of MDO to be carried by the vessel could not be provided at the time of undertaking the OSTM, based on a search of vessel specifications for several seismic operators, it was found that that average diesel fuel storage capacity of seismic vessels is 385 m³. Fuel tanks are typically spread in reasonably uniform sizes around the hull of such vessels (vessels of this size may have six or more tanks), so based on an average total volume of 385 m³, an individual tank is likely to be in the order of 64 m³. For the sake of conservativeness, CarbonNet has assumed the largest tank size for this modelling to contain 80% of the maximum fuel capacity, this being 306 m³; this is the volume that has been used for the OSTM.

Spill Thresholds

An outline of the spill thresholds used for the OSTM, together with the justification for their use, is provided in Table 7.44.

Table 7.44. MDO spill concentration thresholds used in the OSTM study

Segment	Threshold	Justification
Sea surface contact	LOW exposure: 1-10 g/m ² (or 0.001-0.01 mm, or 1-10 µm, equivalent to a rainbow to metallic sheen)	Oil that is 1 µm thick is considered below levels that would cause environmental harm and it is more indicative of the areas perceived to be affected due to its visibility on the sea-surface and potential to trigger temporary closures of areas (i.e. fishing grounds) as a precautionary measure. It is also close to the practical limit of observing oil in the marine environment. The 1-10 µm thickness is likely to be observed in areas where the hydrocarbon is spread thinly, and as such has already undergone evaporation and weathering. The majority of the lighter, more toxic compounds will have been removed from the surface in that process. Ecological impacts at this thickness are unlikely.
	MODERATE exposure: 10-25 g/m ² (or 0.01-0.025 mm, or 10-25 µm, equivalent to a metallic sheen)	This is the minimum thickness of oil that could impart ecological impacts. Research has shown that harm to seabirds through ingestion from preening of contaminated feathers, or the loss of thermal protection of their feathers occurs at 10 µm.
	HIGH exposure: >25 g/m ² (or >0.025 mm, equivalent to a metallic sheen to continuous true colour)	A concentration of surface oil greater than 25 µm on the sea surface would be harmful for all marine birds that come in contact with the oil. Mortality would result from ingestion during preening, or from hypothermia from matted feathers.
Shoreline	LOW exposure: 10-100 g/m ² Equivalent to an oil stain/film (~2 tsp/m ²)	A threshold of 10 g/m ² is a conservative threshold used to define regions of socio-economic impact, such as triggering temporary closures of adjoining fisheries or the need for shore clean-up on beaches or man-made features/amenities (breakwaters, jetties, marinas).
	MODERATE exposure: 100-1,000 g/m ² Equivalent to an oil coating (~½ cup/m ²)	An oil exposure threshold of 100 g/m ² for shorebirds and wildlife (fur-bearing aquatic mammals and marine reptiles) is based on studies for sub-lethal and lethal impacts. This threshold for shoreline contact is also recommended by AMSA (2015) in its foreshore assessment guide as the acceptable minimum thickness that does not inhibit the potential for recovery and is best remediated by natural coastal processes alone. The recommendation applies to shoreline types including sandy beach, boulder shorelines, pebble shorelines, rock platforms and industry facility structures. 100 g/m ² (a 'stain' or 'film', and equivalent to 0.1

Segment	Threshold	Justification
		mm) is considered the lethal threshold for invertebrates living on hard substrates (rocky, artificial/man-made, rip-rap, etc.) and sediments (mud, silt, sand or gravel) in intertidal habitats. 100 g/m ² oil thickness would be enough to coat the animal and likely impact its survival and reproductive capacity (French-McCay, 2009).
	<p>HIGH exposure: >1,000 g/m² Equivalent to oil cover (~1 litre/m²)</p>	<p>Loadings of more than 1,000 g/m² of oil during the growing season would be required to impact marsh plants significantly. Similar thresholds have been found in studies assessing oil impacts on mangroves. Hence, 1,000 g/m² has been selected to define the high exposure zone and is representative of higher level ecological impacts (i.e., ecosystem based impacts).</p>
Dissolved aromatic and entrained hydrocarbons	<p>LOW exposure: Dissolved - 576 ppb.hrs Entrained – 11,760 ppb hrs</p>	<p><u>Dissolved phase</u></p> <p>The threshold value for species toxicity in the water column is based on global data that shows 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). Based on scientific literature, a minimum threshold of 6 parts per billion (ppb) over 96-hours or equivalent was used to assess in-water low exposure zones.</p> <p><u>Entrained phase</u></p> <p>Exposure thresholds used to assess entrained hydrocarbon exposure were based on OSPAR guidelines. OSPAR has published a predicted no effect concentration (PNEC) for produced formation water (PFW), which accounts for the dispersed fractions of oil that is more representative of entrained oil droplets. The OSPAR PNEC is 70 ppb (median estimate (50% confidence) at 5% of the hazardous concentration (HC₅)) and is based on biomarker and whole organism testing to total hydrocarbons (THC). The whole organism responses range from oxidative stress and DNA damage to impacts on growth, reproduction and survival. This PNEC represents an acceptable long-term (i.e., chronic, >7 days) exposure concentration from continuous point source discharges in the North Sea, which is one of the most concentrated areas in the world for oil and gas production. The 70 ppb is regarded as the maximum allowable exposure level and thus is considered to be the 'low exposure threshold' in this study.</p> <p>The low exposure level for entrained hydrocarbons is based on an exposure duration of 7 days (168 hours), representative of chronic exposure, compared to the acute 96-hour exposure periods used to classify moderate and high exposures.</p>

Segment	Threshold	Justification
	<p>MODERATE exposure: Dissolved - 4,800 ppb.hrs Entrained – 67,200 ppb.hrs</p>	<p><u>Dissolved phase</u> An average 96 hour LC₅₀ of 50 ppb and 400 ppb could serve as an acute lethal threshold to 5% and 50% of biota, respectively. Hence, the thresholds were used to represent the moderate and high exposure zones, respectively.</p> <p><u>Entrained phase</u></p>
	<p>HIGH exposure: Dissolved - 38,400 ppb.hrs Entrained – 676,800 ppb.hrs</p>	<p>While dissolved aromatics are the largest contributor to the toxicity of solutions generated by mixing hydrocarbons into water, it is still important to model the fate of entrained hydrocarbons because they are the mechanism of delivering soluble aromatics to the water column.</p> <p>Exposure thresholds used to assess entrained hydrocarbon exposure were based on OSPAR guidelines. OSPAR has published a PNEC for PFW, which accounts for the dispersed fractions of oil that is more representative of entrained oil droplets. For this study, moderate and high thresholds have been set at 700 ppb and 7,050 ppb, respectively.</p>
<p><i>The impacts to shoreline species include those species most at risk of oil exposure, being the small sedentary (non-mobile) invertebrates to large mobile species (birds, reptiles and mammals). Impacts to shoreline species are more pronounced for heavy oils (crudes) that are viscose and composed of persistent hydrocarbons, as opposed to condensates and diesel that weather quickly and do not form emulsions. Thus, the thresholds used to assess shoreline contact are conservative for MDO.</i></p>		

Source: RPS-APASA (2016).

A summary of the OSTM results is provided in Table 7.45.

Table 7.45. Summary of the OSTM results

Segment	Threshold	Results (based on 100 spill trajectories commencing between September and April)
Sea surface contact (Figure 7.15)	<p>LOW exposure: 1-10 g/m²</p>	<p>The greatest distance travelled by a spill trajectory is 291 km east.</p> <p>The following protected areas are predicted to be contacted with MDO of a low exposure:</p> <ul style="list-style-type: none"> • Ninety Mile Beach MNP - 20% probability in 9 hours. • Point Hicks MNP - 9% probability in 31 hours. • Beware Reef Marine Sanctuary - 3% probability in 38 hours. • Cape Howe MNP - 2% probability in 50 hours. <p>Four other marine or coastal parks have a 1% probability of contact with MDO of a low exposure, taking between 32 and 64 hours to make contact.</p>
	<p>MODERATE exposure: 10-25 g/m²</p>	<p>The greatest distance travelled by a spill trajectory is 166 km east-northeast.</p> <p>The following protected areas are predicted to be</p>

Segment	Threshold	Results (based on 100 spill trajectories commencing between September and April)
		<p>contacted with MDO of a moderate exposure:</p> <ul style="list-style-type: none"> Ninety Mile Beach MNP - 5% probability in 13 hours. Point Hicks MNP - 1% probability in 44 hours.
	HIGH exposure: >25 g/m ²	<p>The greatest distance travelled by a spill trajectory is 43 km east-northeast.</p> <p>The Ninety Mile Beach MNP is the only protected area with any probability of contact with MDO of a high exposure, this being 2% and takes 14 hours.</p>
Shoreline (Figure 7.16 and Figure 7.17)	LOW exposure: 10-100 g/m ²	There is a 56% probability of shoreline contact, with a minimum time to shore of 2 hours.
	MODERATE exposure: 100-1,000 g/m ²	There is a 50% probability of shoreline contact, with a minimum time to shore of 2 hours.
	HIGH exposure: >1,000 g/m ²	There is a 37% probability of shoreline contact, with a minimum time to shore of 9.5 hours.
	Maximum volume of hydrocarbons ashore – 215 m ³	
	Maximum volume of hydrocarbons ashore – 91 m ³	
Dissolved aromatic and entrained hydrocarbons	LOW exposure: Dissolved - 576 ppb.hrs Entrained – 11,760 ppb hrs	<p><u>Dissolved phase</u> – concentrations did not persist long enough in the water column to trigger the lowest exposure threshold.</p> <p><u>Entrained phase</u> – an isolated location within Point Hicks MNP was the only receptor predicted to be contacted, with a 2% probability.</p>
	MODERATE exposure: Dissolved - 4,800 ppb.hrs Entrained – 67,200 ppb.hrs	<p><u>Dissolved phase</u> – no predicted exposure.</p> <p><u>Entrained phase</u> – no predicted exposure.</p>
	HIGH exposure: Dissolved - 38,400 ppb.hrs Entrained – 676,800 ppb.hrs	<p><u>Dissolved phase</u> – no predicted exposure.</p> <p><u>Entrained phase</u> – no predicted exposure.</p>

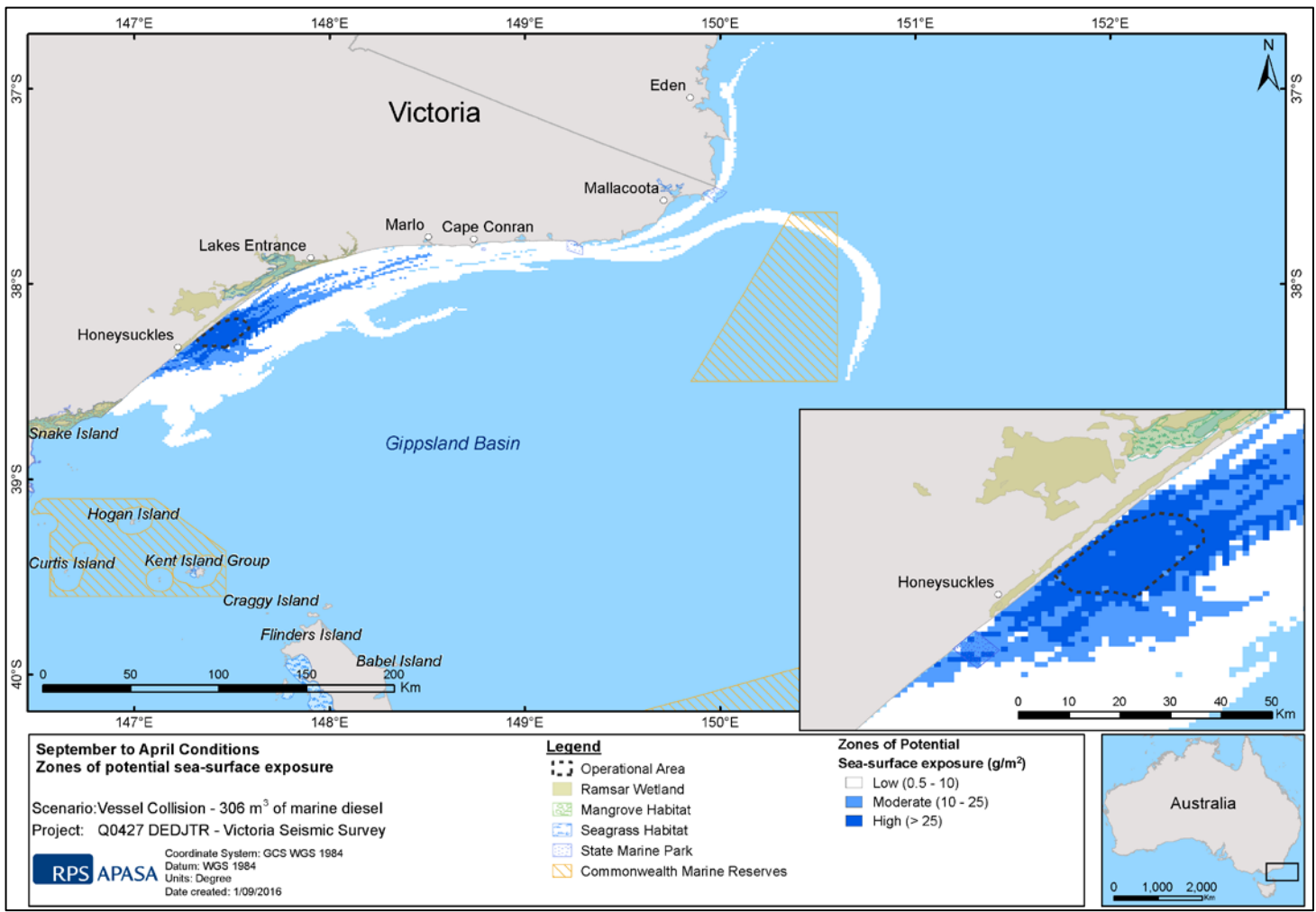


Figure 7.15. Potential zones of sea-surface exposure calculated from 100 spill trajectories during September to April conditions based on a 306 m³ surface release of MDO over 6 hours (tracked for 20 days)

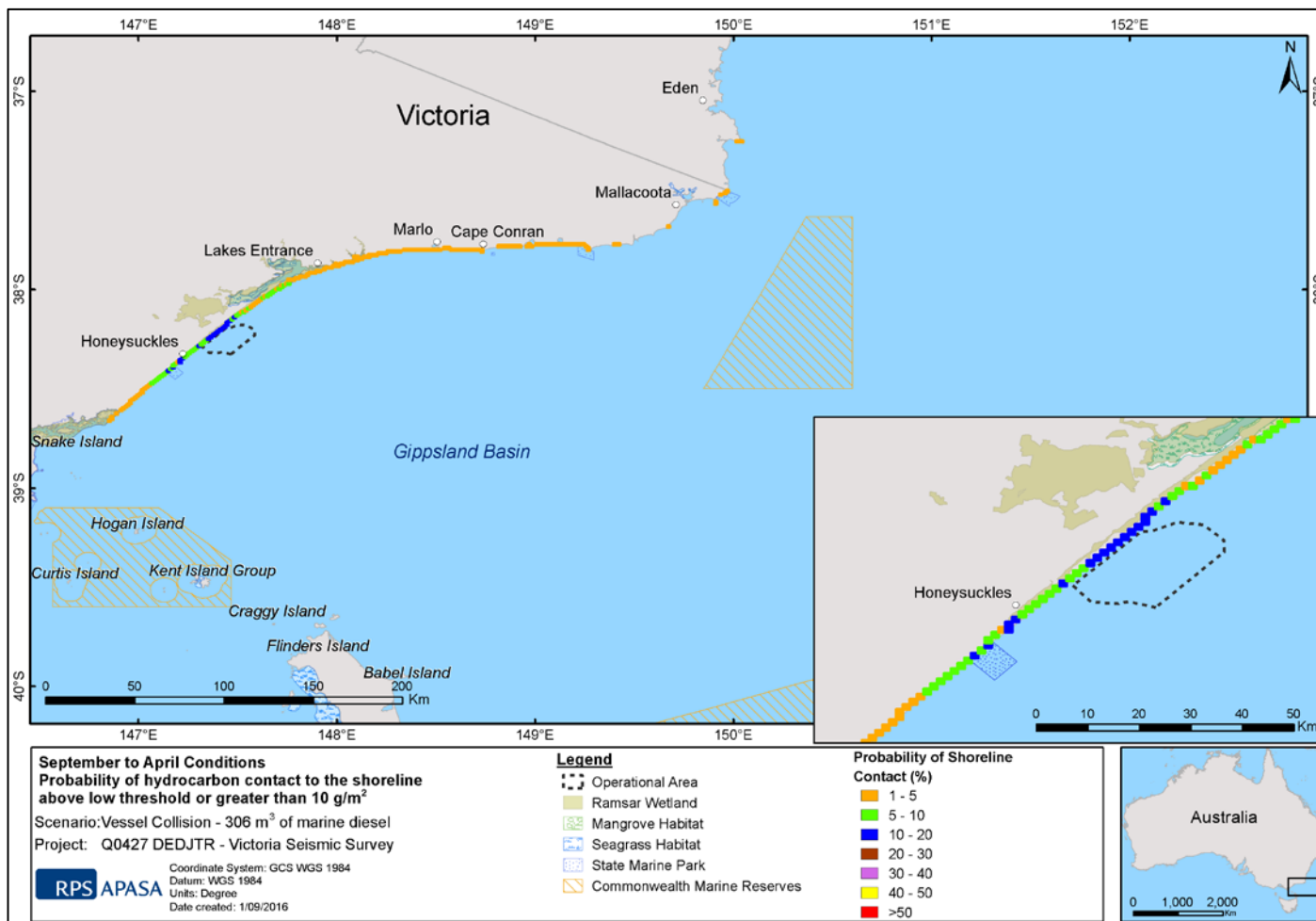


Figure 7.16. Probability of hydrocarbon contact to shorelines above low threshold (film/stain), calculated from 100 spill trajectories during September to April conditions based on a 306 m³ surface release of MDO over 6 hours (tracked for 20 days)

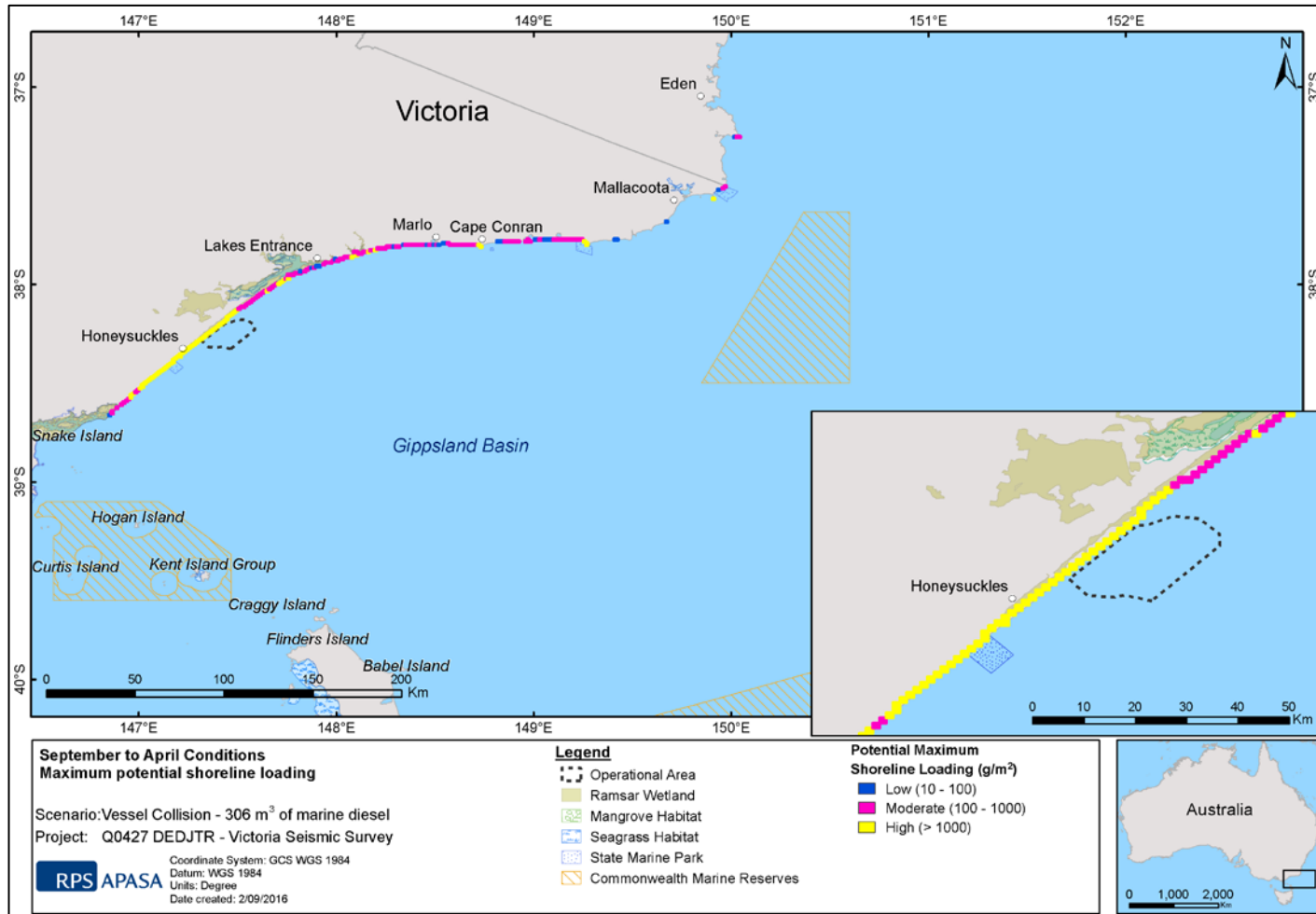


Figure 7.17. Maximum hydrocarbon loadings on shorelines above low threshold (film/stain), calculated from 100 spill trajectories during September to April conditions based on a 306 m³ surface release of MDO over 6 hours (tracked for 20 days)

7.16.2. Potential Environmental Risks

The known and potential impacts of an MDO spill are:

- A temporary and localised reduction in water quality;
- Injury or death of marine fauna and seabirds exposed to the MDO; and
- Habitat damage where the spill reaches shorelines.

Receptors most at risk within the EMBA by a MDO, whether resident or migratory, are:

- Plankton;
- Fish;
- Cetaceans;
- Pinnipeds;
- Avifauna; and
- Shoreline habitats.

7.16.3. Evaluation of Environmental Risks

Tables 7.46 presents the evaluation of risks to receptors within the MDO EMBA.

Table 7.46. Evaluation of risks to receptors within the MDO EMBA

Receptor	Segment	Potential impacts
Benthic assemblages	Sea surface	Not applicable.
	Water column	No predicted exposure, except for an isolated location in the Point Hicks MNP (a 2% probability of low contact with entrained hydrocarbons). Natural values of this park include subtidal and intertidal reefs, subtidal soft sediments and a very high diversity of fauna, including intertidal and subtidal invertebrates. At the low threshold exposure, long-term toxicity impacts to benthic fauna exposed to the MDO is not likely.
	Shoreline	There is a 1-25% probability of shoreline exposure along the coast of the EMBA. Intertidal benthic species would be exposed to MDO (albeit slightly weathered). Resident fauna such as worms, molluscs and crustaceans may suffer lethal impacts if high and moderate hydrocarbon loadings penetrate into the sediments and persist, especially in highly productive sheltered shorelines where hydrocarbon is more likely to be retained. As most of the shoreline of the EMBA is exposed coastline, these impacts are unlikely to occur except for at very isolated sections of the shoreline. Additionally, while MDO penetrates porous sediments (such as sand) quickly, it is also washed off quickly (and weathered within sediments) by waves (NOAA, 2012), thus minimising impacts to intertidal fauna. Long-term depletion of intertidal fauna could have an adverse effect on birds or fish that use this habitat as feeding grounds. Where oiling is heavy, impacts on nearshore benthic fauna could be significant.

Receptor	Segment	Potential impacts
Plankton	Sea surface	<p>Plankton found in open waters of the EMBA is expected to be widely represented within waters of the wider Bass Strait region. Plankton in the upper water column is likely to be directly (e.g., through smothering and ingestion) and indirectly (e.g., toxicity from decrease in water quality and bioaccumulation) affected by dissolved and dispersed hydrocarbons.</p> <p>Once background water quality conditions are re-established, plankton populations are expected to recover rapidly due to the recruitment of plankton from surrounding waters.</p> <p>The overall impact of hydrocarbon spills on plankton is considered insignificant in the long-term.</p>
	Water column	
	Shoreline	Not applicable.
Pelagic fish	Sea surface	<p>Because the majority of fish tend to remain in the mid-pelagic zone, they are not likely to come into contact with surface hydrocarbons.</p> <p>Some syngnathid species associated with nearshore reefs and rafts of floating seaweed may come into contact with surface oil.</p> <p>NOAA (2012) and ITOPF (2011a) state that diesel spills in open water are so rapidly diluted that fish kills are rarely observed. The predicted impact from surface oiling on fish is considered to be negligible at a population level.</p>
	Water column	<p>There are no zones of dissolved hydrocarbons above the low threshold.</p> <p>There is one very small and localised zone of entrained hydrocarbons in the Point Hicks MNP. Hook et al (2016) states that high concentrations of dissolved hydrocarbons are required to cause outright fish mortality; only low concentrations are predicted, so fish mortality is not expected.</p> <p>The MDO EMBA overlaps the BIA for the great white shark. Given the absence of zones of dissolved or entrained phase hydrocarbons, this species (and its key prey) is not likely to be at risk of toxicity effects.</p> <p>The wide geographical distribution of many of the fish species in Bass Strait also prevents large-scale population level impacts from entrained hydrocarbons.</p>
	Shoreline	Not applicable.
Cetaceans	Sea surface	<p>The OSTM modelling shows that exposure zones of surface hydrocarbons will overlap the nearby foraging BIAs for southern right whales and pygmy blue whales, with a minor incursion in the southern-most part of the humpback whale BIA.</p> <p>Southern right whales are unlikely to be present in the EMBA at the time of the survey, whereas there is a chance that pygmy blue whales and humpback whales may be present at this time of year (though there are no known migration paths in Gippsland). If present, these species (and other cetaceans) may be exposed to oil. If large quantities of zooplankton (key prey) exposed to the</p>

Receptor	Segment	Potential impacts
		<p>spill were ingested, chronic toxicity impacts to baleen whales may occur.</p> <p>Biological consequences of physical contact with very localised areas of low to high concentrations of hydrocarbons at the sea surface are unlikely to lead to any long-term impacts, with temporary skin irritation and very light fouling/matting of baleen plates likely to occur (it is unknown whether the latter would affect feeding ability). Therefore, effects at the population level on the cetaceans present in the EMBA are considered unlikely.</p>
	Water column	<p>There are no zones of dissolved hydrocarbons above the low threshold.</p> <p>There is one very small and localised zone of entrained hydrocarbons (at low exposure) in the inshore part of the Point Hicks MNP. Cetaceans are transient through this MNP, making it highly unlikely that anything more than a few individuals may be exposed to entrained hydrocarbons. Transient species moving through an area of low exposure makes it unlikely that cetaceans would experience any toxicity effects of the oil.</p>
	Shoreline	Not applicable.
Pinnipeds	Sea surface	<p>The foraging range for New Zealand fur-seals and Australian fur-seals may be temporarily exposed to MDO at the sea surface (in concentrations ranging from low to high).</p> <p>As fur-seals forage for prey within the water column rather than at the sea surface, exposure to oil at the sea surface will only result when resting at surface or entering and exiting the water.</p> <p>Depending on the duration of time spent at the sea surface, exposure may result in irritation to mucous membranes that surround the eyes and line the oral cavity, respiratory surfaces, and anal and urogenital orifices. If seals inhale large volumes of volatile vapours within a fresh area of a MDO slick, acute or chronic toxicity impacts may eventuate. This would be unlikely to occur to more than several individuals at most.</p> <p>Given the generally brief time spent at the sea surface, permanent injury or mortality is unlikely to occur.</p>
	Water column	<p>There are no zones of dissolved hydrocarbons above the low threshold.</p> <p>There is one very small and localised zone of entrained hydrocarbons (at low exposure) in the inshore part of the Point Hicks MNP. Fur-seals may forage in this area, especially for cephalopods off the reef areas in summer. Transient individuals moving through an area of low exposure makes it unlikely that fur-seals would experience any direct toxicity effects of the oil and effects from consuming affected prey.</p>
	Shoreline	There is no shoreline oil loadings for New Zealand fur-seal breeding locations in Victoria (The Skerries off Wangan Inlet and Kanowna Island, off Wilsons Promontory). They are known to haul out on Beware

Receptor	Segment	Potential impacts
		<p>Reef. MDO is unlikely to strand on this reef due to wave action and rising tides. As such, it is unlikely that oiling of New Zealand fur-seals will occur on shorelines.</p> <p>There are no Australian fur-seal breeding colonies in the EMBA, except for The Skerries. However, the OSTM indicates no shoreline loading at this location. A haul out site exists at Beware Reef, with the impacts the same as those for New Zealand fur-seals. A haul-out site also exists at Gabo Island (used by 30-50 individuals). This location is predicted to have a 1-2% probability of contact with a peak loading of 1,437 g/m². Australian fur-seals exposed to this loading may experience some degree of dermal contact and fur coating, though the MDO will be weathered by the time contact is made (estimated at 56 hours), so toxicity impacts are unlikely. Given the tens of thousands of Australian fur-seals that are resident in the Gippsland region, impacts to this small number of individuals are not likely to impact the health or viability of the regional population.</p> <p>Given the rocky nature of haul-out sites and their ability to self-clean, heavy oiling of pinnipeds at shorelines in general is not expected.</p>
Marine reptiles	Sea surface	<p>Some individual transient marine reptiles may come into contact with localised areas of low to high hydrocarbon exposure on the sea surface. Based on the literature review above, this may result in irritation of skin or cavities.</p> <p>However, due to the absence of turtle BIAs in Gippsland and the low chance of encountering turtles in Victorian waters in general, the potential impacts to marine reptiles (individuals or populations) are considered to be negligible.</p>
	Water column	<p>There are no zones of dissolved hydrocarbons above the low threshold.</p> <p>There is one very small and localised zone of entrained hydrocarbons (at low exposure) in the inshore part of the Point Hicks MNP. Due to the absence of turtle BIAs in Gippsland and the low chance of encountering turtles in Victorian waters in general, the potential impacts to marine reptiles (individuals or populations) are considered to be negligible.</p>
	Shoreline	<p>There are no turtle nesting beaches within the EMBA, so impacts from shoreline oiling will not occur.</p>
Seabirds and shorebirds	Sea surface	<p>The threatened bird species likely to occur in the EMBA forage over an extensive area, such as albatross and petrels, are distributed over a wide geographic area.</p> <p>Seabirds rafting, resting, diving or feeding at sea have the potential to come into contact with oil, ranging from low to high exposure.</p> <p>Given the extensive ocean foraging habitat available to species such as albatross and petrel, the small and temporary area impacted by a spill event is unlikely to limit their ability to forage for unaffected prey. The absence of breeding colonies or nesting areas in the EMBA for albatross and petrel further limits potential exposure to</p>

Receptor	Segment	Potential impacts
		<p>spilled MDO. Petrel breeding takes place from October to February in their sub-Antarctic and Antarctic habitat, making it unlikely that large numbers of petrels will be within the EMBA at the time of the survey.</p>
	Water column	<p>There are no zones of dissolved hydrocarbons above the low threshold.</p> <p>There is one very small and localised zone of entrained hydrocarbons (at low exposure) in the inshore part of the Point Hicks MNP. Fish species residing in or swimming through this small zone of low exposure hydrocarbons that are prey for seabirds or shorebirds will not suffer acute or chronic toxicity effects, so seabirds or shorebirds consuming this prey are similarly not expected to suffer any toxicity effects.</p>
	Shoreline	<p>Areas of shoreline predicted to be exposed to shoreline loading of hydrocarbons that may have biological impacts to birds ($100\text{-}1,000\text{ g/m}^2$ or $>1,000\text{ g/m}^2$) are widespread along the coast of the EMBA.</p> <p>This section of coastline comprises mostly wide sandy beaches that provides habitat for shorebird species such as hooded plovers, terns and penguins, and nesting habitat for seabird species. MDO is unlikely to persist on the surface of sandy beaches because it quickly penetrates porous sediments (NOAA, 2012). This behaviour limits the duration of exposure to fauna on the shoreline.</p> <p>Shorebirds foraging for food in intertidal areas or along the high tide mark and splash zone may encounter weathered hydrocarbons that may be brought back to nests. Hydrocarbon entering the sandy nests of hooded plovers, terns or other bird species is likely to percolate through the sand and not accumulate in the feathers of adults or young. Toxicity effects from ingestion of contaminated prey caught in the intertidal zone or from direct exposure or transport back to are unlikely, as the volatile components are likely to have flashed off prior to stranding (minimum stranding times range from 2 to 9.5 hours).</p> <p>The populations of seabird and shorebird species within the EMBA have a wide geographic range, meaning that impacts to individuals or a population at one location will not necessarily extend to populations at other un-impacted locations.</p>
Sandy beaches	Shoreline	<p>The length of coastline potentially at risk from high MDO shoreline loading ($>1,000\text{ g/m}^2$) is about 60 km (or 8 km in a single trajectory spill analysis). There is a 1-25% probability of contact and most of this contact being above 100 g/m^2. This coastline is dominated by wide sandy beaches.</p> <p>With the shortest time to reach the coast being 2 hours, the hydrocarbons will have only partially weathered. The high shoreline loadings would likely result in acute toxicity, and death, of many invertebrate communities, especially as the MDO will easily penetrate into sandy sediments. However, tidal action is expected to lead to rapid weathering of any hydrocarbons in the intertidal area and</p>

Receptor	Segment	Potential impacts
		<p>the populations of these communities would be likely to rapidly recover.</p> <p>Short-term impacts to tourism and other human uses of the beach may occur as a result of temporary beach closures to protect human health or due to visitor perceptions of a polluted environment that is not desirable to visit.</p>
Rocky shores	Shoreline	<p>There are isolated areas of rocky shoreline (intertidal shore platform and mix sand beach/shore platform) in the EMBA east of Marlo. This section of shoreline has only a 1-5% probability of contact, though predicted shoreline loadings of MDO vary from low to high.</p> <p>The action of reflected waves off rocky shores means it is unlikely that toxicity or smothering effects to exposed vertebrate fauna will occur on this type of shoreline. The oil is likely to be continually washed off the substrate and into the water, leading to further weathering.</p>
Macroalgal communities	Sea surface	<p>Macroalgal communities are generally restricted close to shore (see 'shoreline' two columns to the right).</p> <p>Offshore, surface oiling will not result in impacts to macroalgae.</p> <p>The Giant Kelp Forests TEC is unlikely to be impacted by surface hydrocarbons as they remain submerged under the water surface.</p>
	Water column	<p>There are no zones of dissolved hydrocarbons above the low threshold.</p> <p>There is one very small and localised zone of entrained hydrocarbons (at low exposure) in the inshore part of the Point Hicks MNP. The Giant Kelp Forests TEC is not mapped as being known to occur in this area, though it may occur to the immediate east of Point Hicks.</p> <p>Macroalgae associated with the subtidal reefs of the Point Hicks MNP may be exposed to the entrained MDO, but at the low threshold they are not likely to suffer any toxicity-related impacts.</p>
	Shoreline	<p>There are isolated areas of rocky shoreline (intertidal shore platform and mix sand beach/shore platform) in the EMBA east of Marlo that may support macroalgal communities. This section of shoreline has only a 1-5% probability of contact, though predicted shoreline loadings of MDO vary from low to high.</p> <p>Hydrocarbons are likely to weather rapidly in this area, with high-energy waves breaking up hydrocarbons along rocky shore platforms. Given the likely high abundance of macroalgae along sections of the coast with intertidal shore platforms (east of Marlo), any localised mortality of macroalgae is likely to lead to rapid recruitment from nearby seed stock.</p>
Commercial fisheries	Scallop	<p>No impact to species due to their benthic habitat.</p> <p>No impact to fishing equipment.</p>
	Rock lobster	<p>No impact to species due to their benthic habitat.</p> <p>There is potential for lobster pot buoys to accumulate hydrocarbons if they are set at the time of a spill. The</p>

Receptor	Segment	Potential impacts
		oiled surfaces may themselves be a source of secondary contamination until they are cleaned.
	Abalone	No impact to species due to their benthic habitat. No impact to fishing equipment.
	Wrasse fishery	No impact to species due to their pelagic habitat. Surface buoys marking gillnet locations may accumulate hydrocarbons if they are set at the time of a spill. Vessel hulls may accumulate hydrocarbons if they travel through a slick. The oiled surfaces may themselves be a source of secondary contamination until they are cleaned.
	Ocean access	No impact to species due to their pelagic habitat. Longlines may accumulate hydrocarbons if they are set at the time of a spill. Vessel hulls may accumulate hydrocarbons if they travel through a slick. The oiled surfaces may themselves be a source of secondary contamination until they are cleaned.
	Ocean purse seine	No impact to species due to their pelagic habitat. Surface buoys marking gillnet locations may accumulate hydrocarbons if they are set at the time of a spill. Vessel hulls may accumulate hydrocarbons if they travel through a slick. The oiled surfaces may themselves be a source of secondary contamination until they are cleaned.
	Inshore trawl	No impact to species due to their benthic habitat. Warp wires may accumulate hydrocarbons if they are set at the time of a spill. Vessel hulls may accumulate hydrocarbons if they travel through a slick. The oiled surfaces may themselves be a source of secondary contamination until they are cleaned.
	Southern squid jig	The key fishing area of southwest Victoria makes it highly unlikely that the fishery operates in the EMBA.
	Gillnet & shark hook	Surface buoys marking gillnet locations may accumulate hydrocarbons if they are set at the time of a spill. Vessel hulls may accumulate hydrocarbons if they travel through a slick. The oiled surfaces may themselves be a source of secondary contamination until they are cleaned.
	Commonwealth trawl sector	Warp wires may accumulate hydrocarbons if they are set at the time of a spill. Vessel hulls may accumulate hydrocarbons if they travel through a slick. The oiled surfaces may themselves be a source of secondary contamination until they are cleaned.
	Scalefish hook sector	Longlines may accumulate hydrocarbons if they are set at the time of a spill. Vessel hulls may accumulate hydrocarbons if they travel through a slick. The oiled surfaces may themselves be a source of secondary contamination until they are cleaned.
Marine protected areas	Nooramunga Marine and Coastal Park	There is a 1% probability of exposure to low threshold hydrocarbons. At a low threshold, marine fauna will not experience toxicity effects. Seagrass and mangrove habitats present within Corner Inlet are not predicted to be contacted. There is a 1-5% probability of shoreline contact, with

Receptor	Segment	Potential impacts
		moderate shoreline loadings. See impacts to 'sandy beaches' and 'seabirds and shorebirds.'
	Ninety Mile Beach MNP	<p>There is a 20%, 5% and 2% probability of contact with hydrocarbons at a low, moderate and high threshold, respectively.</p> <p>Natural values of significance are present within the water column or at the seabed, so MDO contact at the sea surface will not impact these values.</p> <p>There is a 5-50% probability of shoreline contact, with high shoreline loadings. See impacts to 'sandy beaches' and 'seabirds and shorebirds.'</p>
	Beware Reef Marine Sanctuary	<p>There is a 3% probability of exposure to low threshold hydrocarbons.</p> <p>At a low threshold, marine fauna will not experience toxicity effects.</p> <p>No shoreline, but the permanently exposed granite reef would be self-cleaning with wave action.</p>
	Point Hicks MNP	<p>There is a 9% probability of exposure to low threshold hydrocarbons and a 1% probability of exposure to hydrocarbons at the moderate threshold.</p> <p>At a low threshold, marine fauna will not experience toxicity effects. At a moderate threshold, fur seals, dolphins, fish and seabirds may experience some toxicity effects, and serious injury or mortality is possible depending on the volume of oil coating or ingestion.</p> <p>There is one very small and localised zone of entrained hydrocarbons (at low exposure) in the inshore part of the Point Hicks MNP. This zone does not intersect mapped reef areas, but if contact with the reef is made, the low exposure means flora and fauna will not experience toxicity effects.</p>
	Cape Howe MNP	<p>There is a 1-10% probability of contact with hydrocarbons with low exposure.</p> <p>At a low threshold, marine fauna will not experience toxicity effects.</p> <p>There is a 1-5% probability of shoreline contact, with isolated occurrences of low to moderate shoreline loadings.</p> <p>See impacts to 'sandy beaches' and 'benthic assemblages.'</p>
	East Gippsland CMR	<p>There is a 1-10% probability of contact with hydrocarbons with low exposure.</p> <p>At a low threshold, marine fauna (most notably seabirds and migrating humpback whales) will not experience toxicity effects. See impacts to 'seabirds and shorebirds' and 'cetaceans.'</p>

7.16.4. Risk Assessment

The following control measures will be implemented to minimise the risk of a MDO spill:

- Preventative controls as per 'Interference with Third-party vessels'
- No refuelling will be undertaken at sea (this will be done in port).
- The vessel has an approved SMPEP (or equivalent appropriate to class) that is implemented in the event of a fuel tank rupture and spill.
- Vessel crew members are inducted into spill response procedures.
- Vessel crew is trained in spill response techniques in accordance with the SMPEP and vessel training matrix.
- Prior to the proposed survey taking place, an oil spill response exercise will be conducted to test interfaces between the SMPEP, OPEP, NatPlan and VicPlan.
- CarbonNet will report the spill to regulatory authorities (see Section 8.8) within 2 hours of becoming aware of the spill.
- The Vessel Master/s will authorise actions in accordance with the vessel-specific SMPEP (or equivalent according to class) and the survey-specific OPEP to limit the escape of MDO.
- CarbonNet will undertake operational and scientific monitoring in accordance with the OSMP.

Table 7.47 presents the residual risk assessment for a MDO spill.

Table 7.47. Residual risk assessment for a MDO spill

Likelihood	Consequence	Risk rating
Rare	Minor	Low

7.17. RISK: Oil Spill Response Activities

This section assesses the responses to the oil spill response strategies outlined in the OPEP. Table 7.48 summarises the strategies available to respond to MDO spills, and whether they are applicable for this project.

Table 7.48 Suitability of response options for MDO spills

Response option	Description	Assessment	Suitable for this project?
Source control	Limit the flow of hydrocarbons from the vessel.	Can be achieved through implementation of the vessel-specific SMPEP.	Yes
Surveillance and tracking	Direct observation – Aerial or marine, vector calculations; OSTM, use of satellite-tracking buoys.	MDO spreads rapidly to thin layers. Maintains situational awareness. Aerial is more effective than vessel to inform spill response.	Yes

Response option	Description	Assessment	Suitable for this project?
Natural degradation	This response occurs regardless of intervention.	For MDO spills, natural degradation is often the best response, in so far as it avoids the additional impacts associated with intervention activities.	Yes
Dispersant application	Breaks down surface spill and draws droplets into upper layers of water column. Increases biodegradation and weathering.	MDO, while having a small persistent fraction, spreads rapidly to thin layers. Dispersant application can result in punch-through where dispersant passes into the water column without breaking oil layer down.	No
In-situ burning (ISB)	Controlled ISB involves the controlled burning of spilled hydrocarbons in order to rapidly reduce the volume of oil on the water's surface, thereby reducing its spread to sensitive receptors.	ISB is only suitable for use on hydrocarbons >1-2 mm thick, with calm waves and light winds. It also requires fire-resistant booms (which is not readily available in Australia). MDO rapidly spreads to less than 10 µm (0.01 mm), making this response unsuitable.	No
Containment and recovery	Use of booms and skimmers to contain surface oil in the open ocean or in nearshore environments. Relies on calm conditions and thicknesses >10 µm to collect.	MDO spreads rapidly to less than 10 µm, usually in less time than is required to deploy this equipment.	No
Protection and deflection	Booms and skimmers deployed to protect environmental sensitivities, such as estuary inlets. Environmental conditions such as strong currents and waves can limit the application of this response.	MDO has persistent components and has the potential to reach shorelines. Effective in protecting open estuaries that have environmental sensitivities (aquatic vegetation, recreational users).	Yes
Shoreline clean-up	Where shoreline impact is predicted, shoreline clean-up assessment technique (SCAT) assessment is initiated. If SCAT and NEBA assess clean-up to have a net environment benefit, clean-up can be initiated. Shoreline clean-up can take several forms,	MDO residues quickly infiltrate sand where it is susceptible to remobilisation by wave action (reworking) until it has naturally degraded. This quick infiltration of sediments makes it very difficult to recover without also recovering vast quantities of shoreline sediments. MDO does not discolour	Possible, but unlikely

Response option	Description	Assessment	Suitable for this project?
	including manual removal, mechanical removal, washing and vacuum recovery.	shoreline as much as other hydrocarbon types. Manual collection techniques are likely to have limited effectiveness.	
Oiled wildlife response	Consists of capturing, cleaning and rehabilitating oiled wildlife. It may also include hazing or pre-spill captive management.	Given the small area of MDO at moderate and high thresholds (that may cause impacts to wildlife), large-scale wildlife response is not predicted. There is the potential for individual birds to be affected along adjacent shorelines.	Yes

In accordance with the NOPSEMA Oil Pollution Risk Management Information Paper (IP1488, Rev 1, February 2017), each of the response identified as being suitable for this activity is assessed to ensure the risks associated with the response are reduced to ALARP and acceptable levels.

Source control and natural degradation are not assessed here, as the former does not introduce any risks additional to the spilled oil, and the latter is a natural process that takes place regardless of human intervention.

The three levels of marine incidents are detailed in Table 7.49, using guidance from the State Maritime Emergencies (non-search and rescue) Plan (EMV, 2016) (herein referred to as Maritime Emergencies NSR Plan) and The National Plan (AMSA, 2014). The scenario of a 306 m³ spill falls into a Level 3 category.

Table 7.49. Suitability of response options for MDO spills

Guidance	Level 1	Level 2	Level 3
	Local, first strike	State	National
Oil volume (guide only)	Less than 10 tonnes.	10-100 tonnes.	Greater than 100 tonnes.
Hazardous and noxious substance	Nature and/or size of substance is unlikely to cause evacuation of the area. Exclusion area limited to immediate site.	Nature and/or size of substance is likely to cause evacuation. Exclusion area beyond to immediate site.	Nature and/or size of substance requires evacuation. Exclusion area beyond to immediate site.
Wildlife	Fewer than 50 birds.	Fewer than five cetaceans. Fewer than 25 seals. 50-200 birds.	More than five cetaceans. More than 25 seals. More than 200 birds.
IMT requirements	One to three people.	Functional groups required, working from an incident control centre (ICC).	
Clean-up	Use of vessel resources.	Resources beyond those of local response required.	State, national and possibly international resources required.
Environmental	Localised, minimal.	Adverse consequences.	Significant

Guidance	Level 1	Level 2	Level 3
	Local, first strike	State	National
impacts			consequences.
Spill duration	Up to 72 hours.	More than 72 hours, but not greater than 2-3 weeks.	Likely to exceed 2 weeks, recovery make take months to years.

7.17.1. Surveillance and Tracking

Oil spill surveillance and tracking is addressed in Section 7 of the OPEP.

Scope of Activity

Ongoing surveillance and tracking of the MDO spill is critical for maintaining situational awareness and to complement and support the other response activities. In some situations, surveillance and tracking may be the primary response strategy if natural dispersion and weathering processes are effective in reducing the volume of MDO reaching sensitive receptors.

It is the responsibility of the Control Agency to undertake operational monitoring during the spill event to inform the operational response. Operational monitoring includes the following:

- Aerial observation;
- Vessel-based observation;
- OSTM (either computer-based or manual vector analysis);
- Utilisation of satellite-tracking buoys.

Availability

The DEDJTR Emergency Management Division (EMD) maintains operational monitoring capability and implements operational monitoring for Level 2 or 3 vessel-based incidents, as outlined in the Maritime Emergencies NSR Plan (EMV, 2016).

Hazards

The hazards associated with surveillance and tracking are:

- Additional vessel activity (over a greater area); and
- Aircraft use.

Known and Potential Impacts of the Response Activity

The known and potential impacts associated with surveillance and tracking are:

- Routine and non-routine impacts and risks associated with vessel operations (as outlined throughout Chapter 7); and
- Noise disturbance to marine fauna and shoreline species by aerial flights.

Evaluation of Environmental Impacts and Risks

The known and potential impacts associated with routine and non-routine vessel operations are assessed in Section 7.1 to 7.14 and are not repeated here. In addition to these impacts and risks are those associated with the presence of aerial resources. These are discussed below.

Helicopter operations produce strong underwater sounds for brief periods when the helicopter is directly overhead (Richardson *et al.*, 1995). Sound generated from helicopter operations is typically below 500 Hz and sound pressure in the water directly below a helicopter is greatest at the surface but diminishes quickly with depth. Reports for a Bell 214ST (stated to be one of the noisiest) identify that noise is audible in the air for four minutes before the helicopter passed over underwater hydrophones. The helicopter was audible underwater for only 38 seconds at 3 m depth and 11 seconds at 8 m depth (Richardson *et al.*, 1995).

Sound levels from helicopters are not expected to cause physical damage to marine fauna, however temporary behavioural changes (avoidance) in species (cetaceans, turtles, fish) may be observed.

The behavioural reaction of cetaceans to circling aircraft (fixed wing or helicopter) is sometimes conspicuous if the aircraft is below an altitude of 300 m, uncommon at 460 m and generally undetectable at 600 m (NMFS, 2001; Richardson *et al.*, 1995). Baleen whales sometimes dive or turn away during over-flights, but sensitivity seems to vary depending on the activity of the animals. The effect on whales seems transient, and occasional over-flights probably have no long-term consequences (NMFS, 2001).

Richardson *et al.* (1995) identifies for Californian sea lions (an Octariid similar to fur seals) the following behaviours to flight sound:

- Jets above an altitude of 305 m produced no reaction and below that height caused limited movement but no major reaction;
- Light aircraft directly overhead at altitudes of < 150-180 m elicited alert reactions and in sea lions movement;
- Helicopters above 305 m usually caused no observable response while those below caused the pinnipeds to raise their heads, often causing some movement and occasionally caused rushes by some animals into the water.

Aerial surveillance flights will operate at between 300 – 500 m altitudes when undertaking observation activities (AMSA, 2003). In accordance with the EPBC Regulations (Part 8), a fixed-wing aircraft will maintain a buffer of 300 m from a cetacean and a helicopter will maintain 500 m from a cetacean. Any noise produced by surveillance aircraft is localised and temporary as the it is in constant movement. On this basis impact to marine mammals is expected to be temporary, localised and recoverable.

Environmental Impact and Risk Assessment

Note that DEDJTR (EMD) will act on behalf of CarbonNet in the event of a hydrocarbon spill.

The following control measures will be implemented for oil spill surveillance and tracking activities:

Preparedness

- Access to operational response capabilities is maintained through the Maritime Emergencies NSR Plan.

- DEDJTR undertakes regular desktop drills to test response capability.
- DEDJTR ensures that regular inspection and testing is undertaken for its oil spill response equipment.
- An oil spill-tracking buoy is available and maintained in operational condition on the survey and support vessels.

Response

- The vessels deploy the oil spill tracking buoys in the event of a Level 2 or 3 MDO spill as soon as practicable, but at least within 30 minutes of the spill.
- Visual observations from the survey support vessels are initiated immediately following a spill.
- An Incident Action Plan (IAP) is prepared by the IMT Planning Officer within the first 24 hours after the spill starts, which is used to guide response activities.
- Visual observations from aircraft are initiated within 12 hours of request (subject to daylight hours).
- Vectoring undertaken by an onsite spill assessor within 3 hours of spill report.
- Real-time OSTM results are provided by AMSA to DEDJTR within 4 hours of notification of the spill.

Activity controls

- Surveillance aircraft will ensure buffer distances of 500 m (helicopters) and 300 m (fixed wing) are maintained around cetaceans in accordance with EPBC Regulations 2000 (Part 8).

Table 7.50 presents the residual risk assessment for surveillance and tracking activities.

Table 7.50. Residual Risk assessment for oil spill surveillance and tracking

Risk assessment (residual)			
Receptor	Likelihood	Consequence	Risk rating
Fauna disturbance	Unlikely	Insignificant	Low

7.17.2. Protection and Deflection

Oil spill protection and deflection is addressed in Section 8 of the OPEP.

Scope of Activity

Protection and deflection involves deploying boom to protect coastal sensitivities from the impacts of oil. This response will be activated onshore and in nearshore waters where surveillance and tracking activities identify that coastal areas of high or moderate sensitivity are likely to be impacted by MDO.

In brief:

- Deflection booming – is deployed to deflect/divert the oil to a suitable collection point on the shoreline or at sea (generally to a less sensitive area than the receptor being protected) for subsequent removal.
- Protection booming – is deployed to hold the oil back away from environmental or socio-economic sensitivities (e.g., river mouths, shorebird nesting sites, seal haul-out sites).

Various anchoring methods are required depending on the type of boom and its location. For example, when used on the shoreline itself, boom skirts are replaced with water-filled chambers designed to allow the boom to settle on an exposed shoreline at low tide.

Protection Priorities

Estuaries within the EMBA that may require deflection and protection are listed in Section 8 of the OPEP.

Availability

The DEDJTR maintains operational monitoring capability and implements operational monitoring for Level 2 or 3 vessel-based incidents, as outlined in the State Maritime Emergencies NSR (EMV, 2016).

Hazards

The hazards associated with protection and deflection booming are:

- Additional vessel activity;
- Boom deployment and management; and
- Waste collection.

Known and Potential Impacts of the Response Activity

The known and potential impacts associated with protection and deflection booming are:

- Routine and non-routine impacts and risks associated with vessel operations (as outlined throughout Chapter 7); and
- Damage to nearshore habitats from inshore shallow draught vessel activities and boom anchoring;
- Damage to shoreline environments from vehicle, machinery and/or foot access and associated land use (e.g., waste storage);
- Deeper mixing of hydrocarbons within beach sediments; and
- Secondary contamination of the shoreline (e.g., from personnel movement).

Evaluation of Environmental Impacts and Risks

The known and potential impacts associated with routine and non-routine vessel operations are assessed in Section 7.1 to 7.14 and are not repeated here.

The nature of disturbance to the shoreline from vehicle and foot access (and associated land use activities such as equipment laydown areas, ablution facilities for

responders, etc) is dependent on the location and scale of activities in any given area.

A booming layout strategy for each of the estuaries in the EMBA has not been prepared, given most of them will not be open to the sea during the warmer months. DEDJTR will prepare an operational NEBA at the time of a spill if any estuaries in the path of an MDO spill are open, tailored to the conditions at the time.

The following impacts may eventuate in the event of deploying protection and deflection booming:

- Damage to nearshore habitats (such as seagrass meadows) from inshore shallow draught vessel activities and boom anchoring may temporarily alter the dynamics of local ecosystems. Sandy habitats are generally able to quickly self-repair due to tidal movements that replenish sand.
- Damage to shoreline environments from vehicle and foot access and associated land use may disturb Aboriginal cultural heritage areas (such as shell middens), and temporarily disturb shoreline bird feeding, nesting, roosting or breeding activities, which may in turn impact on local population dynamics. Coastal vegetation disturbed as a result of gaining access to response sites is likely to regenerate once disturbance has ceased (or can be actively revegetated if natural regeneration is not successful). Shoreline access may also result in soil compaction and erosion, which may result in poor vegetation growth or vegetation death.
- As a result of digging trenches along the beach to trap oil, together with vehicle and foot access along the shore, oil may mix deeper into the beach sediments than it would normally. This has the potential to increase the duration of exposure to toxic components of the oil by delaying the natural weathering process, though constant wave action along the exposed coastline encourages rapid weathering.
- Secondary contamination of the shoreline may occur through vehicle, equipment and foot access spreading oil along and immediately behind the shoreline in areas not originally oiled. This exposes more habitat, flora and fauna to oiling than originally impacted by the spill itself, with the associated impacts of smothering (toxicity is unlikely with weathered MDO), together with potentially creating larger recreational activity exclusion zones.

Environmental Impact and Risk Assessment

The following control measures will be implemented for oil spill protection and deflection activities:

Preparedness

- Access to operational response capabilities is maintained through the Maritime Emergencies NSR Plan.
- DEDJTR participates in regular desktop and shoreline/on-water drills to test response capabilities.
- DEDJTR ensures that regular inspection and testing is undertaken for its oil spill response equipment (for booming, this is related to boom and associated equipment).

Response

- Within 6 hrs of spill event notification, SCAT have mobilised to areas of predicted impact (daylight permitting) in consultation with East Gippsland Shire Council. SCAT information provided to IMT for inclusion in operational NEBA.
- An operational NEBA is prepared by the IMT to determine the net benefits of the booming strategy for the shorelines predicted to be contacted by MDO within 4 hours of receiving OSTM.
- Personnel and equipment resources are deployed to site to undertake the protection and deflection activities within timeframes outlined in the IAP.
- Booming operations continue until such time as no further sheen is visible on the sea surface, at the direction of the IMT Leader.

Activity controls

- Environmental briefings are conducted prior to work commencing in order to identify risks and suitable controls.
- Access to shoreline is via established tracks. Access outside of existing tracks and pathways is determined in consultation with local DELWP representatives.
- Vessels do not anchor in and booms are not anchored to areas of OSRA-mapped or visible kelp forest, reef, sponge gardens or seagrass meadows.
- Adequate monitoring personnel are in place at booming locations to maintain and attend to the operability of booms, including the release of fauna caught in booms (where safe to do so).
- Vessels maintain buffer distances of at least 100 m from seal colonies.
- Vessel Masters maintain the following buffer distances around cetaceans (in accordance with the Australian Guidelines for Whale and Dolphin Watching for sea-faring activities):
 - 'Caution zone' (300 m either side of whales and 150 m either side of dolphins) – vessels must operate at no wake speed in this zone.
 - 'No approach zone' (100 m either side of whales and 50 m either side of dolphins) – vessels should not enter this zone and should not wait in front of the direction
- Waste storage tanks and hoses are located within a contained, impervious area.
- Spill kits are available at oil recovery area and it is under supervision and secured from public access.
- Collected waste is disposed in accordance with Victorian EPA waste disposal requirements.

Table 7.51 presents the risk assessment for protection and deflection booming activities.

Table 7.51. Residual Risk assessment for protection and deflection booming

Risk assessment (residual)			
Receptor	Likelihood	Consequence	Risk rating
Nearshore habitat	Possible	Insignificant	Low
Shoreline habitat	Possible	Insignificant	Low
Fauna disturbance	Possible	Insignificant	Low

7.17.3. Shoreline Assessment and Clean-up

Shoreline assessment and clean-up is addressed in Section 9 of the OPEP.

Scope of Activity

SCAT

A cleanup response will be preceded by a shoreline clean-up assessment techniques (SCAT) survey. NOAA (2010) describes this process as the systematic approach to collecting data on shoreline oiling conditions using the following steps:

- Conduct reconnaissance survey;
- Segment the shore;
- Assign teams and conduct shoreline surveys;
- Develop cleanup guidelines and endpoints;
- Submit reports and sketches to Planning Section (of the IMT);
- Monitor effectiveness of cleanup;
- Conduct post-cleanup inspections; and
- Do final evaluation of cleanup activities.

A trained SCAT team will be deployed by the Planning Section of the IMT at the time of shoreline stranding (informed by surveillance and tracking) to provide feedback on best methods for clean-up.

Shoreline clean-up

Shoreline clean-up consists of different manual and mechanical recovery techniques to remove oil and contaminated debris from the shoreline to reduce ongoing environmental contamination and impact. It may include the following techniques:

- Natural recovery – allowing the shoreline to self-clean (no intervention undertaken);
- Manual collection of oil and debris – the use of people power to collect oil from the shoreline;

- Mechanical collection – use of machinery to collect and remove stranded oil and contaminated material;
- Sorbents – use of sorbent padding to absorb oil;
- Vacuum recovery, flushing, washing – the use of high volumes of low-pressure water, pumping and/or vacuuming to remove floating oil accumulated at the shoreline;
- Sediment reworking – move sediment to the surf to allow oil to be removed from the sediment and move sand by heavy machinery;
- Vegetation cutting – removing oiled vegetation; and
- Cleaning agents – application of chemicals such as dispersants to remove oil.

As predicted by the OSTM, there is a 1-25% probability that most of the shoreline in the EMBA will be contacted in the event of a 306 m³ release of MDO, with predominantly moderate to high shoreline loadings. These shorelines are predominantly sandy beaches with isolated rocky platforms. Shoreline clean-up is only considered practical for sandy beaches that may be affected by hydrocarbon residues. Manual and mechanical collection are the clean-up options most likely to be deployed.

Protection Priorities

The area of coastline predicted to have the highest areas of MDO loading (>1,000 g/m²), where ecological impacts will occur, is entirely sandy beach (see Section 7.16).

The key environmental receptor along this stretch of coastline is the hooded plovers (and their nests).

Availability

DEDJTR maintains shoreline clean-up capabilities for Level 2 or 3 vessel-based incidents, as outlined in the Maritime Emergencies NSR Plan (EMV, 2016).

Hazards

The hazards associated with SCAT and shoreline clean-up are:

- Additional personnel activity on beaches;
- Mechanical access to and activity on beaches;
- Loss of shoreline sediment; and
- Waste collection and transport.

Known and Potential Impacts of the Response Activity

The known and potential impacts associated with SCAT and shoreline clean-up are:

- Damage to foreshore and backshore environments from vehicle, machinery and/or foot access and associated land use (e.g., waste storage);
- Disturbance to Aboriginal cultural heritage (e.g., shell middens);
- Temporary exclusion of the public from anxiety beaches;
- Increased demand for what may be limited resources in small coastal towns (such as accommodation, fuel, hire vehicles in towns such as Golden Beach, Lakes Entrance, Marlo);
- Deeper mixing of hydrocarbons within beach sediments; and

- Secondary contamination of foreshore and backshore areas from personnel and equipment movement.

Evaluation of Environmental Impacts and Risks

Damage to foreshore and backshore environments

Damage to habitat is likely to be caused by high-pressure washing, whereby site-attached fauna such as limpets, mussels and lichen (on rocky substrates) will become detached from their habitat and may die. High-pressure washing may also damage the substrate itself. In both circumstances, the substrate is likely to be recolonized in a matter of weeks or months depending on site-specific conditions.

The mechanical collection of oil from sandy beaches will also result in significant volumes of clean sand lost from beaches, resulting in a temporary loss of shoreline habitat and associated macrofauna and meiofauna. The reduced profile of sandy beaches may also make them more vulnerable to damage (such as additional sand loss, erosion of dunes and loss of dune vegetation) created by spring tides and storm surges. However, this risk will be temporary as tides eventually replenish the lost sand over the following weeks and months.

The noise, light and general disturbance created by shoreline cleanup activities are likely to disturb the feeding, breeding, nesting or resting activities of resident and migratory fauna species that may be present. This is particularly the case for beach-nesting shorebirds such as hooded plovers, which are known to occur along the Gippsland coast. As an example, the eggs of hooded plovers (that nest only on sandy beaches) have small eggs that are very well camouflaged, so they are easily trodden on by accident.

If the incubating adult is scared off the nest by passers-by, the eggs may literally bake in the sun, or become too cold in the cool weather. Either way, it kills the chick developing in the egg, and the egg will not hatch. Similarly, when people disturb a chick, it quickly runs into the sand dunes and hides. While it is running, the chick uses up valuable energy, and while it is hiding it is unable to feed (they usually forage at the water's edge), so that a chick that is forced to run and hide throughout the day could easily starve (Birdlife Australia, 2016). Any erosion caused by responder access to sandy beaches, or the removal of sand, may also bury nests. In isolated instances, this is unlikely to have impacts at the population level.

Secondary contamination of the shoreline

Untreated, secondary contamination of the environment (e.g., oil released into sand dunes, oil spilled along roadsides during transport) may cause chronic toxicity impacts to any flora and fauna directly contacted. Habitat degradation or loss may occur as a result of soil pollution (that may result in temporary or permanent soil sterilisation, thereby inhibiting or reducing plant growth). The degree to which these impacts occur is a function of the volume of oil spilled and how long it remains in the environment before being cleaned (if at all).

Disturbance to Aboriginal cultural heritage

The movement of people, vehicles and equipment through sand dunes may disturb cultural heritage artefacts that occur at the surface or are buried. The most likely cultural heritage artefacts to be present are Aboriginal shell middens, especially

where freshwater and brackish water sources occur nearby, such as the Gippsland Lakes.

Infiltration of oil into beach sediments

The vertical infiltration of oil into shoreline sediments caused by heavy machinery and equipment can expose fauna to oil that would not otherwise have been exposed. This exposes the base of the foodweb to contamination that may bioaccumulate up through the food chain. It also results in the need for the increased removal of contaminated substrate, exacerbating risks such as beach erosion.

Temporary exclusion of the public from amenity beaches

The very presence of stranded MDO and cleanup operations may necessitate temporary beach closures (likely to be days to weeks, depending on the degree of oiling and nature of the shoreline). This means recreational activities (such as swimming, walking, fishing) in affected areas will be excluded until access is again granted by local authorities. Given the prevalence of sandy beaches along the coastline and the sparse nature and small population of coastal towns, the predicted rapid weathering of MDO, and the generally short-lived nature of clean-up activities, this is unlikely to represent a significant drawback to residents or tourists.

Increased demand for limited resources

The influx of shoreline clean-up personnel to a given region will place increased demand on the resources of small coastal towns such as Golden Beach, Lakes Entrance and Marlo, such as accommodation, meals, vehicle hire, fuel, groceries and other day-to-day consumables. In most instances, the increased activity associated with clean-up operations will be a boost to local economies, however sudden influxes of workers to small Australian towns is often fraught with social unrest as the demand for goods and services can negatively impact on the provision of services to residents and tourists. As with most of the risks associated with clean-up operations, this is likely to be temporary and localised.

Environmental Impact and Risk Assessment

Preparedness

- Access to operational response capabilities is maintained through the Maritime Emergencies NSR Plan.
- A current database of equipment and service providers is readily available.

Response

- SCAT teams mobilised to site within 6-24 hours of the notification of the spill (daylight hours permitting).
- SCAT information is provided to the IMT Leader for inclusion into the NEBA. An operational NEBA is undertaken to determine net benefits.
- If an operational NEBA identifies that shoreline clean-up is required, the IAP includes this information to guide the response, with personnel and equipment deployed to relevant locations.
- Shoreline clean-up resources are deployed to site within timeframes identified in the IAP.

Activity controls

- Environmental briefings are conducted prior to clean-up commencing in order to identify risks and suitable controls.
- Access to shoreline is via established tracks (with track edges fenced with bunting if required). Access outside of existing tracks and pathways is determined in consultation with local DELWP representatives.
- Mobile equipment to be driven as close to the water's edge as possible to prevent impacts to shoreline birds. Clean-up will keep to the inter-tidal zone as far as possible.
- In consultation with local DELWP representatives, known occurrences of Aboriginal cultural heritage are flagged for avoidance.
- Waste storage is located within a contained, impervious area. Area is under supervision and secured from the public.
- Oiled waste is transported in accordance with EPA waste disposal requirements.
- All access points (personnel and equipment) will be controlled via designated access points through decontamination facilities.

Table 7.52 presents the residual risk assessment SCAT and shoreline clean-up activities.

Table 7.52. Residual Risk assessment for SCAT and shoreline clean-up

Risk assessment (residual)			
Receptor	Likelihood	Consequence	Risk rating
Shoreline habitat	Likely	Minor	Medium
Recreational users	Likely	Minor	Medium
Cultural heritage disturbance	Possible	Minor	Medium

7.17.4. Oiled Wildlife Response

Oiled wildlife response is addressed in Section 10 of the OPEP.

Scope of Activity

Oiled wildlife response (OWR) may form a key component of the response to an MDO release, both at sea (especially nearshore) and at the shoreline because of the known presence of seabirds (e.g., albatross and petrels), nesting shorebirds (e.g., fairy terns, hooded plovers and little penguins) and fur-seals.

Broadly, oiled wildlife response involves the following three-tiered approach:

1. Primary response – involves undertaking surveillance to determine the location and extent of wildlife injuries or death, and deflecting oil away from areas of high sensitivity where practicable.

2. Secondary response – involves deterring or displacement strategies, by hazing (scaring animals through auditory bird scarers, visual flags or balloons, barricade fences, or pre-emptive capture).
3. Tertiary response – involves capture and stabilisation of oiled wildlife (on vessels or the beach), transport to treatment facilities, treatment of affected animals and rehabilitation and release of affected animals.

Oiled wildlife response equipment owned and maintained by DELWP, AMSA, and AMOSC is available at various locations along the Victorian coastline, and can be deployed to affected areas on an as-required basis (as units transportable by road or air). These will be called on through the SMEP, NatPlan (and AMOSPlan, if required), with DELWP taking the lead in any activities involving OWR with support from other agencies as requested.

Availability

DELWP is the responsible agency for responding to wildlife affected by a marine pollution incident in the Victorian jurisdiction. DELWP manages the rescue and rehabilitation with assistance from Parks Victoria (a DELWP agency) and Phillip Island Nature Park. DELWP's wildlife response is undertaken in accordance with the Wildlife Response Plan (a sub-plan of the Maritime Emergencies NSR Plan (EMV, 2016)) by trained DELWP officers.

Hazards

The hazards associated with OWR are:

- Hazing of target fauna may deter non-target species from their normal activities (resting, feeding, breeding, etc.);
- Distress, injury or death of target fauna from inappropriate handling and treatment;
- Euthanasia of target individual animals that cannot be treated or have no chance of rehabilitation;
- Damage to shoreline environmental sensitivities from the establishment of OWR response centres.

Known and Potential Impacts of the Response Activity

The known and potential impacts associated with SCAT and shoreline clean-up are:

- Disturbance, injury or death of fauna.

Evaluation of Environmental Impacts and Risks

It is preferable to have oil-affected animals that have no prospect of surviving or being successfully rehabilitated and released to the environment humanely euthanased than to allow prolonged suffering. The removal of these individuals from the environment has additional benefits in so far as they are not consumed by predators/scavengers, avoiding secondary contamination of the foodweb. There are no species within the EMBA with such a small or geographically-restricted population that the death of a low number of individuals would result in population-wide impacts.

Hazing and exclusion of wildlife from known congregation, resting, feeding, breeding or nesting areas may have a short- or long-term impacts on the survival of that group

if cannot access preferred resources. These effects may be experienced by target and non-target species. For example, shoreline booming or ditches dug to contain oil may prevent penguins from reaching their burrows after they've exited the water and low helicopter passes flown regularly over an beach to deter coastal birds from feeding in an oil-affected area may also deter penguins from leaving their burrows to feed at sea, which may impact on their health.

Onshore, the establishment of OWR centres will preferentially avoid locating infrastructure on or in close proximity to native habitat, thereby avoiding impacts associated with vegetation clearing (such as loss of habitat, reduction in local native species diversity and abundance). Facilities such as portable toilets and showers will be established to deal with day-to-day requirements of first responders so wastes are not discharged to the environment. Similarly, facilities will be supplied for the collection and/or treatment of oily water and detergents associated with the treatment of oiled wildlife so these wastes are not inappropriately discharged to the environment. A licensed waste management contractor will coordinate the supply of waste facilities and regular removal of wastes (including animal carcasses) to licensed facilities for disposal and/or treatment.

Untrained resources capturing and handling native fauna may cause distress, injury and death of the fauna. To prevent these impacts, only DELWP-trained oiled wildlife responders will approach and handle fauna. This will eliminate any handling impacts to fauna from untrained personnel and reduce the potential for distress, injury or death of a species.

Environmental Impact and Risk Assessment

Preparedness

- Access to operational response capabilities is maintained through the Maritime Emergencies NSR Plan.
- DELWP maintains a current database of equipment and service providers.

Response

- DELWP personnel are mobilised to site within 12 hours of the notification from the SCAT team that fauna are at risk.
- OWR kits are mobilised to site within 12 hours of the notification from the SCAT team that fauna are at risk.
- An operational NEBA is undertaken to determine net benefits of undertaking OWR.
- If an operational NEBA identifies that OWR is required, the IAP includes measures to guide the response, with personnel and equipment deployed to relevant locations.

Activity controls

- Environmental briefings are conducted prior to clean-up commencing in order to identify risks and suitable controls.
- Access to shoreline is via established tracks (with track edges fenced with bunting if required). Access outside of existing tracks and pathways is determined in consultation with local DELWP representatives.

- Mobile equipment to be driven as close to the water's edge as possible to prevent impacts to shoreline birds.
- Wildlife is only handled and treated by DELWP-trained or Phillip Island Nature Park wildlife clinic oiled wildlife responders.

Table 7.53 presents the residual risk assessment for OWR activities.

Table 7.53. Residual Risk assessment for OWR activities

Risk assessment (residual)			
Receptor	Likelihood	Consequence	Risk rating
Fauna injury	Unlikely	Insignificant	Low
Fauna death	Rare	Insignificant	Low

8. Implementation Strategy

The Crown in Right of Victoria retains full and ultimate responsibility as the Titleholder of the activity and is responsible for ensuring that the environmental performance outcomes and standards outlined throughout Chapter 7 are adequately implemented.

8.1. Environmental Management System

8.1.1. DEDJTR

The DEDJTR has in place an Environmental Management System (EMS) that is aligned with ISO 14001:2004 (Environmental Management Systems – requirements with guidance for use). The EMS is outlined in the department's EMS Manual (Version 1, July 2015).

8.1.2. Seismic Survey Contractor

CarbonNet is responsible for ensuring that the proposed Pelican 3DMSS is managed in accordance with this EP. Accordingly, CarbonNet has appointed a seismic management company to ensure that tenders for a seismic survey contractor meet all legislative requirements, the requirements of this EP and that the contractor has a robust EMS in place.

8.2. Roles and Responsibilities

The organisation structure for the survey consists of onshore and offshore CarbonNet personnel and seismic survey contractor personnel. Day-to-day implementation of the EP will occur on the source vessel under the leadership of the Party Chief and the CarbonNet Site Representative. The CarbonNet Survey Project Manager will have oversight of the performance of the project against the EP and other project plans, and will initiate reviews and audits as required.

8.3. Training and Awareness

8.3.1. Environmental Induction

A survey-specific HSE induction for all personnel working on the survey and support vessels will be undertaken prior to the survey commencing. The environmental component of the induction will include information regarding the environmental controls as outlined in the EP.

The CarbonNet Survey Client Representative is responsible for ensuring personnel receive this induction prior to the commencement of the survey. All personnel are required to sign an attendance sheet to confirm their participation in and understanding of the induction.

The seismic contractor will conduct their own company and vessel-specific inductions independently of the project-specific HSE induction.

8.3.2. Oil Spill Response Training

Quarterly training of vessel crews in SMPEP procedures is a MARPOL requirement for vessels over 400 GRT (Annex 1, Regulation 37).

During its contractor selection process, CarbonNet's seismic management company will ensure that the chosen contractor has been implementing this requirement.

An office-based desktop spill response exercise of the project OPEP will be conducted by DEDJTR prior to the survey commencing.

8.3.3. Marine Mammal Observers

Only appropriately qualified and experienced MMOs will be hired by the seismic survey contractor.

The MMOs will provide an information session to control room operators and other essential personnel at the start of the survey regarding their fauna observation duties and the communication protocols required with the control room operators to ensure shut downs and power downs occur efficiently.

8.3.4. Toolbox Talks and HSE Meetings

Environmental matters will be included in daily toolbox talks as required by the specific task being risk assessed (e.g., waste management).

Environmental issues will also be addressed in daily operations meetings and weekly HSE meetings.

8.3.5. Communications

The Survey Vessel Master, Party Chief and CarbonNet Client Representative are jointly responsible for keeping the marine and survey crews informed about HSE issues, acting as a focal point for personnel to raise issues and concerns, and consulting and involving all personnel in the following:

- Issues associated with the implementation of the EP;
- Any proposed changes to equipment, systems, or methods of operation of equipment, where these may have HSE implications; and
- Any proposals for the continuous improvement of environmental protection, including the setting of environmental objectives and training schemes.

Meetings include daily CarbonNet management meetings, daily operations meetings, daily pre-start safety meetings, toolbox meetings before each task and weekly HSE meetings.

8.4. Environmental Emergencies and Preparedness

In the event of an emergency of any type, the 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 CarbonNet Client Representative will maintain communications with DEDJTR in the event of an emergency. Emergency response support will be provided by DEDJTR as required by the situation.

The source and support vessels will have equipment aboard for responding to emergencies, including but not limited to lifesaving appliances, medical equipment, fire fighting equipment and oil spill response equipment.

8.4.1. Adverse Weather Protocols

It is the duty of the Vessel Master to act as the focal point for all actions and communications with regards to any emergency, including response to adverse weather or sea state, to safeguard his vessel, all personnel onboard and environment.

In addition to in-vessel VHF Marine Radio Weather Services, the seismic survey contractor will obtain daily weather forecasting from the Bureau of Meteorology to monitor weather within the operational area in the lead up to and for the duration of the survey.

8.4.2. Vessel Emergencies and Oil Spills

Survey-specific emergency response procedures for the proposed survey will be included in the seismic survey contractor's ERP. The ERP will contain instructions for vessel emergency, medical emergency, search and rescue, reportable incidents, incident notification and emergency contact information.

Vessel-specific SMPEP and ERPs typically include vessel-specific procedures for the following:

- Vessel incidents – collision, grounding, hull damage, man overboard, equipment failure;

- Waste management;
- Hazardous materials and handling; and
- Hydrocarbon and chemical spills.

The SMPEP includes information about initial response, reporting requirements and arrangements for the involvement of third-parties having the appropriate skills and facilities necessary to respond effectively to oil spill issues. The SMPEP will be the principal working document for the vessel and crew in the event of a marine oil spill incident. This document will include specific emergency procedures including steps to control discharges for bunkering spills, hull damage, grounding and stranding, fire and explosion, collisions, vessel list, tank failure, sinking, and vapour releases. The SMPEP also includes requirements for regular drills of the plan and revision following drills or incidents.

The OPEP developed by CarbonNet for this project will be implemented (and supplements the vessel-specific SMPEP) in the event of a Level 2 or Level 3 hydrocarbon spill that requires response resources beyond those immediately available to the survey vessel.

The Vessel Master will ensure that all crew on board are fully aware of the vessel-specific requirements and that exercises for vessel-related incidents are conducted.

8.5. Monitoring

This section describes the environmental monitoring requirements of the proposed survey.

8.5.1. Field Environmental Monitoring

Carbonnet will maintain a quantitative record of emissions and discharges, and other environmental matters generated on location during the survey.

The contractor's Party Chief is responsible for collecting this data and reporting it to the CarbonNet Client Representative. This is facilitated by completing a daily environmental monitoring register that will be provided by CarbonNet to the survey contractor, which captures the commitments made in Table 8.1. These results will be reported in the end-of-survey EP performance report submitted to NOPSEMA and ERR.

Table 8.1. Summary of the Pelican 3DMSS field environmental monitoring

Aspect	Monitoring requirement	Frequency
Impacts		
Underwater sound	MMO megafauna visual observations.	Continuous during survey.
	Underwater sound validation.	Pre-survey and continuous during survey.
Atmopsheric emissions	Fuel consumption.	Tallied at end of survey from daily reports and/or bunker receipts.
Bilge water	Volume of bilge water discharged during the survey.	Noted in Oily Water Logbook.

Aspect	Monitoring requirement	Frequency
Risks		
Seabed disturbance	Vessel Master and/or seismic crew note any contact between streamers or hull with the seabed.	Noted as required.
Waste disposal	Weight/volume of wastes sent ashore (including oil sludge, solid/hazardous wastes).	Tallied at end of survey from the project-specific waste manifest. Garbage Record Book updated during backload in port.
Displacement of or interaction with merchant and/or fishing vessels	Ongoing patrol for, and communications with, third-party vessels by the support vessels. Radar surveillance from source vessel.	Continuous during survey.
Interference or damage to shipwrecks	Ongoing surveillance and reporting of disturbance to shipwrecks within the acquisition area.	Continuous during survey.
Introduction of IMS to acquisition area	Volume and location of ballast water discharges noted.	As required, noted in the ballast water log.
Swimmers and divers	Bridge watch for 'diver below' flags and swimmers.	Continuous during survey.
	Beach patrols.	As required (i.e., not when the survey vessel is at the most seaward parts of the acquisition area).
Vessel strike or entanglement with cetaceans	MMO continuous megafauna observations.	Continuous during survey.
Diesel spill (in the event of)	Operational monitoring in line with the OPEP.	As required.

Pre- and Post-MSS Marine Habitat Assessment

CarbonNet has been in discussions with the fishing industry and the VFA about undertaking a pre- and post-MSS marine environmental assessment. CarbonNet has proposed a non-invasive observation-based methodology similar to the assessment undertaken in April 2017, which sought to determine the presence or absence of:

- Environmentally sensitive habitats;
- Broad seabed substrate types;
- The presence or absence of commercial scallop beds (*Pecten fumatus*); and
- The presence or absence of southern rock lobsters (*Jasus edwardsii*) and their preferred reef habitat.

CarbonNet again proposes to adopt a non-invasive survey technique (such as towed video), consistent with the project's regulatory approvals.

Purpose

The purpose of the pre- and post-MSS marine environmental assessment is to provide more certainty to the fishing industry regarding the presence or absence of

commercial scallop beds and southern rock lobsters, thereby providing more certainty regarding the extent of potential impacts to scallop and lobster fisheries. The additional monitoring will allow for comparisons of key environmental habitats and species prior to and after the MSS takes place, designed and undertaken on a scientific basis.

Timing

The pre-MSS marine habitat assessment will take place at least several weeks prior to the MSS (subject to logistics and weather). It is anticipated that the post-MSS assessment will take place notionally within 3-6 months from the completion of the MSS. The ultimate timing of this post-MSS assessment is subject to discussion and agreement with the fishing industry stakeholders (based on relevant science), availability of the chosen consultants undertaking the work, vessel availability and sea state conditions.

Proposed methodology

It is envisaged that the work will involve:

- Using a small, locally-based vessel with which to undertake non-invasive observations;
- Establishing pre-determined monitoring locations in accordance with a scientifically robust survey design designed to detect the presence of scallop beds. In addition to sampling locations within the acquisition area, additional sampling locations will be included within the operational area and underwater sound EMBA for benthic invertebrates (i.e., at least a distance of 1,220 m from the boundary of the acquisition area);
- Having suitably experienced and qualified marine biologists on board the vessel to set up the survey and review live video footage;
- Recording video footage for further review and analysis;
- Deliver geo-referenced information as geographic information systems (GIS) data; and
- Summarising the data in a concise report, with the post-MSS report comparing the 'before' and 'after' MSS results.

Consultants

After a competitive tender process, Advisian, in conjunction with CEE, has been awarded the contract to undertake the pre- and post-MSS marine habitat assessment. Advisian and CEE are well placed to undertake this work given that they undertook the initial marine habitat assessment for the project in April 2017.

Advisory panel

To ensure that the pre- and post-MSS marine habitat assessments are undertaken in a scientifically robust manner, CarbonNet has established an Advisory Panel that will provide advice to the CarbonNet Project in relation to:

- The methodology of the marine habitat assessment methodology, refining its design as required;
- The definitions of what constitutes:
 - Commercial quantities of scallops.

- Natural mortality ranges of scallops.
- A mass mortality event of scallops.
- Results of the upcoming Victorian Eastern Ocean Scallop Stock Assessment (that may or not be undertaken prior to the pre-MSS assessment);
- Scallop catch effort in and around the project area;
- The draft pre-MSS assessment report;
- The draft post-MSS assessment report(s); and
- Stakeholder engagement approaches regarding the outcomes of the assessments.

Terms of Reference for the Advisory Panel have been developed. The members of the Advisory Panel are independent of the Pelican 3DMSS project and highly experienced in marine matters, which ensures their suitability to provide technical feedback on the design and results of the marine habitat assessments.

Decision trees are presented in Figure 8.1 and Figure 8.2 to outline the response management framework for the pre- and post-MSS marine habitat assessments. It is important to note that the impact assessment for scallops has assumed the presence of scallops at an abundance equivalent to the 1998-2003 catch rates. The findings of the additional pre-MSS marine habitat assessment, based on those from the April 2017 habitat assessment, are likely to indicate scallop abundances far lower than historical records. This being the case, CarbonNet does not anticipate impacts to scallops being any higher than that presented in this EP.

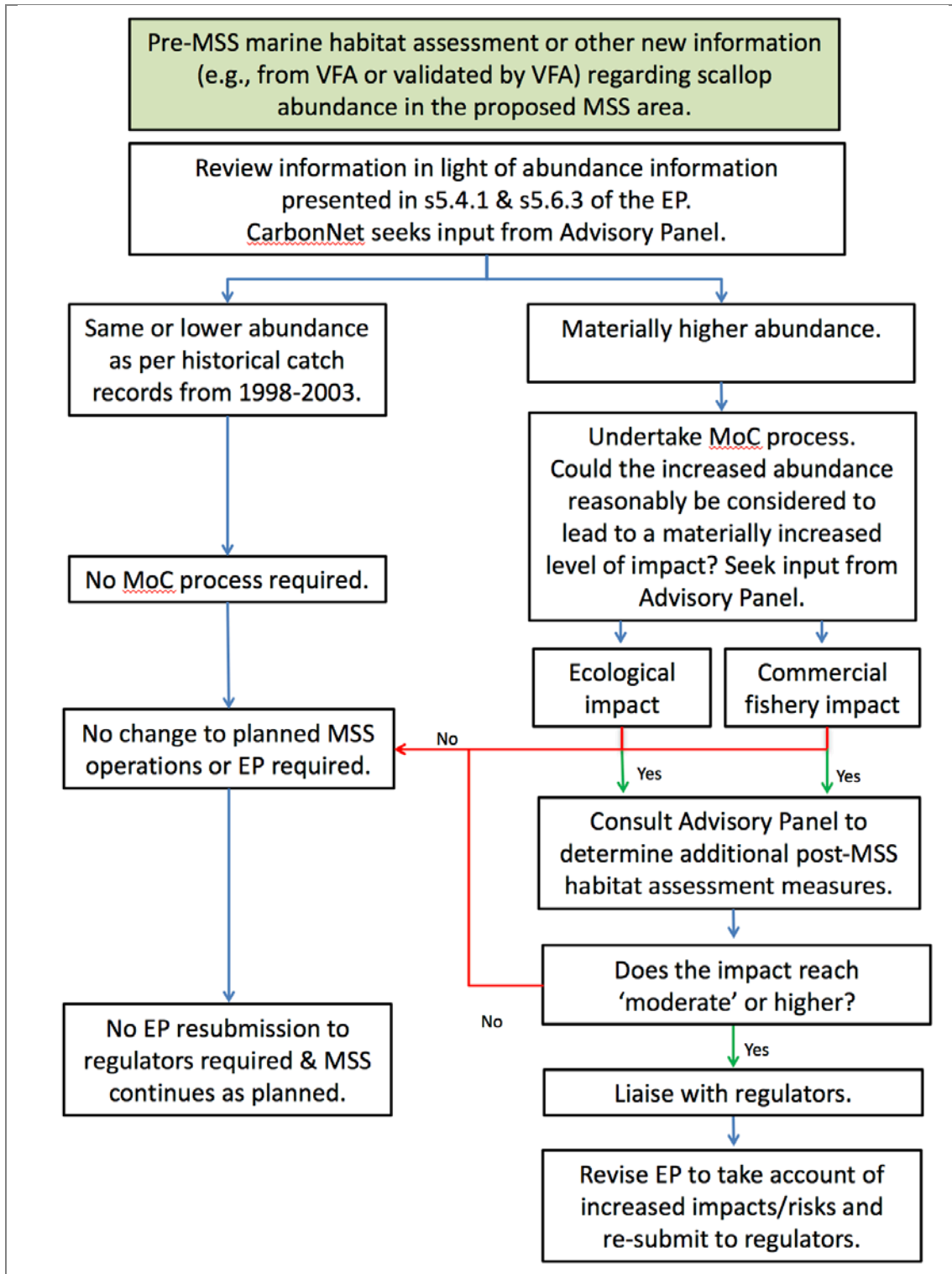


Figure 8.1. Response management framework for the pre-MSS marine habitat assessment

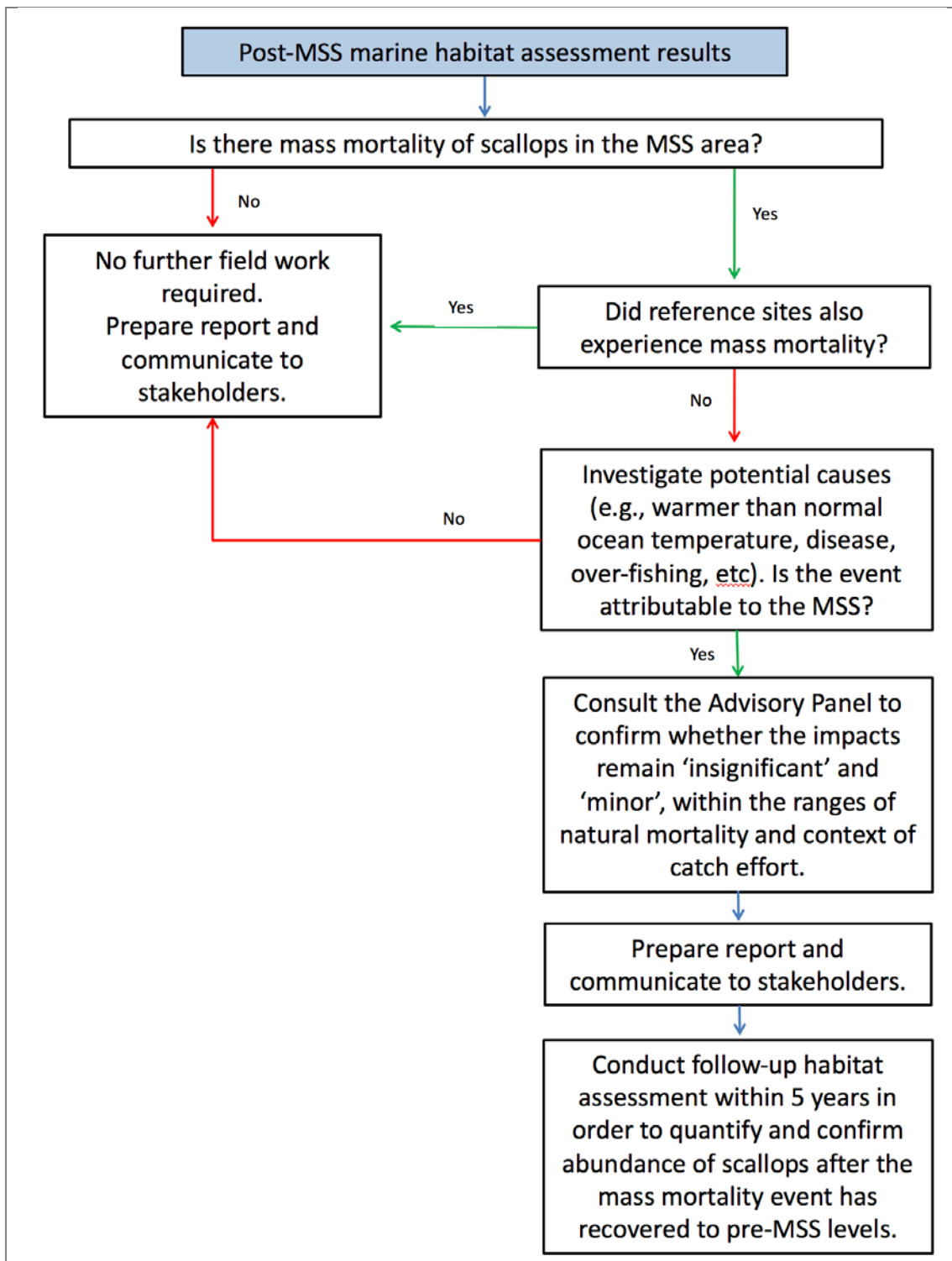


Figure 8.2. Response management framework for the post-MSS marine habitat assessment

Underwater Sound Validation

Purpose

As part of its contribution to the wider scientific body of knowledge around MSS and to determine the accuracy of modelled predictions regarding the extent of potential impacts to commercial scallop and rock lobster fisheries (and thus aim to provide more certainty to the commercial fishing industry), CarbonNet proposes to validate

the STLM (SEL, SPL, PK, PK-PK and particle motion) prepared for the proposed Pelican 3DMSS.

Timing

It is proposed that several underwater sound loggers are deployed within the proposed acquisition area at least a week prior to the MSS commencing in order to collect ambient ocean sound data. The loggers will then be left at the same locations for the duration of the MSS. If logistics don't allow for the loggers to be deployed in sufficient time ahead of the MSS to collect ambient underwater sound data, then they will remain in location for up to a week after the completion of the MSS to perform the same role.

Proposed methodology

It is envisaged that the work will involve:

- Using a small, locally-based vessel (or survey support vessel) to deploy the loggers;
- Placing the loggers (autonomous multichannel acoustic recorders) on the seabed;
 - The base plate and/or weight/s used to keep the underwater sound loggers on site during the MSS will not be placed over mapped sensitive habitat, such as sponge gardens or reef.
- Deploying multiple loggers at locations within the acquisition area and the underwater sound EMBA for benthic invertebrates (i.e., greater than 1,220 m) in order to verify predictions of acceptability;
- Deploying the loggers at least a week prior to the survey commencing in order to record ambient underwater sound levels;
- Recording sound for the duration of the MSS;
- Recovering the loggers at the completion of the MSS (no equipment will remain on the seabed once the sound validation work is complete);
- Downloading and analysing the recovered data; and
- Summarising the data in a concise report that compares the underwater sound during the survey with predictions from the STLM report, and with ambient sound levels recorded immediately prior to the survey.

Consultants

Jasco Applied Sciences has been awarded the contract to undertake the underwater sound sound verification work. Jasco is well placed to undertake this work given that they undertook the STLM for the project (see Section 7.1) and have undertaken numerous sound validation studies globally.

8.5.2. Auditing, Assurance and Inspections

The following arrangements will be established to review environmental performance of the activity:

- HSE due diligence pre-survey audit – audit(s) of the survey and support vessels will be carried out prior to the survey (and after contract award) to ensure that procedures and equipment for managing routine discharges and emissions are in place to enable compliance with the EP.
- Internal operations inspections – the Party Chief will continually supervise the survey, ensuring adherence to the environmental controls specified in this EP. Regular inspections using an environmental checklist issued by CarbonNet will be completed by the Party Chief and provided to the CarbonNet Client Representative.

A summary of the EP commitments for the survey will be distributed aboard the vessels, and implementation of the EPS will be monitored by the CarbonNet Client Representative.

Any non-compliance with the environmental performance standards outlined in this EP will be internally and externally reported and subject to investigation and follow-up action.

8.6. Oil Spill Preparedness and Response

Project-specific oil spill preparedness and response plans have been prepared, as outlined herein.

8.6.1. OPEP

The Pelican 3DMSS OPEP outlines details the oil spill response arrangements to be undertaken in the event of a Level 2 or 3 MDO spill from any of the vessels associated with the survey. It outlines the reporting arrangements and response structure, and essentially bridges to the Victorian Government's State Maritime Emergencies (non-search and rescue) Plan (EMV, 2016).

The responses outlined in the OPEP are:

- Source control – the responsible Vessel Master will ensure that the impacted fuel tank/s are managed so as to minimise the volume of MDO lost to sea (as per the SMPEP).
- Surveillance and tracking – vessel-based and aerial monitoring will be undertaken to determine the trajectory of the spill in order to ascertain receptors that may be at risk.
- Protection and deflection – relates to booming estuaries that may be open in order to protect their values.
- Shoreline assessment and clean-up – involves undertaking a survey of shoreline impacts and allocating resources to clean up stranded MDO, where possible.
- Oiled wildlife response – the DELWP is the agency responsible for responding to oiled wildlife. CarbonNet would work with DELWP to provide resources as necessary.
- Decontamination and waste management – this process involves responsibly decontaminating oiled equipment used in the spill response, and disposing of waste to suitable facilities.

8.6.2. SMPEP

The survey vessel has in place a SMPEP. This document is required under MARPOL Annex 1, Regulation 37. This plan outlines reporting procedures and the steps that should be undertaken to control the discharge. This document does not outline on-water or shoreline oil spill response actions; the OPEP fills this void.

8.6.3. OSMP

An Operational and Scientific Monitoring Program (OSMP) has been prepared for the Pelican 3DMSS, which is designed to provide a framework for operational and scientific monitoring in the event of a Level 2 or 3 hydrocarbon release. Such a program aims to assess the impacts of a hydrocarbon spill. The OSMP is divided a description of operational and scientific studies, as follows:

Operational monitoring (or Type 1 monitoring, response phase) studies

1. Predictive oil spill trajectory modelling.
2. Surveillance and reconnaissance to detect hydrocarbons and resources at risk.
3. Detecting and monitoring for the presence and properties of hydrocarbons.
4. Monitoring of contaminated resources.

Scientific Monitoring (or Type 2, recovery Phase) studies

1. Assessment of the presence, quantity and character of hydrocarbons in marine waters.
2. Assessment of the presence, quantity and character of hydrocarbons in seabed sediments.
3. Assessment of impacts and recovery of subtidal and intertidal benthos.
4. Assessment of impacts and recovery of seabird and shorebird populations.
5. Assessment of impacts and recovery of pinniped populations.
6. Desktop assessment of impacts to marine megafauna.
7. Assessment of impacts and recovery of marine fish.
8. Assessment of physiological impacts to commercially important fisheries species (fish health and seafood quality/safety) and recovery.

Consultancies and government organisations suitable to undertake this monitoring work, and the resources required, are presented in the OSMP Framework and associated OSMP Implementation Plan.

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