

STAR OF THE SOUTH OFFSHORE WIND FARM

Technical Report D: Marine Mammals and Turtles



AU213013334.002.004
Version 0
March 2026

REPORT

Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
0	Authorisation	RW/AP/MA	JE	KS	25/03/2026

Approval for issue

KS

25 March 2026

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ACKNOWLEDGEMENT

This technical report for marine mammals and turtles has been developed in partnership with the technical expertise of Deakin University, CMST and JASCO. RPS acknowledges the considerable contributions of subject matter experts towards the production of this report.

EXECUTIVE SUMMARY

Overview

Star of the South (SOTS) is Australia's most advanced offshore wind project. Located off the south coast of central Gippsland, the project comprises an offshore wind farm and supporting transmission infrastructure to transfer energy to the existing electricity network.

A delegate for the Commonwealth Minister for the Environment and Water determined that the proposed action (project) has the potential to have significant impact on the environment (as set out in notice dated 2 June 2020) and is required to be assessed under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). The action has potential to have a significant impact on the following matters of national environmental significance (MNES) protected under Part 3 of the EPBC Act, all of which are relevant to marine mammals and turtles:

- Listed threatened species and communities
- Listed migratory species
- The environment in Commonwealth marine areas.

It was determined that the proposed action will be assessed through the preparation of an Environmental Impact statement (EIS). The Victorian Minister for Planning has determined that an Environment Effects statement (EES) is required (as set out in notice dated 11 May 2020) under the *Environment Effects Act 1978* (Vic) (EE Act).

This report has been prepared to address the requirements of the EIS and EES. Future management plans will link EPBC and EE Act assessments through to delivering requirements under the *Offshore Energy Infrastructure Act 2021* (OEI Act).

Existing environment

The Offshore Wind Farm Area (OWFA) is located between approximately ten and 27 kilometres from the coast of central Gippsland, approximately 200 kilometres east of Melbourne and located in the South-west Shelf Transition bioregion of the South-east Marine Region. The Gippsland region has been recognised as an important foraging area for various cetacean species as they travel through the area to the Bonney Upwelling (located 480 kilometres west of the OWFA). The OWFA and surrounds (broadly defined based on a field assessment and literature review) also lies approximately 100 kilometres south-west of the Upwelling East of Eden KEF, 200 kilometres south-west of Big Horseshoe Canyon and is subject to the Bass Cascade (not spatially defined), meaning that the area may also intersect with migration pathways for marine mammals moving between these upwelling areas of high productivity.

A total of 19 marine mammals and turtle species that may occur within or migrate through the OWFA plus a 10-kilometre buffer (based on the area within which impacts can be reasonably mitigated) were identified using the protected matters search tool (PMST), these were 14 cetacean (whale and dolphin) species, two pinniped (seal, sea lion and walrus) species and three marine turtle species. Each of the identified marine mammal and turtle species are listed under the *EPBC Act* as 'threatened', 'migratory', 'cetacean' and / or 'marine'. Of these 19 species identified under the *EPBC Act*, four cetaceans and three turtles are listed as 'Threatened'.

In addition, two baleen whale species, one pinniped and one turtle species that could occur in the OWFA are listed at the state level as 'Threatened' under the Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act).

Eleven of the 19 species identified by the PMST as potentially occurring within or migrating through the OWFA and surrounds were recorded in one or more scopes of the Star of the South Marine Ecology Survey Program (MESp) and / or Energy Innovation Fund (EIF) survey program baseline periods. Moreover, four cetacean species not identified by the PMST were detected in the surrounding OWFA waters throughout the SOTS MESp and / or EIF survey program baseline periods.

The OWFA and its surrounds overlap with biologically important areas (BIAs), defined and mapped on the Australian Marine Spatial Information System (AMSIS) by the Australian Government's Department of Climate Change, Energy, Environment and Water (DCCEEW), including a foraging BIA for blue whales, and migration and reproduction BIAs for southern right whales. For marine turtles, the OWFA is in the 'known /

likely species range in the Commonwealth marine area' for leatherback, loggerhead and green turtles (Commonwealth of Australia, 2017a).

During the MESP baseline survey, nine marine mammal species and one turtle species were identified from visual aerial surveys: including the common dolphin, bottlenose dolphin, humpback whale, southern right whale, dwarf minke whale, Bryde's whale, pygmy blue whale, killer whale, fur seal and a single leatherback turtle. The majority of sightings (87.6 per cent) were outside of the OWFA; however, it is presumed all species may utilise the OWFA. Additionally, a loggerhead turtle was recorded during opportunistic sightings. Acoustic recordings from the MESP identified humpback whale, dwarf minke whale, Antarctic minke whale and Eastern Indian Ocean pygmy blue whale and New Zealand pygmy blue whale vocalisations and the 'spot' call. Assessments of locally breeding Australian fur seal (AUFS) and New Zealand fur seal (NZFS) were also completed, identifying OWFA utilisation and population counts.

Impact assessment findings

An assessment of potential impacts associated with the project was completed, considering the existing environment within the study area and associated construction, operation and decommissioning activities.

The assessment found the following:

- Underwater noise generated from pile driving and project vessels could cause temporary hearing impairment and / or behavioural disturbance unless managed
 - Modelling that included animal movement, i.e. realistic behavioural parameters, found that baleen whales could experience temporary threshold shift (TTS) and/or behavioural disturbance within a range of approximately five kilometres during impact piling of wind turbine generator (WTG) monopile foundations with a double big bubble curtain (DBBC), hydro sound damper (HSD) and modified hammer system (MHS) in place as a noise abatement system (NAS) .
 - This distance is applicable when whales are displaying movement patterns like those parameters entered into the model; blue whale feeding and migrating, humpback whales migrating with and without a calf, southern right whales migrating with and without a calf, and minke whales (other baleen whales) migrating. Such parameters may not be suitable for whales that are foraging in a localised area or resting. For the endangered blue whale and southern right whale, which have biologically important areas for these behaviours in or near the project area, the results of the static underwater noise modelling, which assumes whales are stationary, i.e. there is no consideration of normal animal movement and resulting reduction in noise exposure over time, are also considered in the impact assessment as a conservative approach, and would inform monitoring ranges used under adaptive management circumstances.
 - Impact ranges for odontocetes and pinnipeds to PTS and TTS onset during pile driving of monopiles with a DBBC, HSD and MHS in place were not reached within the limits of the modelling and were significantly reduced during installation of jacket pin piles with a DBBC and MHS, to less than 160 metres due to the different frequencies at which they primarily hear.
 - For all marine mammal species, animals could experience a behavioural response within six kilometres during pile driving of monopiles with a DBBC, HSD and MHS in place.
 - Marine turtles could experience TTS onset during pile driving with a DBBC, HSD and MHS in place within around a one-kilometre range and experience a behavioural response within around three kilometres.
- Baleen whales could experience TTS onset within a maximum range of approximately 1.1 kilometres during vessel operations for WTG installation, based on animal underwater noise modelling, for vessels using 50% thruster power, which is likely to represent a worst-case operating scenario during marginal weather conditions.
 - For odontocetes and pinnipeds, impact thresholds for TTS onset were significantly reduced compared to LF cetaceans to around 100 to 200 metres during vessel operations for WTG installation using static results.
 - For all marine mammal species the same behavioural threshold is used for continuous noise, therefore current modelling suggests that animals could experience a behavioural response

within 16 kilometres during vessel operations for WTG installation using static results.

However, for baleen whales for which animal movement modelling was undertaken, ranges for behavioural disturbance are predicted to be reduced to a maximum of around 12 kilometres.

- Marine turtles could experience TTS onset within 40 metres during vessel operations for WTG installation using static results.
- Changes in prey distribution and abundance during the construction and operation phases, could potentially alter foraging ability and bioenergetics
 - Marine mammals and turtles could respond to small-scale changes created by offshore developments by moving to alternate foraging grounds, changing predominant prey species and / or changing the time spent foraging.
 - Species that are known to forage in OWF areas, such as bottlenose and common dolphins, and fur seals, or may forage in the OWFA such as the blue whale (on account of the OWFA overlapping with a designated 'foraging' biologically important area (BIA)) or humpback whales that have been observed to foraging around oil and gas infrastructure in the region, could encounter changes in prey distribution and abundance, though this may result in increased prey availability rather than a decrease.
- Physical presence of operational turbines – infrastructure attraction, barrier effects and displacement
 - The Australian fur seal and New Zealand fur seal were identified as species that are potentially most likely to be attracted to offshore wind farms because of increased food resources provided by the physical presence of the structures.
 - A potential beneficial outcome has been observed between Australian fur seals and existing offshore oil and gas infrastructure, with the animals reportedly resting on and foraging within the vicinity of the structures.

The impact assessment also identified several pathways that may have limited impacts to marine mammals and turtles. These include:

- Routine vessel discharges causing a decline in water quality and / or turbidity, potentially introducing marine pest species and / or temporary toxicity
 - During construction of the wind farm, vessels will need to routinely discharge liquid and solid waste into the marine environment. All marine mammal and turtle species were identified as having the potential to be impacted from this discharge as it may lead to a change in water quality, affecting fauna health or behaviour.
 - However, vessel discharges are expected to have only localised (within a kilometre) and short-term (less than an hour) effects as discharges are expected to disperse and dilute rapidly in the water column and be compliant with international discharge standards.
- Artificial light disrupting critical behaviours
 - The species most likely to be impacted by artificial lighting in the offshore environment are marine turtles such as loggerhead turtle, leatherback turtle and green turtle. However, the presence of all marine turtle species in the OWFA and surrounds is expected to be rare and limited to occasional transient individuals.
 - There are no important habitats for marine turtles (i.e. nesting beaches) in proximity to the OWFA.
- Seabed disturbance altering foraging behaviour and / or decreasing abundance / species diversity in the area
 - Elevated suspended sediment concentrations that were modelled for potential drilling during foundation installation were evident across the full water column, with the highest near the sea surface. The modelling showed it took several tidal cycles for the plume to dissipate below reporting thresholds
 - However, any impacts on marine mammals and turtles due to seabed disturbance is not expected to be significant, because they and their habitat are typically widely spread, and any impact is likely to be localised to the OWFA and at a small spatial scale (metres to hundreds of metres) and short temporal scales (hours to days).

- Electromagnetic interference (EMI) disguising or distorting natural cues for important life functions
 - Transmission power cables that will be a part of the activity will be buried or covered to protect them from damage. This has the added benefit of reducing the potential for EMI in the water column. This makes it unlikely for any EMI to cause behavioural changes to marine mammal and turtle species during the operation of the OWF.

Risk assessment findings

An assessment of potential risks associated with the project was completed, considering the existing environment within the study area and associated construction, operation and decommissioning activities.

The assessment found the following key potential risks:

- Risk of vessel strike to marine fauna during construction and operation leading to injury or mortality
 - The species most at risk from vessel strike leading to injury / mortality were the blue, southern right, humpback and other mysticetes
 - The risk is highest during the construction period, particularly for the southern right whale, when vessels are frequently transiting the nearshore coastal zone including the 'reproduction' BIA, with the potential risk for vessel strike reduced during operations as vessel movements will be less.
 - Mitigation measures will be applied to the risk of injury or death to all marine mammal species from vessel strike.
- Accidental hydrocarbon release from vessel collision, spills on deck, and at sea re-fuelling accidents that could directly impact physical health or indirectly impact prey species
 - This is an extremely unlikely event, but with potentially serious consequences for marine mammal and turtle species if they are in the area at the time, in terms of oil contact with sensitive areas, inhalation, and indirect ingestion.
 - With the implementation of appropriate vessel management plans and procedures to manage simultaneous operations, including around fishing activities, the risk is very low. Oil pollution response plans will be implemented in the event of a major spill to limit the impact to marine fauna and the environment.
- Debris escape during construction and operation leading to injury or mortality
 - Entanglement and ingestion may occur either accidentally while feeding or scavenging, or deliberately if marine debris is mistaken for prey items. Standard industry vessel management practices will apply to prevent debris escape and debris would be retrieved if lost.
- Accidental discharges leading to a decline in water quality and / or temporary toxicity of prey species
 - Accidental discharges from large vessels may entail changes to water quality through contamination from hydrocarbons, detergents, solvents, and chemicals, or the introduction of marine pests' species.
 - This event is extremely unlikely, and vessel procedures will be in place to avoid accidental discharges.

Cumulative impact assessment

A cumulative impact process was used to conceptualise potential overlap of activities in the Gippsland region that could impact marine mammal and turtles that may also be affected by the SOTS project activities. Activities were generally associated with other offshore wind farms, petroleum activities, port activities or transmission activities. The potential for cumulative impacts was determined by a screening process whereby projects could be screened out due to no spatial overlap between the impact footprints of project areas, because receptors were unlikely to move through both project footprints, there was no temporal overlap, projects were not sequential or projects were in the early stages of development that meant it was not possible to undertake an assessment.. The remaining projects could be assessed for potential cumulative impacts for the purposes of this report. Projects that were included for assessment were either feasibility studies for offshore wind, or other activities such as short-term drilling / marine survey campaigns

or cable laying projects that could overlap or occur immediately the predicted timing of the activities described in this assessment. While there were no cumulative impacts predicted due to the mitigation measures included in this project and in the other projects assessed, a process was determined by which the potential for cumulative impact can be assessed and management measures implemented, if required, at the time of SOTS activities.

Mitigation and adaptive management measures

Potential impacts on marine mammals and turtles due to the construction, operation and decommissioning of the project will be avoided, minimised or managed through the recommended mitigation measures. In addition to standard mitigation measures to meet legislative and policy guidelines, additional mitigation measures are proposed to ensure environmental impacts and risks are at or below an acceptable level of impact defined by acceptance criteria. These include:

- Reducing the risk of vessel strike to marine mammals and turtles, and in particular the endangered southern right whale and blue whale, as prescribed by the Commonwealth EPBC Regulations 2000 Part 8 and Victorian State Wildlife (Marine Mammal) Regulations 2019 to minimise the risk of collision with a whale or dolphin by including vessel speed restrictions and no approach distances in the event marine mammals and turtles are seen.
- Reduce the potential for TTS onset (and thereby PTS) to blue whales, southern right whales, humpback whales and other mysticetes, and all other marine mammals and turtles. This will be done through the application of the following measures:
 - Limiting piling durations (only a single monopile will be installed at time, there will be no concurrent piling).
 - Soft-start procedures – soft start and ramp-up of hammer energy measures will occur at the commencement of each impact pile driving activity for both monopile and jacket pile foundations during the construction phase. These measures are aimed at discouraging marine mammals and turtles from remaining near the noise source and reduce the number of individuals potentially occurring within TTS onset ranges, with the exception of southern right and blue whales whereby piling would not commence if any whales are within behavioural disturbance ranges.
 - Using Noise Abatement Systems (NAS) during impact pile driving. The project will implement the best available NAS techniques at the point of construction that meets the noise level limit determined by feasible monitoring ranges (i.e. and is feasible for the site's water depths, metocean conditions, pile size and vessels). The underwater noise modelling used to inform the current impact assessment has included a double big bubble curtain (DBBC), hydro sound damper (HSD) and a modified hammer system in the form of the IQIP PULSE.
 - Verifying pile driving noise levels at the commencement of construction as per the Construction Underwater Noise Framework. Pre-construction modelling based on detailed final designs of the foundations and utilisation of best available NAS will be validated by in field monitoring. If noise levels are greater than predicted additional NAS will be implemented until predicted noise levels are reached or less, or the monitoring range will be extended for marine mammals and turtles so as to align with relevant thresholds for behavioural disturbance and TTS.
 - Use of EPBC Act Policy Statement 2.1 Part A measures (standard measures whenever whales are encountered) and Part B measures (additional mitigation measures used to avoid or minimise impacts where the likelihood of encountering whales is moderate to high) (e.g. marine fauna observers (MFOs) and passive acoustic monitoring (PAM) procedures, increased precaution and buffer zones, adaptive management).
 - Use of emerging technologies as practicable (e.g. infra-red imagery, long range real-time noise monitoring, vessel launched long range drones) to improve detections of whales at night, during periods of low visibility and at distances over which observations are not possible.
 - Marine Fauna Observers will be used on multiple platforms (i.e. dedicated observer vessels) to cover the extent of TTS onset and behavioural disturbance as predicted by the underwater noise modelling and as verified by acoustic noise measurements.

- Reduce the likelihood of marine mammals and turtles encountering poor water quality from vessel discharges by avoiding discharging when nearby to sensitive areas and receptors where practicable.
- Standard industry vessel management would limit the likelihood of debris escape, but in the event of debris escape, retrieval of any debris escape will occur only if practicable and with marine mammal / turtle monitoring in place.

In cases where residual uncertainty remains about the potential impact or risk to marine mammals and turtles, a program of monitoring during construction and operation of the OWFA will be implemented to validate predictions / expectations (e.g. of species occurrence, levels of effect) and to inform adaptive management where necessary. Adaptive management measures include:

- If a southern right whale or blue whale is sighted, vessels will increase the caution zone and reduce vessel speeds.
- An adaptive management procedure will be implemented if behaviour, occurrence or abundance is different to what has been predicted as per the Construction Underwater Noise Management Framework
- Details of mitigation measures and management procedures will be outlined in a Marine Mammals and Turtles Monitoring and Management Plan (MMTMMP).

The above mitigation and adaptive management measures will ensure the project meets the environmental assessment criteria used to ensure that the requirements of the EPBC Act are met.

Monitoring programs

Monitoring measures that will confirm that assessment criteria have been met for marine mammals and turtles are summarised below:

- Monitoring of marine mammal and turtle presence, abundance and behaviour during construction and decommissioning, as a part of mitigation measures will indicate whether assessment criteria are being met.
- Monitoring during routine turbine inspection and maintenance visits for the presence of marine mammals and turtles during operations to understand if abundance, habitat use, or behaviour of marine fauna has changed due to OWF presence.
- Monitoring of noise emissions to validate operational noise of WTGs

The above monitoring programs will ensure the project meets the environmental assessment criteria used to ensure that the requirements of the EPBC Act are met.

Abbreviations

Abbreviation	Definition
ABW	Antarctic blue whale
AC	Alternating current
AIS	Automatic identification system
ALA	Atlas of Living Australia
ALARP	As low as reasonably practicable
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
ATBA	Area-to-be-avoided
AUFS	Australian fur seal
BBMT	Barry Beach Marine Terminal
BIA	Biologically important areas (assigned by DCCEEW)
BW	Blue whale
CITES	Convention on International Trade in Endangered Species
CLV	Cable lay vessel
CMR	Capture-mark recapture
COLREGS	Collision regulations
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTV	Crew transfer vessel
dB	Decibel
DBBC	Double big bubble curtain, a method for mitigating underwater noise
DCCEEW	Department of Climate Change, Energy, the Environment and Water (Commonwealth)
DEECA	Department of Energy, Environment and Climate Action (Victoria)
DELWP	Department of Environment, Land, Water and Planning (Victoria; now DTP)
DISER	Department of Industry, Science, Energy and Resources (Commonwealth)
DoE	Department of Environment
DoEE	Department of Environment and Energy
DP	Dynamic positioning
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
DTP	Department of Transport and Planning (Victoria)
EAC	East Australian current
EE Act	<i>Environment Effects Act 1978</i> (VIC)
EES	Environment effects statement (EE Act – Victoria)
EEZ	Economic Exclusion Zone
EIA	Environmental impact assessment
EIO	Eastern Indian Ocean
EIS	Environment impact statement (EPBC Act– Commonwealth)
EMF	Electromagnetic fields
EMI	Electromagnetic interference
EMP	Environment management plan
EPBC Act	<i>Commonwealth Environment Protection and Biodiversity Conservation Act 1999</i>
EPBC Regulations	Environment Protection and Biodiversity Conservation Regulations 2000
ESD	Ecologically Sustainable Development
FFG Act	<i>Flora and Fauna Guarantee Act 1988</i> (VIC)
GBR	Great Barrier Reef
HDD	Horizontal directional drilling
HOB	Head of Bight
HV	High voltage
HVAC	High voltage alternating current
HVDC	High voltage direct current

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Abbreviation	Definition
Hz	Hertz
IUCN	International Union for Conservation of Nature
IMS	Invasive marine species
JASMINE	JASCO Animal Simulation Model Including Noise Exposure
KEF	Key ecological feature
kHz	Kilohertz
kV	Kilovolts
LF	Low frequency
MARPOL	The International Convention for the Prevention of Pollution from Ships
MDS	Maximum design scenario
MESP	Marine ecology survey program
MFO	Marine fauna observers
MGO	Marine gas oil
MHS	Modified hammer system
MMO	Marine mammal observers
MNES	Matter/s of national environmental significance
MW	Megawatt
NCVA	National Conservation Values Atlas
NIMS	Non-indigenous marine species
nm	Nautical mile
NOPSEMA	National Offshore Petroleum Safety and Environment Management Authority
NRP	National Recovery Plan
NSW	New South Wales
NZ	New Zealand
NZFS	New Zealand fur seals
OECA	Offshore export cable area
OEI	<i>Offshore Electricity Infrastructure Act 2021</i>
OPA	Offshore project area
OPEP	Oil Pollution Emergency Plan
OPGGS	Offshore Petroleum and Greenhouse Gas Storage
OSS	Offshore substation
OSV	Offshore support vessel
OWF	Offshore wind farm
OWFA	Offshore wind farm area
PAH	Polycyclic aromatic hydrocarbons
PAM	Passive Acoustic Monitoring
PDE	Project design envelope
PFLA	Pre-feasibility License Area
PMST	Protected matters search tool (DCCEEW)
PSV	Platform support vessel
PTS	Permanent threshold shift
QLD	Queensland
ROV	Remote operated vehicle
RPA	Remote piloted aircraft
SA	South Australia
SAST	South Australian Sea Turtle
SOLAS	Safety of life at sea
SOV	Service operation vessel
SOTS	Star of the South
SPL	Sound pressure level
SPRAT	Species Profile and Threats (database)
SRW	Southern right whale

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Abbreviation	Definition
SWIFFT	State Wide Integrated Flora and Fauna Team
TAS	Tasmania
TAP	Threat Abatement Plan
TR	Technical report
TSSC	Threatened Species Scientific Committee
TTS	Temporary threshold shift
µPa	Micro pascal
µT	Microtesla
V	Volts / voltage
VBA	Victorian Biodiversity Atlas (DEECA)
VIC	Victoria
VNPA	Victorian National Parks Association
WA	Western Australia
WTG	Wind turbine generator
WTGIV	Wind Turbine Generator Install Vessel
ZOI	Zones of influences

Glossary

Term	Definition
Acceptable level	Specified amount of environmental impact and risk that an activity may have which is tolerable, is consistent with relevant principles, and does not compromise the management / conservation / protection objectives of the environment
Accident	An event that would only occur under unexpected circumstances
Activity	Any operations or works carried out in relation to the project that may have an environmental impact e.g. piling of foundations and operating turbines.
Adaptability	Ability to shift (e.g. in behaviour, biology) in response to change that supports survival and resilience; responses that decrease the negative effects of change and capitalise on opportunities (SoE, 2021).
Adaptive management	An iterative management process that seeks to reduce scientific uncertainty and improve management through rigorous monitoring and periodic review of management decisions in response to growing knowledge gained from monitoring data
Affected receptor	A receptor that is subject to adverse impacts from the project
Animal movement exposure (animat) model	A JASCO Applied Sciences underwater noise model that is used to predict the exposure of individual animals (termed 'animats' in the model) to sound. The model integrates the predicted sound field with biologically important movement rules for each species modelled, which results in an exposure history for each animat in the model. Animat modelling can be considered as a more representative estimate of cumulative noise exposure to an animal over a 24-hour period, as opposed to the static model, due to the highly mobile nature of marine mammal species.
Assessment criteria	Defines the environmental performance outcomes that must be achieved
Baleen whale	Any whale of the suborder mysticete, having plates of baleen on the sides of the upper jaw for filtering plankton.
Biologically important area	Spatially defined areas where aggregations of individuals of a species are known to display a biologically important behaviour such as breeding, foraging, resting or migration
Bonn Convention	The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or the Bonn Convention) aims to conserve terrestrial, marine and avian migratory species throughout their range.
Cetacean	A marine mammal of the order Cetacea; a whale, dolphin, or porpoise.
Commonwealth waters	Any waters of the sea beyond three nautical miles (state waters) to the boundary of the exclusive economic zone (EEZ). Jurisdiction over the water column and the subjacent seabed is vested to the Commonwealth.
Consequence	Outcome of an event affecting a receptor and is based on the assessment of magnitude of impact and sensitivity of the receptor.
Cumulative impact	The resultant impact of the project, in combination with one or more other existing or proposed projects in the area, on the same environmental asset. The total impact from the contributing projects is the cumulative impact
Direct impact	Where an effect is a direct result of the project.
Ecological resilience	The ability of ecosystems to resist permanent structural change and maintain ecosystem functions
Effect	Term used to express the consequence of an impact, that is a change to the environment (including socio-economic changes) resulting from the project that may be positive or negative. The significance for the effect is determined by correlating the magnitude of the impact and the sensitivity of the receptor.
Event	Occurrence or change of a particular set of circumstances in accordance with AS / NZS ISO 31000 Guidelines
Environment	Consistent with the <i>Environment Protection and Biodiversity Conservation Act 1999</i> and the <i>Environment Effects Act 1978</i> , the definition of environment encompasses physical, biological, heritage, cultural, social, health, safety and economic aspects
Environmental asset	Any physical part of the environment worthy of protection and includes ecological assets (vegetation), social assets (community buildings) and heritage assets (scarred trees)
Final mitigation measures	Initial mitigation measures plus any additional mitigation measures adopted to address the findings of impact assessments to further reduce impacts to acceptable and as low as reasonably practicable (ALARP) levels.
Impact	A positive or negative change to an environmental asset (including physical, ecological and socio-economic assets) that is caused by a project activity. For example, seabed clearing for cable construction (activity) which results in habitat loss (impact).

Important habitat	Under the <i>Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)</i> <i>Significant Impact Guidelines 1.1</i> , an area of 'important habitat' for a migratory species is: • habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, or • habitat that is of critical importance to the species at particular life-cycle stages, or • habitat utilised by a migratory species which is at the limit of the species range, or • habitat within an area where the species is declining.
Important population	Under the <i>EPBC Act Significant Impact Guidelines 1.1</i> , an important population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, or • populations that are near the limit of the species range.
Indirect impact	Indirect environmental impacts are typically separated in time and space from direct impacts and include downstream impacts such as on wetlands due to pollution discharged or upstream impacts such as extraction of raw materials which are used to deliver the project. They may also relate to an impact on an asset via a secondary mechanism, such as the effects on birds due to impacts upon their prey species.
Initial mitigation measures	The standard suite of mitigation measures that will be implemented by the project as part of the initial assessment. These may include measures required under legislation, national or international standards and standard measures implemented on similar projects.
Inter-related impact	Multiple impacts on the same receptor arising from the project. This occurs where a number of separate impacts, such as noise and habitat loss, affect a single receptor (for example marine mammals) at the same time.
Key ecological feature	Elements of the Commonwealth marine environment that are considered to be of regional importance for either a region's biodiversity or its ecosystem function and integrity.
Key threatening process	Under the <i>Threat Abatement Plan (TAP) for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (Commonwealth of Australia, 2018)</i> , a key threatening process is 'a process that threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community'.
Likelihood	The change of an event occurring resulting in the identified outcome (the consequence).
Listed species	Species of conservation importance listed under the EPBC Act or <i>Flora and Fauna Guarantee Act 1988</i> (FFG Act)
Magnitude	A combination of geographical extent, duration and severity of an impact. • Geographic extent – spatial extent of the impact e.g. local, regional, widespread • Duration – time-scale of the effect e.g. short, medium or long term • Severity – scale or degree of change from the baseline condition as a result of the impact.
Management measure	Management measures are implemented during construction or operation of the project to control the level of impact, such as implementing marine mammal observers to detect whales prior to piling.
Maximum design scenario	Design parameters that represent the greatest potential impact to a defined sensitive receptor group (referred to as the 'maximum design scenario' in this assessment)
Mitigation measures	Actions, commitments or measures that are implemented to avoid, minimise or manage potential impacts. These include boundaries around project design parameters (including construction), as well as the implementation of actions, systems and procedures to avoid, minimise and manage impacts (including monitoring)
Monitoring	Methods used to review the environmental performance and effectiveness of mitigation measures and to determine if project activities are within defined acceptable levels of impact.
Odontocete	An animal that belongs to the Odontoceti or the family of toothed whales, a sub-group of the order Cetacea including orcas, other dolphins and sperm whales
Offshore export cable area	A 232 square kilometre area extending from the offshore wind farm area to the shore crossing. Includes offshore export cables to connect the wind farm to land. This area traverses Commonwealth waters and Victorian coastal waters.
Offshore project area	The maximum offshore geographical extent that would be used for the development of the project, including permanent structures and areas used for construction and operation works. This area comprises both the offshore export cable area and the offshore wind farm area
Offshore wind farm area	A 586 square kilometre area extending approximately 10 to 40 kilometres offshore from the shore crossing. Includes offshore wind turbines installed on foundations, offshore substations and offshore transmission cables. This area is in Commonwealth waters.
Pinniped	Carnivorous aquatic mammals of the suborder Pinnipedia, including seals, sea lions and walrus

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Productivity	Ocean productivity largely refers to the production of organic matter by phytoplankton, plants suspended in the ocean.
Productivity hotspot	Areas of aggregating phytoplankton and zooplankton aggregations which can attract pelagic species including fish and mammals
the Project	Star of the South offshore wind farm
Project design envelope	A description of the range of possible design parameters that make up the proposed project design options under consideration when the exact engineering parameters are not yet known. The range is representative of the smallest and largest project that could be built.
Ramsar site	Wetlands of international importance, designated under the Ramsar Convention. Near to the project includes Corner Inlet and Western Port.
Receptor	The physical or biological resource or user group that could be impacted by the project, both positively and negatively.
Recoverability	Re-establishment of the pre-disturbance population / processes following disturbance (e.g. mortality of the original individuals, through recruitment or colonisation).
Residual impact	The predicted remaining impacts following the implementation of committed mitigation measures, considering the expected effectiveness of these measures
Residual risk	The predicted remaining risk following the implementation of committed mitigation measures, considering the expected effectiveness of these measures.
Risk	The effect of an accident occurring and can be both positive and negative. Risk is expressed in terms of a combination of the likelihood of an accident occurring and the potential consequences should the accident occur.
Sensitivity	The sensitivity of a receptor is determined by its vulnerability (potential for harm), resilience to change, recoverability and status (level of protection, uniqueness).
Sensitive receptor	An environmental and socioeconomic feature (receptor) that could be subject to negative or positive impacts from the project
Significant impact	Under the <i>EPBC Act Significant Impact Guidelines 1.1</i> , a 'significant impact' is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment, which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts.
State waters	Belt of water between the shoreline and three nautical miles seaward. Jurisdiction over the water column and the subjacent seabed is vested in the adjacent state or territory.
Study area	Waters of the wider Gippsland region
Terms of reference	The terms of reference for the project are defined as the Commonwealth Guidelines for the Content of an Environmental Impact statement for Star of the South Offshore Wind Farm Project and Victorian Scoping Requirements for Star of the South Offshore Wind Farm Environment Effects statement.
Tolerance	Whether a receptor can absorb disturbance or stress without changing character
Zone of influence	The temporal and spatial area in which a receptor is impacted. For the cumulative impact assessment, the zone of influence is the area in which impacts to a receptor caused by another project overlap spatially and temporal with those caused by the Star of the South project

1 INTRODUCTION

The Star of the South Offshore Wind Farm (the project) is Australia's most advanced offshore wind farm. The project is located in Commonwealth waters off the coast of Gippsland and will connect to the electricity network via the proposed VicGrid connection hub in Giffard.

The project represents a significant opportunity to diversify Australia's energy resources. As Australia's ageing coal fleet retires, new sources of power are needed to address the anticipated gap in electricity generation. The project will address this gap, by harnessing Bass Strait's strong, consistent winds and delivering significant amounts of clean, reliable power to the grid starting in 2032. With a capacity of up to 2.2 gigawatts (GW), the project can meet approximately 20 per cent of Victoria's current electricity demand, enough to power around 1.2 million homes annually.

The project is located within both Commonwealth and Victorian jurisdictions and is subject to planning and environmental assessment and approval under Commonwealth and Victorian legislation.

A delegate of the Commonwealth Minister for the Environment and Water has determined the project is a controlled action (as set out in a notice dated 2 June 2020) and must be assessed and approved under the *Environment Protection and Biodiversity Conservation Act 1999 (Cth)* (EPBC Act) through an Environmental Impact Statement (EIS). The Victorian Minister for Planning has determined the project requires an Environment Effects Statement (EES) (as set out in a notice dated 11 May 2020) under the *Environment Effects Act 1978 (Vic)* (EE Act).

1.1 Purpose of this report

The purpose of this technical report is to assess the potential impacts to marine mammals and turtles associated with the project to inform the preparation of the EIS and EES required for the project.

This Marine Mammal and Turtle Technical Report (TR):

- Presents the existing environmental baseline established from desktop studies, field surveys and consultation
- Identifies any assumptions and limitations encountered in compiling the environmental information
- Identifies the criteria adopted to assess the project's potential impacts and risks
- Identifies the potential project impacts and risks to marine mammals and turtles arising from the Star of the South project marine infrastructure and activities (for construction, operation and decommissioning)
- Identifies mitigation measures that will prevent, minimise, reduce or offset the possible environmental effects identified in the environment impact assessment (EIA) process and the monitoring that will be undertaken to verify environmental outcomes.

Detailed baseline information, which underpins the impact assessments presented in this report, is contained within Appendix A.

The objective(s) of this report are to:

- Determine and present criteria sourced from relevant legislation and guidance documents (including bioregional plans and species recovery plans), industry best practice, stakeholder expectations, and relevant standards against which potential impacts and risks will be assessed (refer Section 3.3).
- Assess, and propose the measures that will be used to avoid and mitigate potential adverse effects on marine mammals and turtles (including listed threatened and migratory species), their prey species and habitats, supported by assessments of fish and invertebrates, benthic ecology and coastal processes (refer Section 5.9 for linkages to other technical reports).
- Undertake an evaluation of the significance of potential effects against pre-defined criteria and significant impact guidelines (including the acceptability of impacts in relation to key management / recovery plans and guidance documents).
- Propose additional mitigation measures if necessary to avoid and mitigate potential adverse impacts until potential effects are not inconsistent with significant impact guidelines and relevant statutory documents such as species recovery plans according to the above step.

- Propose the monitoring that will be used to (a) verify predictions made regarding environmental effects and (b) trigger the adaptive management measures that will be implemented, if required, to ensure impacts are within the levels predicted and therefore meet environmental protection goals.

2 PROJECT DESCRIPTION

Section 2 provides a high-level overview of the project in its entirety. Detailed descriptions of project components and construction processes are provided in Chapter 4 – Project description of the EIS for the whole of project assessment across the Commonwealth jurisdiction, and in Chapter 4 – Victorian works project description of the EES for the Victorian jurisdiction. Specific project parameters that have informed the marine mammals and turtles study are detailed in Section 7 of this report.

2.1 Project overview

The offshore wind farm will be installed within a 586-square-kilometre offshore wind farm area, located approximately 10 to 40 kilometres off the coast of Gippsland, as shown in Figure 2-1.

The project comprises an offshore wind farm and supporting transmission infrastructure to generate and transfer power to the grid. The offshore infrastructure extends from the shore crossing at Reeves Beach, to the offshore wind farm area.

The onshore infrastructure primarily comprises of an underground cable system that will connect the project to the proposed VicGrid connection hub in Giffard (also referred to as 'proposed Giffard terminal station area'). The onshore transmission infrastructure is located in Central Gippsland, extending approximately 30 kilometres from Reeves Beach to the proposed VicGrid connection hub.

This technical report focusses on construction, operation and decommissioning of the offshore wind farm and transmission components, within offshore project area shown in Figure 2-3.

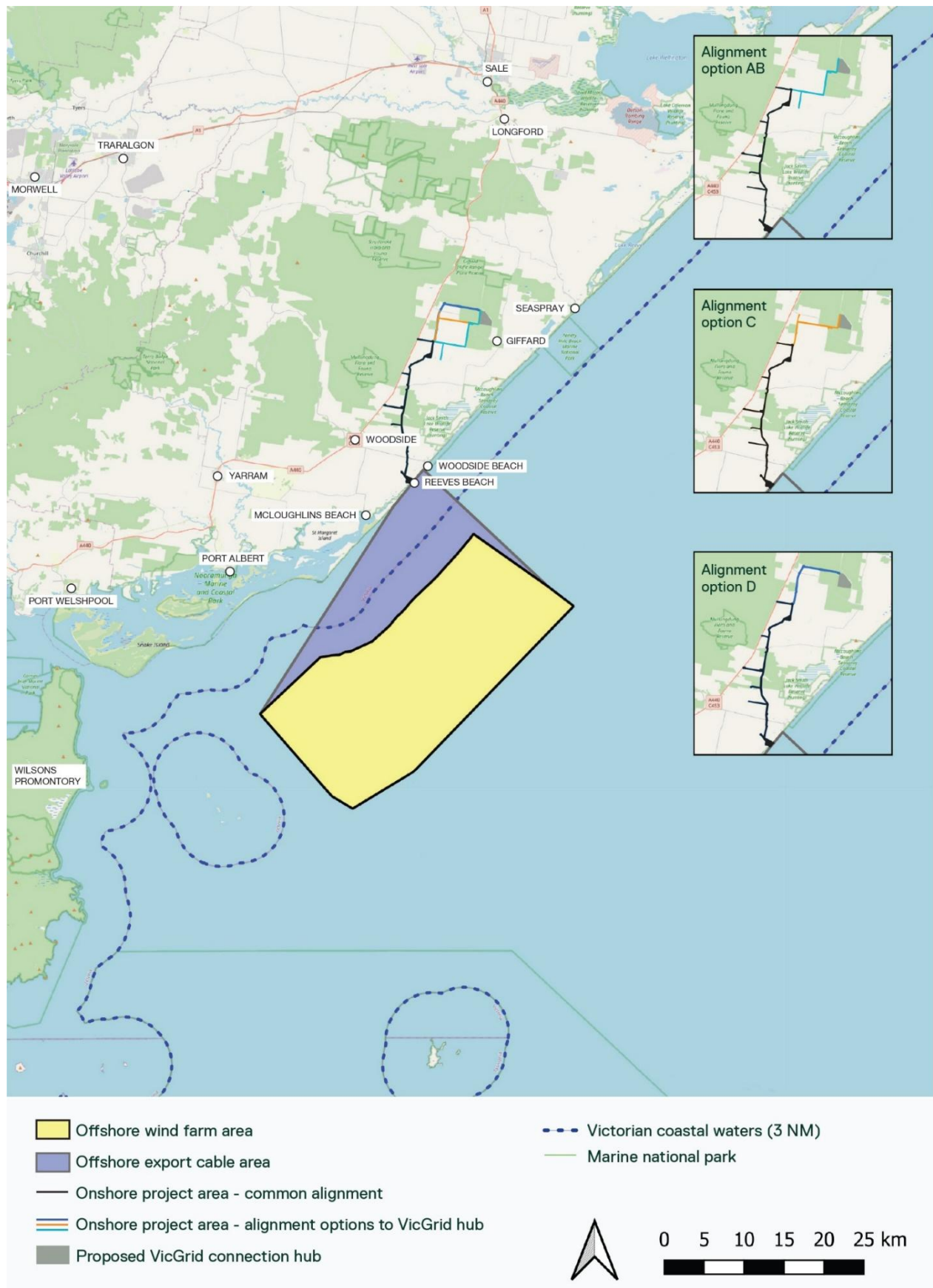


Figure 2-1: Project location

2.2 Project development

Over several years of project development, opportunities to avoid and minimise environmental impacts have been realised in accordance with the mitigation hierarchy shown in Figure 2-2. The assessment framework has also enabled the identification and adoption of further avoidance and minimisation measures as part of the planning and environmental approvals process.

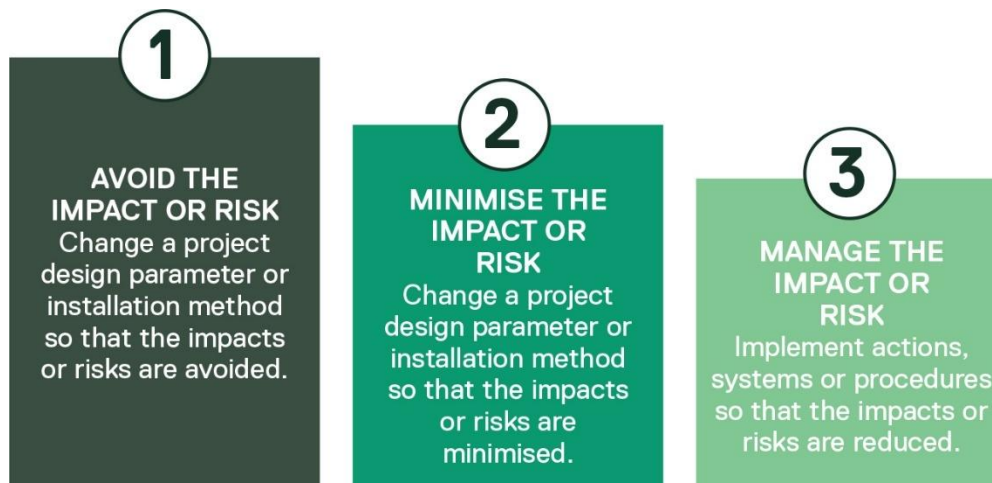


Figure 2-2: Mitigation hierarchy

Avoidance and minimisation of social and environmental impacts is central to the project's decision making and as such, the project will continue to be refined in response to technical requirements and potential environmental and social impacts identified during the development phase.

This was considered in the preparation of the project description which is found in Chapter 4 – Project description of the EIS for the whole of project assessment across the Commonwealth jurisdiction and Chapter 4 – Victorian works project description of the EES for the Victorian jurisdiction. A description of how avoidance of impact has informed the design in relation to marine mammals and turtles can be found in Section 5.6.

Examples of this include the decision to design the shore crossings without directly impacting coastal areas, utilising existing roads for construction site access wherever possible and adopting construction techniques which avoid impacts on sensitive receptors such as waterways.

Once avoidance and minimisation measures are exhausted, residual impacts and risks are managed. In the case of risks, mitigation measures can be applied both before and after an event occurs. Residual impacts and risks are then evaluated against the assessment criteria to ensure they are at an acceptable level.

2.3 Project area

The project area, shown in Figure 2-3, has been broken down into three main sections - offshore, shore crossing, and onshore areas:

- 1. Offshore project area**, comprising:
 - Offshore wind farm area:** A 586 square kilometre area extending approximately 10 to 40 kilometres offshore from the shore crossing. Includes offshore wind turbines installed on foundations, offshore substations and offshore transmission cables. This area is in Commonwealth waters.
 - Offshore export cable area:** A 232 square kilometre area extending from the offshore wind farm area to the shore crossing. Includes offshore export cables to connect the wind farm to land. This area traverses Commonwealth waters and Victorian coastal waters.
- 2. Shore crossing:** Located at Reeves Beach, this is where the offshore export cables will transition to land and connect to the underground cable system onshore.
- 3. Onshore project area:** An approximately 30 kilometre corridor extending from the shore crossing to the proposed VicGrid connection hub. Includes an underground cable system within a (common) alignment to

Giffard West, at which point there are three alignment options (AB, C and D) to reach the proposed VicGrid hub in Giffard.

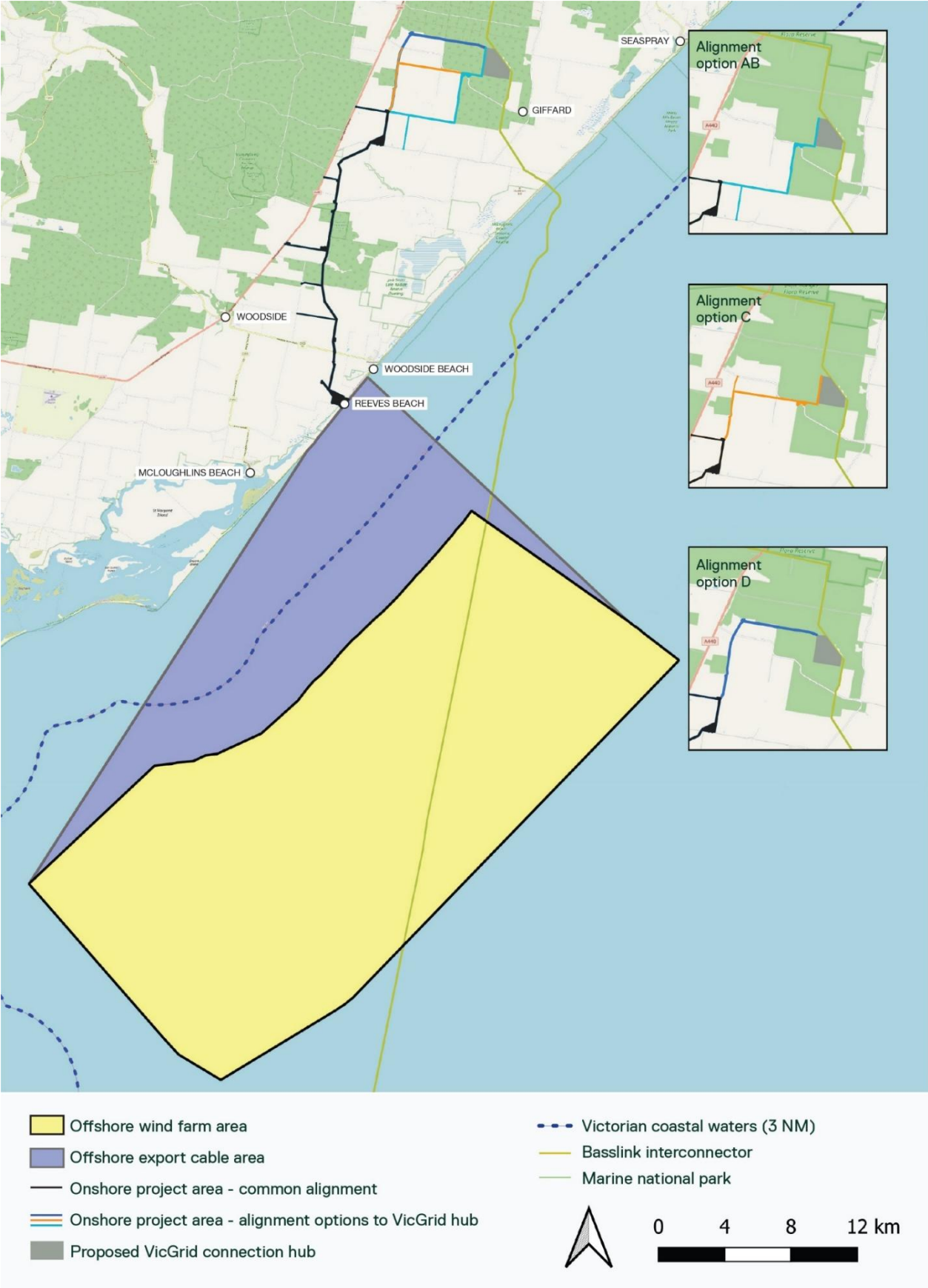
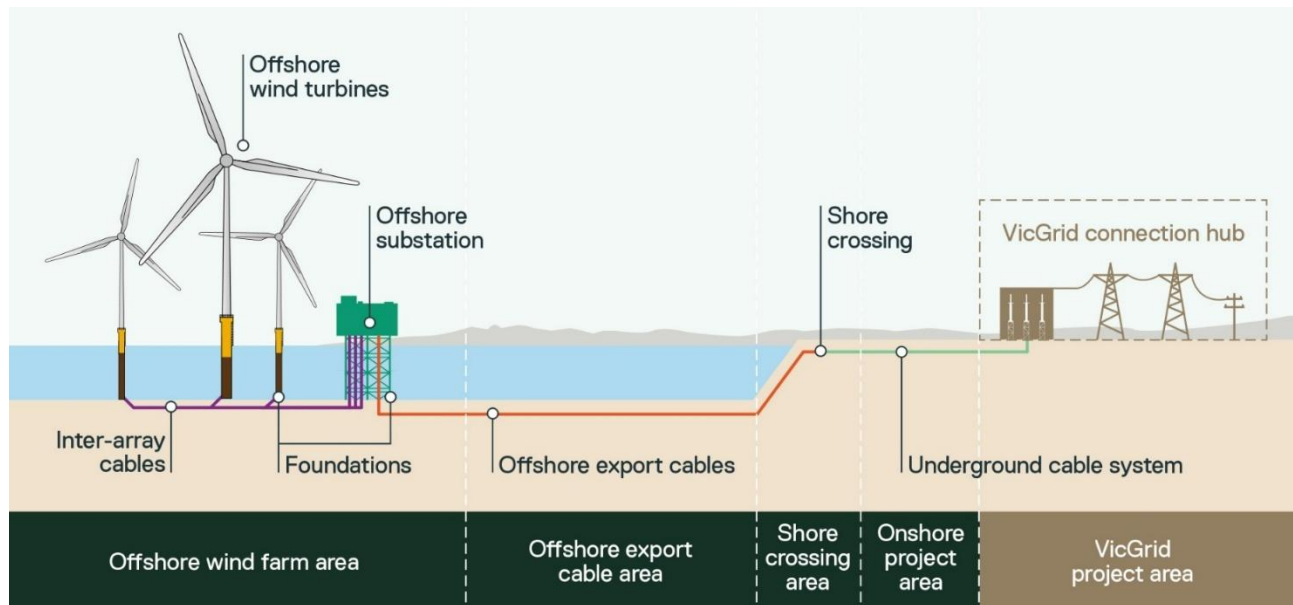


Figure 2-3: Project overview

2.4 Key project components

The key components that make up the project are the offshore wind farm and transmission infrastructure (inter-array cables, offshore substations and offshore export cables), the shore crossing infrastructure and onshore transmission infrastructure.



Source: AECOM Australia Pty Ltd (2021)

Figure 2-4: Project components

The key components of the project are shown in Figure 2-4 and include:

- The offshore wind farm and transmission infrastructure
 - up to 147 turbines and connecting inter-array cables
 - up to five offshore substations and three interlink cables
 - up to eight offshore export cables
- The shore crossing infrastructure
 - up to eight trenchless crossings containing the offshore export cables
- Onshore transmission infrastructure
 - an underground cable system connecting to the proposed VicGrid connection hub

2.5 Construction approach

The offshore components of the project are likely to be constructed in the general sequence below:

- Site preparation activities
- Offshore export cable installation
- Foundation installation
- Offshore substation topside installation
- Inter-array and interlink cable installation
- Offshore wind turbine installation.

Construction of the shore crossing involves 2 main activities and phases:

- Drilling and duct installation
- Cable pulling

2.6 Project timeline

The project has been under development for approximately seven years. If approvals are obtained in the next few years, construction could start around 2030 and electricity generation from 2032. The operational life of the project is approximately 30 years, with the possibility of repowering to extend its life, if deemed appropriate by Star of the South and regulators closer to the time.



Figure 2-5: Project timeline

2.7 Construction schedule

The project is expected to take up to seven years to construct, if built to its full capacity in a single stage. The project could also be built in two stages, depending on energy market and government requirements and timing. Figure 2-6 shows the order and maximum duration of construction for key components.

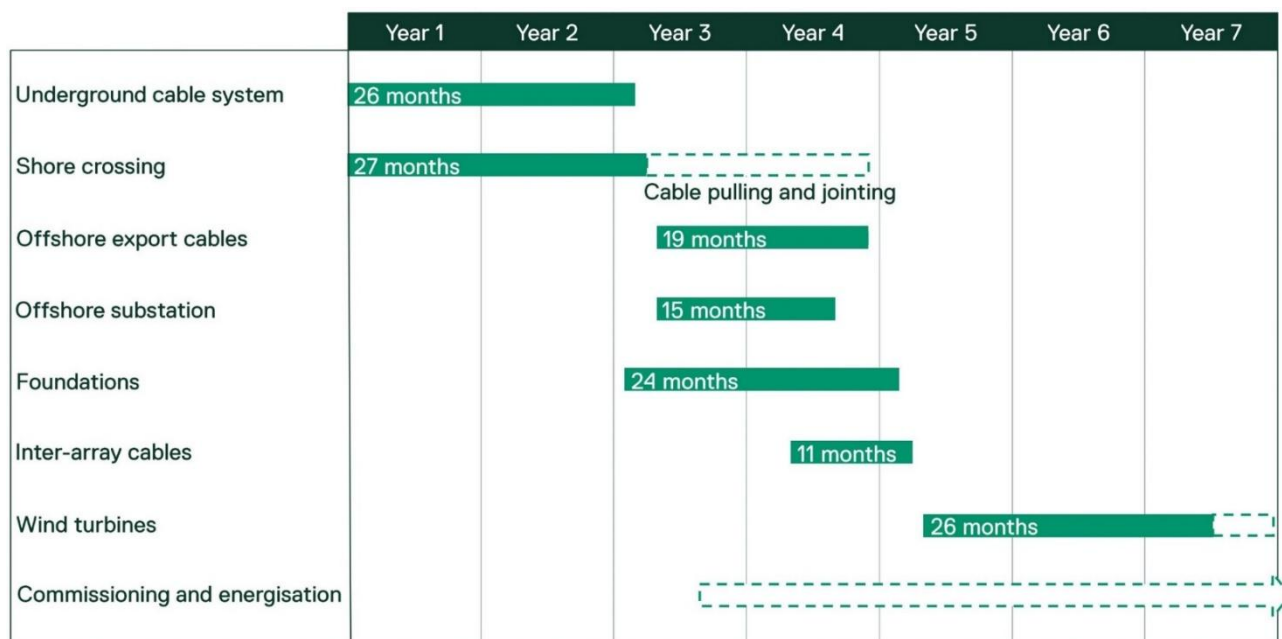


Figure 2-6: Indicative project construction schedule

2.8 Operational requirements

The project is expected to have an operational life of approximately 30 years. The offshore wind turbines will be available to operate continuously during the operations phase. Infrastructure will be monitored and operated remotely from a local O&M facility located at either Barry Beach Marine Terminal or Port Anthony, supported by a service operation vessel (SOV) and/or crew transfer vessel (CTV) logistics strategy.

O&M activities will be both preventative (planned) and corrective (unplanned). Preventative activities are carried out as part of regular scheduled services, such as removing marine growth. Corrective maintenance covers unexpected repairs, component replacement and breakdowns.

2.9 Decommissioning

The key principles that will apply to the offshore components of the project include:

- Decommissioning progressively planned and budgeted for, as identified in the OEI Act
- Consideration of the relevant environmental and stakeholder context when proposing decommissioning end state of activities
- Seabed will be returned to baseline conditions as far as reasonably practicable.

Decommissioning is expected to involve similar types and numbers of vessels and equipment as the construction phase. Requirements at the time will determine the scope of decommissioning activities and impacts. The anticipated duration is up to three years. Indicative activities include:

- Removal of offshore substation topsides and foundations to just below seabed
- Removal of WTGs, transition pieces and monopiles to just below seabed
- Removal of scour protection where reasonably practicable and appropriate to do so
- Retention of subsea cables in situ

3 EVALUATION FRAMEWORK

The identification, assessment and evaluation of potential impacts from the project to marine mammals and turtle and the required management and mitigation measures to control those impacts and risks to acceptable levels, is guided by relevant legislation, policy, guidelines, expert opinion, recovery plans, published conservation advice and action plans as well as other social context such as stakeholder feedback.

The evaluation framework describes the way that the project was assessed to determine the impacts on assets, values and uses as shown in Figure 5-1. The key components of the evaluation framework are:

- Terms of reference
- Legislation, policy and standards
- Assessment criteria.

The terms of reference set by the Victorian Minister for Planning (the EES scoping requirements) and the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) (the EIS guidelines) are outlined in Section 3.1. All the relevant international conventions, Commonwealth and state legislation, policy, guidelines, and standards that are broadly relevant to the project and management and mitigation of potential impacts are included in Section 3.2. The legislation, guidelines and standards that are relevant to determining specific 'assessment criteria' that have been adopted for the project are included in Section 3.2.

3.1 Terms of reference

3.1.1 EIS guidelines

The Guidelines for the Content of an Environment Impact statement for Star of the South Offshore Wind Farm Project ('the guidelines') set out the requirements to allow the Commonwealth Minister to make an informed decision on the approval of the project under the EPBC Act.

The aspects of the guidelines relevant to the assessment are shown in Table 3-1, as well as where these items have been addressed in this report.

Table 3-1: EIS requirements addressed within this report

Requirement	Sections addressed
Description of the environment	
Include the listed threatened species and ecological communities, listed migratory species and listed marine species that are likely to be present in the vicinity of the proposed action.	6.2, 6.3
Include important areas, recognised populations and habitat, aggregations of marine species and Biologically Important Areas (BIAs).	6.2
Include the current condition of the marine environment, including its values and sensitivities, and conservation values, including information placing these features into appropriate local and regional contexts (e.g. south-east region).	6.1, 6.2
A description of listed species, which includes listed threatened species and ecological communities (EPBC Act sections 18 and 18A), listed migratory species (EPBC Act sections 20 and 20A) and listed marine species (protected under EPBC Act sections 23 and 24A) that are likely to be present in the vicinity of the onshore or offshore components of the proposed action (and in areas that may be impacted by the project).	6.2, 6.3
Details of the scope, timing (survey seasons) and scientifically robust methodology for studies or surveys used to provide information on the listed species / community/habitat at the site (and in areas that may be impacted by the project)	5.3, 6.2, Appendix A
Details how studies or surveys are consistent with (or a justification of divergence from) relevant Departmental guidelines or policy statements, or are in accordance with best practice studies or surveys	6.2, Appendix A
Details marine, migratory and threatened species and ecological communities' abundance, distribution and site fidelity at the proposed development site and in areas that may be impacted by the development, and known habitat utilisation or requirements, including Biologically Important Areas (BIAs) and habitat critical to the survival of the species	6.2, Appendix A

Requirement	Sections addressed
Describes usage of the project area by listed species in regional context including, but not limited to migratory pathway, breeding and foraging behaviours	6.2, Appendix A
Describes the predicted temporal and spatial variability in occurrence of listed species within the onshore or offshore project area and in areas that may be impacted by the project	6.2, Appendix A
Details relevant threats to the survival, habitat utilisation, site fidelity and essential life functions of listed species, including foraging, breeding or migratory behaviours, and past and projected trends and existing threats to the condition of habitat.	7 to 14
Relevant impacts	
Describes the relevant impacts throughout the life of the project from construction through to operations and decommissioning on listed marine, migratory and threatened marine mammal and turtle species and relevant ecological communities.	7 to 14
Describes the relevant impacts on the Commonwealth marine environment (as described in Section 528 of the EPBC Act).	7 to 14
Includes a detailed assessment of the nature, extent, severity / intensity and duration of the likely short-term and long-term relevant impacts.	7 to 14
Includes an analysis of the significance of the relevant impacts.	7 to 14
Includes baseline study results presented with sufficient detail to allow a quantified comparison between the pre-development state of the environment and changes to the environment attributed to the project during implementation.	6 to 14
Assesses the significance of potential short-term and long-term impacts on listed threatened and migratory marine mammals and turtles from noise, vibrations and electromagnetic fields associated with the construction and ongoing operations of the action compared with measured background noise levels.	8.1, 10.1, 10.3, 12 to 14
Assesses the significance of potential impacts from noise, vibrations and electromagnetic fields on marine mammals and turtles including consequences such as the disruption of migration, resting, breeding or foraging behaviours including consideration of requirements in relevant statutory documents; and the potential for the activity to impede the recovery of a listed species.	8.1, 10.1, 10.3, 12 to 14
Assesses the significance of potential impacts from light pollution on listed threatened and migratory marine mammals and turtles including the consequences of disrupting migration, breeding or foraging behaviours.	8.4, 10.3, 12.1
Assesses the significance of potential impacts on listed threatened and migratory marine mammals and turtles from collision with vessels including disruption of migration, breeding or foraging behaviours of listed species as a result of the collision impact; and long-term decreases in population sizes of the listed species as a result of mortality due to collision	9.1, 11.1, 12.1, 13.1
Assesses the significance of potential impacts on listed threatened and migratory marine mammals and turtles from barrier effects of offshore infrastructure that may result in disruption of migration, breeding or foraging behaviours and evaluate the potential for population level impacts and subsequent consequences for population viability and in the case of threatened species, population recovery.	10.2
Assesses the potential impacts to marine mammals and turtles from vessel discharges associated with the action	8.2, 12.1
Assesses the potential impacts to marine mammals and turtles from spills and waste associated with the action. In discussing potential impacts, consider how the interaction of extreme environmental events and any related safety response may impact on the environment	9.2 to 9.4, 11.2 to 11.4, 12.1
Cumulative impacts	
Identify and address cumulative impacts (including climate change) in terms of overall consequence or magnitude of impacts on each relevant MNES.	14
The EIS should also address the potential cumulative impact of the proposed action on ecosystem resilience. The cumulative effects of climate change impacts on the environment must also be considered in the assessment of ecosystem resilience and listed species attributes where scientific information on the effects of climate change on ecosystem resilience is available.	14
Proposed avoidance, management and mitigation measures	
Management and mitigation measures must reduce the level of impact and risk to an acceptable level in consideration of the EPBC Act. Identify key adaptive management measures addressing uncertainties and inherent risks.	8 to 15
In accordance with the environmental risk and impact assessment guidance above, where a risk is assessed to be low, this risk will be deemed acceptable, and no further management is required. Where the risk level is higher than low, additional management and mitigation measures are required to be considered and implemented.	8 to 15
Specific and detailed descriptions of proposed measures must be provided and substantiated, based on best available practices and must include the following elements:	8 to 15

Requirement	Sections addressed
• A description of each proposed avoidance, minimisation or mitigation measure in relation to the likely impacts • An assessment of the expected or predicted effectiveness and achievability of each proposed avoidance or mitigation measure including timeframes for achieving effectiveness. • An evaluation of whether residual impacts (following the application of mitigation measures) are consistent with the defined acceptable levels of impact relevant to the action.	
The EIS must include a consolidated list of measures proposed to be undertaken to prevent, minimise, mitigate or compensate for the relevant impacts of the action, including: • A description of the environmental outcomes the measures are expected to achieve including details of any baseline data, environmental indicators and proposed monitoring to demonstrate progress towards achieving these outcomes • A description of proposed mitigation measures to avoid relevant direct and indirect impacts of the action, including avoidance measures to avoid areas of high conservation value as far as possible • A description of the measures proposed to be undertaken by the proponent that have been proposed by state or local governments • Details of ongoing management of the construction, operation and decommissioning of the project, an analysis as to the effectiveness of these management measures, monitoring programs to determine the effectiveness of the measures proposed, and a framework for adaptive management including: • Management strategies that will be implemented if mitigation and management measures are insufficient and / or ineffective. • Adequate monitoring regimes and defined trigger levels that will prompt further management and / or remediation actions to prevent unacceptable impacts to protected matters occurring • Who will be responsible for such measures and the extent of their responsibility?	15
Include an analysis of how the mitigation measures are in accordance with any statutory or policy requirements, including but not limited to: • Any relevant threat abatement plan for listed threatened species and communities • Any relevant recovery plan for listed threatened species and communities • Relevant conventions and agreements under which a migratory species is listed, including the Convention on the Conservation of Migratory Species of Wild Animals (the Bonn Convention), and agreements relevant to the conservation of the species.	8 to 15
Include a detailed outline of any Environment Management Plans (EMPs) that sets out the framework for management, mitigation and monitoring of relevant impacts of the action, including any provisions for independent environmental auditing.	5.6
Offsets and net benefits	
Describe an offset strategy designed and implemented to compensate for the residual significant impacts of the project if these are determined likely, as well as an analysis about how the offset(s) meets the requirements in the Commonwealth EPBC Act Environmental Offsets Policy October 2012 (EPBC Act Offset Policy)	N/A
Consultation	
Details of consultation permanent to the action must include: • Consultation that has already taken place • Proposed consultation about relevant impacts with persons, groups, organisations that may be directly affected, or with any interested parties • Identification of any objections or claims and description of views • A summary of how and when stakeholders will be notified of key phases of the development	4
In addition, the EIS should include a process for ongoing consultation with Indigenous people, including an engagement plan and mitigation measures and management of protected areas. This must also incorporate the identification of those bodies being consulted, and how feedback has been incorporated in project planning, implementation and rehabilitation.	
Information sources– data, reliability, and uncertainties	
The EIS must state the source, date, reliability, and uncertainties (if any) of the information presented	3.3, 5
The whole of the environment within the Commonwealth Marine Area is considered an MNES, as such, an integrated assessment of the marine ecosystem and its components is required. The interaction of different receptors and potential combined impacts on the ecosystem as a whole are contained EIS Chapter 24 - EIS summary and conclusions.	

3.1.2 EES evaluation objectives and scoping requirements

The Scoping Requirements for Star of the South Offshore Wind Farm Environment Effects statement ('scoping requirements') by the Minister for Planning, set out the specific environmental matters the project must address to satisfy the Victorian assessment and approval requirements.

The scoping requirements include a set of evaluation objectives. These objectives identify the desired outcomes to be achieved in managing the potential impacts of constructing, operating, and decommissioning the project in accordance with the ministerial guidelines for assessment of environmental effects under the EE Act.

The following evaluation objective is relevant to the marine mammals and turtle scope:

- To avoid, and where avoidance is not possible, minimise, potential adverse effects on protected native vegetation and listed threatened species and their habitat, and listed ecological communities, in both onshore and offshore environments, as well as address offset requirements consistent with state policies.

The aspects from the scoping requirements relevant to the evaluation objective are shown in Table 3-2, as well as where these items have been addressed in this report.

Table 3-2: Scoping requirements relevant to the evaluation objective

Aspect	Scoping requirement	Section addressed
Key issues	Direct or indirect loss, disturbance, and or/degradation of listed or other protected species and nearby habitat values that may support listed or other protected fauna, or ecological communities.	8 to 14
	Disruption to the movement of fauna between areas of habitat across the broader landscape, for example, through collisions with transmission line infrastructure.	8 to 12
	Potential cumulative effects on listed threatened flora and fauna species, and their habitats, from the project in combination with other projects.	14
	Characterise the type, distribution, and condition of biodiversity values within a suitable study area, comprising the project site and its environs, including aquatic / marine habitat and habitat corridors or linkages.	6
Priorities for characterising the existing environment	Describe the biodiversity values that could be directly or indirectly affected by the project, including presence of, or suitable habitats for, protected flora and fauna species, in particular species listed under the FFG Act.	6
	Describe any existing threats to biodiversity values, including but not limited to: • Historic or ongoing disturbance, or alteration of habitat conditions (e.g. habitat fragmentation) • Potentially threatening process listed under the FFG Act • The presence of any declared weeds, pathogens and pest animals within and in the vicinity of the project area.	6
	Characterisation of the existing environment is to be informed by relevant databases, literature (and published data), community observations (including citizen science and information from residents and landholders in or adjacent to the area of interest), appropriate targeted and / or seasonal surveys and modelling of the potential and actual presence of threatened species and communities consistent with Department of Energy, Environment, and Climate Action (DEECA) survey guidelines, conservation advice notes and threatened species recovery plans or action statements. Where surveys do not identify a listed species or community, but past records and / or habitat analysis suggest that it may occur, a precautionary approach to the further investigation and assessment of its occurrence should be applied.	6
	Assess the direct and indirect effects of the project, including feasible alternatives, on listed threatened and other protected fauna species under the FFG Act or their habitats.	8 to 14

Aspect	Scoping requirement	Section addressed
Design and mitigation measures	Identify staging or timing options for works that could help to avoid or minimise adverse effects on seasonal values (e.g. migratory species, breeding behaviour).	8 to 14
	Justify and describe the assumptions and level of uncertainty associated with the proposed measures achieving their desired outcomes.	8 to 14
	Describe and evaluate proposed commitments to manage residual effects of the project on biodiversity values, including an outline of an offset strategy to secure appropriate offsets to satisfy state offset requirements.	8 to 15
Assessment of likely effects	Assess the direct and indirect effects of the project during construction and operation on biodiversity values, including: • Disturbance or alteration of habitat conditions (e.g. habitat fragmentation, displacement due to avoidance of project infrastructure) • Disturbance through noise or vibration in the offshore environment • Disturbance through changed shipping activities due to the project • Direct removal of individuals or destruction of habitat • Threats of mortality of listed threatened or other protected fauna (including site- and species-specific risk factors).	8 to 14
	Assess the potential effects on listed threatened or other protected fauna species having considered issues and experiences with similar projects elsewhere in the world, as well as being cognisant of unique values existing in this locale.	8 to 14
	Assess the potential impacts on habitat connectivity of listed or other protected species, both onshore and offshore, including but not limited to migratory species.	8 to 14
	Assess the potential cumulative effects on listed threatened or other protected fauna species, and their habitats, from the project in combination with other projects that might have similar types of impacts.	14
	Identify and describe potential alternatives, proposed design options and mitigation measures and their expected effectiveness in avoidance or reduction of significant effects on fauna and ecological communities listed on the FFG Act or other protected species. Provide clear statements noting which avoidance and / or mitigation measure will be committed to.	8 to 15
	Develop contingency measures to be implemented in the event of unintended adverse residual effects (including ineffective mitigation) on flora and fauna values requiring further management.	8 to 15

3.2 Legislation and agreements

The Commonwealth and Victorian legislation and international agreements relevant to this assessment are summarised in Table 3-3.

Table 3-3: Legislation relevant to the marine mammals and turtles impact and risk assessment

Document title	Summary	Relevance to project
International conventions / guidance		
Convention on the Conservation of Migratory Species of Wild Animals 1979 (Bonn Convention)	The Bonn Convention aims to improve the status of all threatened migratory species through conservation and management actions being implemented by all states within the national jurisdictional boundaries of which such species spend any part of their life cycle.	The Bonn Convention presents guidelines for the protection of migratory species from activities that may impact their health, survival and conservation. Noise generating activities and light pollution are a main consideration under the Bonn Convention, with international guidelines aimed at decreasing any adverse impacts to wildlife. Project activities, including those that generate underwater noise and light pollution, may interact with MNES (threatened and migratory species) protected under the EPBC Act.
IALA Recommendation R0139 The Marking of Man-made Offshore Structures 2021 (IALA, 2021b)	Recommendations to ensure marking of offshore structures are standardised internationally, with recommendations to serve as minimum requirement of safety of navigation in the vicinity of offshore structures	International best practice around the marking of offshore structures, advisable for the project to follow in order to minimise potential shipping and navigation impacts. Specifically, this guidance will inform the lighting and markings of the project's offshore structures, including turbines and substations.
International Convention for the Prevention of Pollution from Ships 1973 (MARPOL)	Aimed at preventing both accidental pollution and pollution from routine vessel operations	Australia is a signatory to this Convention, meaning projects within the Australian jurisdiction will need to be conducted in line with it. MARPOL is applied as an initial mitigation measure for safety of navigation to reduce potential impacts to birds associated with the risk of vessel collision. This convention applies to international, Commonwealth and state waters.
United Nations Convention on Biological Diversity 1992	An international treaty to sustain life on earth. The Convention establishes three main goals: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits from the use of genetic resources.	The convention provides a framework and management policies to ensure the protection of natural resources and the environment while enabling sustainable development. Project activities may interact with MNES (threatened and migratory species) protected under the EPBC Act and / or protected areas and habitats that support key ecological functions and maintain biodiversity. The EPBC Act also requires the principles of ecologically sustainable development to be met under Section 3A, which are similar to the requirements under the convention.
Commonwealth Government		
<i>Offshore Electricity Infrastructure Act 2021</i> (Cth)	The OEI Act regulates offshore infrastructure used to generate electricity including wind farms, and infrastructure used for transmitting or storing electricity or energy offshore in Commonwealth waters. The Act provides a framework for the construction, operation, maintenance and decommissioning of offshore electricity projects. The Act allows the minister to declare areas and issue licences suitable for offshore energy infrastructure and can require conditions to be met under those licences. Three main licensing approaches are: - Commercial use (with a feasibility licence being a pre-requisite for scoping activities) - Research/demonstration. - Transmission and infrastructure.	The Commonwealth Government declared an offshore wind zone in Gippsland in December 2022, and Star of the South was issued with a Feasibility Licence in July 2024. The Feasibility Licence does not provide an automatic right to build or operate an offshore wind farm. The Project will require commercial and transmission and infrastructure licences under the Act before installing any infrastructure. The following will also be required prior to commencing installation: - Demonstration of financial security - An approved management plan for the licences - Have all other relevant state and Commonwealth approvals in place. The project will need to comply with the requirements of this Act for all applicable activities and infrastructure development in Commonwealth waters and approval from the Commonwealth Minister for the Environment..
<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cth)	Assessment, protection and management of potential impacts on Matters of National Environmental Significance including Commonwealth marine areas. The Act aims to: - Protect Matters of National Environmental Significance (MNES). - Provide for Commonwealth environmental assessment and approval processes. - Provide an integrated system for biodiversity conservation and management of protected areas. - Protected species management plans have been developed under the act that aim to minimise impact with each species. Relevant ones are sei whale, blue whale, fin whale, southern right whale, humpback whale and marine turtles.	Determined that the project is a 'controlled action' (EPBC 2020/8650) requiring assessment through an Environment Impact Statement (EIS). The project will need to adhere to the protection of whales and other cetaceans that is outlined in Chapter 5, Part 13, Division 3 of the EPBC Act. This section outlines whale sanctuaries, important cetacean habitats, offences (killing or injuring cetaceans) and permits required to undertake activities. In the absence of direct guidance of offshore wind and managements of underwater noise the project will need to comply with requirements of the Act and DCCEEW guidance (e.g. EPBC Act Policy Statement 2.1) and not be inconsistent with requirements of statutory instruments established under the Act such as species recovery plans. The Threatened Species Scientific Committee (TSSC) was established under the EPBC Act and plays a critical role in protection and management of native species and ecological communities. Relevant recovery plans, conservation management plans and approved conservation advice are described in Section 3.3.
Environment Protection and Biodiversity Conservation Regulations 2000 Part 8 (EPBC Regulations)	The regulations are designed to provide a streamlined national environmental assessment and approvals process whilst enhancing the protection and management of the environment.	Part 8 (Interacting with cetaceans and whale watching) sets minimum approach distances for cetaceans and prohibits or regulates activities in the vicinity of cetaceans in Commonwealth waters.
<i>Protection of the Sea (Prevention of Pollution from Ships) Act 1983</i> (Cth)	The Act implements international maritime law (MARPOL) to which Australia is signatory and addresses requirements for addressing emissions and discharges from vessels.	Sets pollution prevention and discharge management requirements for vessels used in the project.
Victorian Government		
<i>Environment Effects Act 1978</i> (VIC)	Requires certain public works to have an environmental impact assessment carried out before proceeding. It was amended by the <i>Environment Effects (Amendment) Act 2005</i> .	Determined that an Environment Effects statement (EES) be prepared for the project (Star of the South Offshore Wind Farm final scoping requirements).
<i>Environment Protection Act 2017</i> (VIC)	Provides governance structure for the Environment Protection Authority and sets out the principles of environment protection and legislative framework for protection of human health and the environment from pollution and waste.	Principles of environment protection and duties relating to environment protection are relevant to potential impacts from accidental hydrocarbon releases.
Environment Protection Regulations 2021 (VIC)	The regulations further the purposes of, and give effect to, the <i>Environment Protection Act 2017</i> through various prescriptions, provisions and obligations	Regulates the discharge or deposit of waste from vessels used in the project, within Victorian waters
<i>Flora and Fauna Guarantee Act 1988</i> (FFG Act)	Provides for the conservation and protection of Victoria's native flora and fauna through listing threatened species and ecological communities, and threatening processes. The amendment provides a modern and strengthened framework for the protection of Victoria's biodiversity. Action statements have been developed under the act which aim to minimise impact with each species. Relevant ones are blue whale, southern right whale and humpback whale.	Relevant through protection of marine mammals and turtles including: - Objective to 'guarantee' the survival of all of Victoria's flora and fauna - Emphasises action that prevents species from becoming threatened - Action statements setting out relevant management actions The amended Act contains an obligation or duty on public authorities and ministers to consider potential biodiversity impacts when exercising their functions.
Flora and Fauna Guarantee Regulations 2020	The regulations further the purposes of and give effect to the FFG Act through various prescriptions, provisions and obligations.	Regulates the eligibility criteria for determining the eligibility for listing of species, communities and potentially threatening processes under the FFG Act.
<i>Marine and Coastal Act 2018</i> (VIC)	Protection and enhancement of the Victorian marine and coastal environment between the outer limit of Victorian coastal waters (3 nautical miles) and 200 metres inland of the high-water mark of the sea.	Establishes the following principles that are relevant to the project: - That planning and management incorporate an ecosystem-based approach including avoidance of cumulative impacts - That development be consistent with the principles of ecological sustainability - That planning and management decisions be based on the best available environmental, social and economic information - That management of impacts incorporate the precautionary principle - That risk management and regulatory approaches be proportionate to the risk involved.

Document title	Summary	Relevance to project
<i>National Parks Act 1975</i> (VIC)	Establishes the basis for the protection, use and management of national and other parks, e.g. marine sanctuaries within the Victorian State jurisdiction. Includes marine, coastal and fisheries management	The project will require a consent for works on coastal Crown land under this Act. Relevant to the protection of national and other parks and their values in the vicinity of the offshore elements of the project. Consideration of such protected areas will be required as part of the EIS / EES and is potentially relevant to subsequent state approvals and protection of values that move between jurisdictions.
<i>Pollution of Waters by Oils and Noxious Substances Act 1986</i> (VIC) as amended on 8 February 2022)	The purpose of this Act is to make certain provisions for the protection of the sea and certain waters from pollution by oil and other noxious substances and to implement the MARPOL Convention	Sets pollution prevention and discharge management requirements for vessels used in the project, within Victorian waters
Pollution of Waters by Oil and Noxious Substances Regulations 2022 (VIC)	The regulations prescribe notification and reporting requirements regarding discharges of oil or oily mixtures, including the necessary entries into a ship's oil record book	Prescribes specific discharge management requirements for vessels used in the project, within Victorian waters
<i>Victorian Wildlife Act 1975</i> (as amended on 1 December 2021)	Provides rules around how we protect, conserve, sustainably manage and use wildlife in Victoria.	Relevant for the protection and conservation of wildlife in Victoria including marine mammals and turtles. The Act provides a legislative framework concerning the protection, conservation and sustainability of wildlife and their habitats. It prohibits and regulates activities that relate to wildlife, including the management and control of activities impacting species survival and prevention of extinction.
Wildlife (Marine Mammals) Regulations 2019	These regulations provide for the management, conservation and humane use of wildlife, and establish provisions for licensing, fees and offences, and exemptions under the <i>Wildlife Act 1975</i> . It also includes an offence for destruction of wildlife habitat.	Sets minimum approach distances for whales, dolphins and seals, prohibits or regulates activities in the vicinity of whales, dolphins and seals in Victorian waters.

3.3 Policy and guidelines

The relevant guidelines for the assessment of marine mammals and turtles are summarised in Table 3-4.

Table 3-4: Policy and guidelines relevant to the marine mammals and turtles impact and risk assessment

Document Title	Summary	Relevance to project
Key Environmental Factors for Offshore Windfarm Environmental Impact Assessment Under the EPBC Act 1999 (DCCEEW, 2023)	Provides consolidated information to offshore renewable energy proponents on the key environmental factors for consideration when developing projects in the Australian marine environment under the EPBC Act. Outlines EPBC Act statutory requirements and regulatory context. Contains information on the specific key environmental factors that may be considered pertinent to an offshore wind farm (OWF). The main impact pathways are outlined and should be read in conjunction with the key species information within the context of ecologically sustainable development.	Management practices outlined in the document that are relevant to the project include: • Underwater noise: – Selection of foundation types that do not require pile driving (e.g. gravity structures, caissons, floating) – Selection of vibratory pile driving over impact pile driving – Application of underwater noise thresholds – If pile driving is in BIAs or important times, application of best available technology for noise dampening (e.g. double big bubble curtain and noise shielding) and demonstrate how impacts will be managed to acceptable levels • Electromagnetic Interference (EMI): – Engineering controls to reduce EMI (current flow, voltage, cable configuration and design, sheath / armouring characteristics) – Adopting cable layouts that allow field vectors from the cables to cancel each other out – Burying cables • Seabed disturbance: – Consider the presence of KEFs and benthic communities – Limit area of seabed required for installation and operation – Cable installation techniques that minimise turbidity – Design considerations for scour protection, moorings that minimise seabed interaction – Horizontal directional drilling rather than trenching for nearshore elements and shore crossing for export cables • Physical presence of OWF infrastructure: – Modelling to inform site selection – Adoption of best practices in design of infrastructure (e.g. creation of corridors) • Light emissions: – Reduce light emissions to minimum required – Consider wavelength, orientation / shielding, intensity and timing – Limit reflective surfaces – Good housekeeping for offshore vessels • Vessel interactions – injury & mortality: – Limit transit speeds & number of vessels to / from OWF • Multiple impact pathways:

Document Title	Summary	Relevance to project
		– Design OWF to reduce impacts of all pathways
EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales: Industry guidelines	The policy is written with the aim of minimising the likelihood of hearing impairment of whales based on current scientific understanding, it provides: • practical standards to minimise the risk of auditory impairment in whales, • a framework that minimises the risk of biological consequences from acoustic disturbance to whales in BIAs or during critical behaviours, and • legal guidance to both proponents and operators conducting surveys	The potential to injure and disturb marine mammals and turtles from underwater noise is a key impact for the Project. While the policy is written specifically for seismic surveys, the aims intended remain the same in regard to the Project. However, consideration must be given to the different technologies used in the Project and therefore appropriate modelling for specific methods, technologies and equipment was undertaken to inform the impact and risk assessment. Monitoring and management programs: apply baseline monitoring program where necessary, monitor the effectiveness of controls, application of a monitoring program for shutdowns and restart procedures
Important Marine Mammal Protected Areas Task Force	The task force identifies habitats that are important to marine mammal species (Important Marine Mammal Areas, IMMAs) in order to prioritise their conservation.	The project area lies within the Southeastern Australia and Tasmanian Shelf Waters IMMA that provides migratory, breeding and foraging habitat for many species including several species of baleen whales, toothed whales, dolphins, and pinnipeds.
Revised Guidelines for the Reduction of Underwater Radiated Noise from Shipping to Address Adverse Impacts on Marine Life	Provides guidance on the reduction of underwater noise from commercial shipping to address adverse impacts on marine life. The guidelines may be applied to any ship, taking into account their design and construction, and modifications, as well as their operation.	The guidelines list requirements for the operation and maintenance of vessels to reduce underwater noise emissions with an aim to decrease impacts on marine wildlife and noise sensitive species. The inclusion of ongoing operational monitoring to reduce ocean noise is recommended through actual / real time measurements and modelling of ship parameters and environmental conditions. • Maintenance: maintaining surface or propellers, reducing hull roughness, and proper maintenance of moving parts and machinery. • Operation: Optimising trim, routeing, speed and sail time. Efforts should be made to support community-led efforts to understand underwater noise from shipping and its impacts on marine species and coastal communities.

3.4 Assessment criteria

To assess the acceptability of predicted impacts and risks of the project, refine the design and identify further mitigation and / or management measures that may be needed, those predicted impacts and risks are compared against pre-defined 'assessment criteria' that define the environmental performance outcomes that must be achieved. Assessment criteria can be quantitative or qualitative. The specific assessment criteria relevant to this technical report and the species of marine mammals and turtles that have the potential to be impacted have been guided by and derived from international, national and state agreements, legislation and policy including:

- The principles of ecologically sustainable development as defined in section 3A of the EPBC Act and the Ministerial guidelines for assessment of environmental effects under the EE Act (DTP 2023)
- General Environmental Duty requirements of the *Environment Protection Act 2017* (Vic)
- EPBC Act Significant Impact Guidelines 1.1 - Matters of National Environmental Significance
- Requirement of the EIS guidelines and EES scoping requirements

- The listed conservation status of the various species that have potential to utilise the OWFA and wider area that may be impacted (e.g. area of ensonification from underwater noise emissions)
- Specific targets, key threats and actions outlined in any relevant species recovery plans, conservation management plans, conservation advice, action plans and other government guidance material
- Known stakeholder or First Nations values based on ongoing consultation with First Nations people since 2017
- Outcomes-based conditions guidance - Environment Protection and Biodiversity Conservation Act 1999 (2016)
- Key environmental factors for offshore windfarm environmental impact assessment under the *Environment Protection and Biodiversity Conservation Act 1999* (2023).

The specific assessment criteria relevant to this technical study and the species of marine mammal and turtles that have the potential to be impacted are outlined below in Table 3-5. Refer to Section 6.2 for scoping of individual species relevant to the OWFA.

Table 3-5: Assessment criteria for marine mammals and turtles

Receptor	Potential impacts/ risks	Source of requirements	Relevant specific requirements	Assessment criteria
Cetaceans				
Listed Threatened (endangered and vulnerable) cetacean species (EPBC Act EN, V) •Blue whale (two subspecies) (EN, Mi) <i>Balaenoptera musculus</i> spp. •Southern right whale (EN, Mi) <i>Eubalaena australis</i> •Sei whale (V, Mi) <i>Balaenoptera borealis</i> •Fin whale (V, Mi) <i>Balaenoptera physalus</i>	Potential impacts •Underwater noise from construction piling and/or project vessels causing auditory impairment, behavioural disturbance, and/or masking •Underwater noise from operational wind turbines causing behavioural disturbance and/or masking •Project activities resulting in changes in prey distribution and abundance (indirect impact) •Routine discharges and reduced water quality leading to changes in marine mammal health/behaviour Potential risks •Risk of vessel strike causing injury / mortality •Accidental hydrocarbon release resulting in fauna oiling •Debris leading to entanglement or ingestion •Accidental discharges and reduced water quality leading to changes in marine mammal health/behaviour	Statutory Instruments •EPBC Act Principles of Ecologically Sustainable Development (ESD) •EPBC Regulations 2000 Part 8 •EPBC Act Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015a) •EPBC Act National Recovery Plan for the Southern Right Whale (DCCEEW, 2024b) •Fin Whale Conservation Advice (TSSC, 2015a) •Sei Whale Conservation Advice (TSSC, 2015b) •Wildlife (Marine Mammals) Regulations 2019 •FFG Act Action Statement – Blue whale •FFG Act Action Statement – Southern right whale •General Environmental Duty under the EP Act (VIC) •South-East Commonwealth Marine Reserves Network Management Plan 2013–23 (DNP 2013) •Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia’s coasts and ocean (Commonwealth of Australia 2018) Guidance Documents: •MNES Significant Impact Guidelines 1.1 – critically endangered and endangered species (Commonwealth of Australia 2013a) •MNES Significant Impact Guidelines 1.1 – vulnerable species (Commonwealth of Australia 2013b) •National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (Commonwealth of Australia, 2017c) •Australian National Guidelines for Whale and Dolphin Watching (Commonwealth of Australia, 2017b) •South-east Marine Region Profile (Commonwealth of Australia, 2015b) •Revised Guidelines for the Reduction of Underwater Radiated Noise from Shipping to	•Principles of ESD, Chapter 1, Part 1, Section 3A EPBC Act (met by AC1) The following ESD principles are relevant to the project: – The precautionary principle – if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation – The principle of inter-generational equity – that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations – The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making. •Conservation Management Plan for the Blue Whale (met by AC2) – Action Area A2: Assessing and addressing anthropogenic noise– the following conservation management actions apply: – Assessing the effect of anthropogenic noise on blue whale behaviour. – Anthropogenic noise in biologically important areas will be managed such that any blue whale continues to utilise the area without injury and is not displaced from a foraging area. – Action Area A4: Minimising vessel collisions– the following conservation management actions apply: – Ensure all vessel strike incidents are reported in the National Ship Strike Database (https://data.marinemammals.gov.au/report/shipstrike). – Ensure the risk of vessel strikes on blue whales is considered when assessing actions that increase vessel traffic in areas where blue whales occur and, if required, appropriate mitigation measures are implemented. – The Guidance on key terms within the Blue Whale Conservation Management Plan (2021) have been considered as part of the management plan and applied throughout the assessment, including the definitions of ‘a foraging area’, ‘displaced from a foraging area’ and ‘injury to blue whales’. •National Recovery Plan for the Southern Right Whale (Note: Actions below supersede the Conservation Management Plan for the southern right whale 2011-2021 Actions) (met by AC3): – Action Area A5: Assess, manage and mitigate impacts from anthropogenic underwater noise: – Actions within and adjacent to southern right whale BIAs and HCTS should demonstrate that it does not prevent any southern right whale from utilising the area or cause auditory impairment. – Actions within and adjacent to southern right whale BIAs and HCTS should demonstrate that the risk of behavioural disturbance is minimised. – Ensure environmental assessments associated with underwater noise generating activities include consideration of national policy (e.g., EPBC Act Policy Statement 2.1) and guidelines related to managing anthropogenic underwater noise and implement appropriate mitigation measures to reduce risks to southern right whales to the lowest possible level. – Quantify risks of anthropogenic underwater noise to southern right whales, including studies aimed to measure physiological effects, behavioural disturbance, and changes to acoustic communication (e.g., masking of vocalisations). – Improve understanding and characterisation of marine soundscapes, including the application of new technologies for data processing, within southern right whale BIAs to facilitate quantification of anthropogenic noise in the marine soundscape. – Very little is known about the sensitivity of southern right whales to anthropogenic noise and so there is a need to better understand the overlap between southern right whale distribution and potential sources of significant anthropogenic sound. – Action area A6: Manage, minimise, and mitigate the threat of vessel strike – the following conservation management actions apply: – Assess risk of vessel strike to southern right whales in BIAs. – Improve understanding of the behavioural response of southern right whales in close vicinity to vessels in BIAs to inform risk assessments of vessel strike. – Ensure environmental impact assessments and associated plans consider and quantify the risk of vessel strike and associated potential cumulative risks in BIAs and HCTS. – Ensure all vessel strike incidents are reported in the National Ship Strike Database. •Fin Whale Conservation Advice and Sei Whale Conservation Advice – the following conservation management actions apply (met by AC4): – Assessing and addressing anthropogenic noise – Once the spatial and temporal distribution (including biologically important areas) of sei whales is further defined an assessment of the impacts of increasing anthropogenic noise (including from seismic surveys, port expansion, and coastal development) should be undertaken on this species.	•AC1: Biological diversity and productivity of the environment is not compromised because of the project.. •AC2: The project will be managed such that residual impacts and / or risks will not be inconsistent with the objectives of the Conservation Management Plan for the Blue Whale, including application of the “Guidance on key terms” and the requirements of the following relevant Action Areas defined within the: – Action Area A2 – assessing anthropogenic noise – specifically that anthropogenic noise will be managed such that any blue whale continues to utilise biologically important areas without injury and is not displaced from a foraging area – Action Area A4 – minimising vessel collisions •AC3: The project will be managed such that residual impacts and/or risks will not be inconsistent with the objectives of the National Recovery Plan for the Southern Right Whale including the requirements of the following relevant Action Areas: – Action Area A5 – assessing, managing and mitigating impacts to southern right whales from anthropogenic underwater noise – specifically that anthropogenic noise will be managed such that it does not prevent any southern right whale from utilising biologically important areas or habitat critical to the survival of a species or cause auditory impairment – Action Area A6 – manage, minimise and mitigate the threat of vessel strike. •AC4: The project will not have a significant impact on Threatened (Endangered and Vulnerable) Species as defined in the MNES Significant Impact Guidelines 1.1 •AC5: The project will be managed to prevent vessel strike with marine fauna. •AC6: The project will be managed to prevent pollution from routine and/or accidental discharges to the marine environment.

Receptor	Potential impacts/ risks	Source of requirements	Relevant specific requirements	Assessment criteria
		Address Adverse Impacts on Marine Life (IMO, 2023)	– If required, additional management measures should be developed and implemented to ensure the ongoing recovery of sei whales. – Ensure all vessel strike incidents are reported in the National Ship Strike Database (https://data.marinemammals.gov.au/report/shipstrike). – Mitigation measures should be implemented to reduce the risk of collision-related mortality of a species. •FFG Act Action Statements – the following management actions and objectives apply (met by AC1 to AC6): – Assess and manage disturbances from oil and gas exploration and development, shipping and recreational boating. – Reduce the likelihood of whales being entangled in marine debris and marine industry equipment •Threat Abatement Plan (TAP) for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (Commonwealth of Australia, 2018) (met by AC5 and AC6) – Contribute to the long-term prevention of marine debris and the number of marine vertebrates dying or being injured from ingestion of and/or entanglement by limiting marine debris from land-based and marine-based sources, including offshore installations and shipping. •South-east Commonwealth Marine Reserves Network Management Plan 2013 – 2023 (met by AC1 to AC7): Overall objective: to provide clear direction for the management of the Marine Reserves Network to protect and conserve the biodiversity and key values and enable the ecologically sustainable use of natural resources within the network, where possible. Relevant values identified within the plan are the blue whale, southern right whale, sei whale, sea lions and seals. Key strategies of the plan relevant to offshore wind projects include: – Strategy 1. Improve knowledge and understanding of the conservation values of the marine reserves network and of the pressures on those values – Strategy 2. Minimise impacts of activities through effective assessment of proposals, decision-making and management of reserve specific issues – Strategy 3. Protect the conservation values of the marine reserves network through management of environmental incidents. – MNES Significant Impact Guidelines 1.1 – Critically Endangered and Endangered species. The following relevant criteria apply (met by AC4): An action is likely to have a significant impact on an endangered species if there is a real change or possibility that it will: – lead to a long-term decrease in the size of an important population of a species – reduce the area of occupancy of an important population – fragment an existing important population into two or more populations – adversely affect habitat critical to the survival of a species – disrupt the breeding cycle of an important population – modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, – result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat – introduce disease that may cause the species to decline, or – interfere substantially with the recovery of the species. •MNES Significant Impact Guidelines 1.1 – Vulnerable species (met by AC4): An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will: – lead to a long-term decrease in the size of an important population of a species – reduce the area of occupancy of an important population – fragment an existing important population into two or more populations – adversely affect habitat critical to the survival of a species – disrupt the breeding cycle of an important population, – result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat – introduce disease that cause the species to decline, or – modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline. •National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (met by AC2, AC3 and AC5): – Data acquisition of both species at risk of vessel strike, and vessel movements	

Receptor	Potential impacts/ risks	Source of requirements	Relevant specific requirements	Assessment criteria
			- Identify and adopt best-practice mitigation measures and emerging technologies and encourage the development of new mitigation measures - Develop and implement vessel strike management plans which identify appropriate mitigation measures in locations where the relative risk of vessel strike is higher, as determined by a risk assessment - Ensure all vessel strike incidents are reported in the National Ship Strike Database (https://data.marinemammals.gov.au/report/shipstrike). •EPBC Regulations 2000 Part 8 / Australian National Guidelines for Whale and Dolphin Watching (met by AC2, AC3, AC5): - Vessels should be manoeuvred with care around whales and dolphins, and erratic vessel behaviour around animals should not occur - Comply with the approach distances for whales: - Vessels must not enter the no approach zone (within 100 metres to the side and 300 metres in front and to the rear of an adult whale) and must not wait in front of the direction of travel of an animal or pod of animals - No more than three vessels allowed within the caution zone (within 300 metres either side of a whale) - Vessels must operate at speeds of less than six knots within the caution zone - Vessels must not enter the caution zone when a calf is present - Vessels must not enter the caution zone if a whale shows signs of disturbance - Comply with the approach distances for dolphins: - Vessels must not enter the no approach zone (within 50 metres to the side and 150 metres in front and to the rear of an adult dolphin) and must not wait in front of the direction of travel of an animal or pod of animals - No more than three vessels allowed within the caution zone (within 150 metres either side of a dolphin) - Vessels must operate at speeds of less than six knots within the caution zone - Vessels must not enter the caution zone when a calf is present - Vessels must not enter or remain in the caution zone if a dolphin shows signs of disturbance - Whales that are calving, accompanied by young, resting or feeding should not be approached - Helicopters must not fly lower than 500 metres within a 500 metre radius of a whale or dolphin and must not approach a whale or dolphin from head on. •Wildlife (Marine Mammals) Regulations 2019 (met by AC2, AC3, AC5): - The regulations requirements for management of vessel activities around whales and dolphins are the largely the same as described under the EPBC Regulations 2000 Part 8 / Australian National Guidelines for Whale and Dolphin Watching (refer above). The following measures for whales and dolphins are in addition to the EPBC Regulations: - A person operating a vessel within the caution zone of a marine mammal must move the vessel at a constant speed that does not exceed five knots. •South-east Marine Region Profile (met by AC1 to AC7) - Describes the characteristics of the SEMR, including identifying the conservation values for which the Region is important, in order to support the conservation and ecologically sustainable use of the area. Relevant nationally protected species in the region include the blue whale, southern right whale, humpback whale, fin whale, sei whale, Gray's, Strap-toothed and Cuvier's beaked whales, long-finned pilot, minke, pygmy right, false killer and killer whales, bottlenose, Risso's and common dolphins, Australian sea lion, subantarctic fur seal, Antarctic fur seal, Australian fur seal, New Zealand fur seal, and southern elephant seals. •Revised Guidelines for the Reduction of Underwater Radiated Noise from Shipping to Address Adverse Impacts on Marine Life (met by AC2, AC3 and AC4): - The guidelines list requirements for the operation and maintenance of vessels to reduce underwater noise emissions with an aim to decrease impacts on marine wildlife and noise sensitive species. The inclusion of ongoing operational monitoring to reduce ocean noise is recommended through actual measurements and modelling of ship parameters and environmental conditions. - Maintenance: maintaining surface of propellers, reducing hull roughness, and proper maintenance of moving parts and machinery. - Operation: Optimising trim, routeing, speed and sail time. - Efforts should be made to support community-led efforts to understand underwater noise from shipping and its impacts on marine species and coastal communities. •General Environmental Duty (GED) requirements of the <i>Environment Protection Act 2017</i> (EPA Act) (Vic) - The GED (section 25(4) of the Act) requires risks to be minimised so far as reasonably practicable and consequently requires you to:	

Receptor	Potential impacts/ risks	Source of requirements	Relevant specific requirements	Assessment criteria
			○ Use and maintain plant, equipment, processes and systems in a manner that minimises risks of harm to human health and the environment from pollution and waste; ○ Use and maintain systems for identification, assessment and control of risks of harm to human health and the environment from pollution and waste that may arise in connection with the activity, and for the evaluation of the effectiveness of controls; ○ Use and maintain adequate systems to ensure that if a risk of harm to human health or the environment from pollution or waste were to eventuate, its harmful effects would be minimised; ○ Ensure that all substances are handled, stored, used or transported in a manner that minimises risks of harm to human health and the environment from pollution and waste; and ● Provide information, instruction, supervision and training to any person engaging in the activity to enable those persons to comply with the GED.	
Listed Migratory cetacean species (EPBC Act, Mi) ● Humpback whale (Mi, CE – critically endangered, FFG Act (VIC)) <i>Megaptera novaeangliae</i> ● Antarctic minke whale (Mi) <i>Balaenoptera bonaerensis</i> ● Bryde’s whale (Mi) <i>Balaenoptera edeni</i> ● Pygmy right whale (Mi) <i>Caperea marginata</i> ● Killer whale (Mi) <i>Orcinus orca</i>	Potential impacts ● Underwater noise from construction piling and / or project vessels causing auditory impairment, behavioural disturbance, and/or masking ● Underwater noise from operational wind turbines causing behavioural disturbance and / or masking ● Project activities resulting in changes in prey distribution and abundance (indirect impact) ● Routine discharges and reduced water quality leading to changes in marine mammal health / behaviour Potential risks ● Risk of vessel strike causing injury / mortality ● Accidental hydrocarbon release resulting in fauna oiling ● Debris leading to entanglement or ingestion ● Accidental discharges and reduced water quality leading to changes in marine mammal health / behaviour	Statutory Instruments ● EPBC Act Principles of Ecologically Sustainable Development (ESD) ● EPBC Regulations 2000 Part 8 ● Wildlife (Marine Mammals) Regulations 2019 ● General Environmental Duty under the EP Act (VIC) ● South-East Commonwealth Marine Reserves Network Management Plan 2013–23 (DNP 2013) ● Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia’s coasts and ocean (Commonwealth of Australia 2018) ● FFG Act Action Statement – Humpback whale Guidance Documents: ● MNES Significant Impact Guidelines 1.1 – migratory species (Commonwealth of Australia 2013c) ● National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (Commonwealth of Australia, 2017c) ● Australian National Guidelines for Whale and Dolphin Watching (Commonwealth of Australia, 2017b)	● Principles of ESD, Chapter 1, Part 1, Section 3A EPBC Act (refer to requirements described under ‘Listed Threatened Cetaceans’ above) (met by AC1) ● MNES Significant Impact Guidelines 1.1 – Migratory species (met by AC8) An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will: – substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species. – result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or – seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species. ● Wildlife (Marine Mammals) Regulations 2019 (refer to requirements described under ‘Listed Threatened Cetaceans’ above) (met by AC5). ● FFG Act Action Statements – the following management actions and objectives apply (met by AC1, AC5, AC6, AC7): – Assess and manage disturbances from oil and gas exploration and development, shipping and recreational boating. – Reduce the likelihood of whales being entangled in marine debris and marine industry equipment ● Threat Abatement Plan (TAP) for the impacts of marine debris on the vertebrate wildlife of Australia’s coasts and oceans (refer to requirements described under ‘Listed Threatened Cetaceans’ above) (met by AC5 and AC6). ● National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (refer to requirements described under ‘Listed Threatened Cetaceans’ above) (met by AC5) ● Australian National Guidelines for Whale and Dolphin Watching (refer to requirements described under ‘Threatened Cetaceans’ above) (met by AC5) ● South-east Marine Region Profile (refer to requirements described under ‘Threatened Cetaceans’ above) (met by AC1 and AC5 to AC7) ● General Environmental Duty requirements of the EPA Act 2017 (Vic)	● AC1: Biological diversity and productivity of the environment is not compromised because of the project. ● AC5: The project will be managed to prevent vessel strike with marine fauna. ● AC6: The project will be managed to prevent pollution from routine and/or accidental discharges to the marine environment. ● AC7: The project will not have a significant impact on Migratory Species as defined in the MNES Significant Impact Guidelines 1.1.
Marine-listed Cetacean species (EPBC Act) ● Dwarf minke whale (ce) <i>Balaenoptera acutorostrata</i> unnamed subspecies ● Common dolphin (ce) <i>Delphinus delphis</i> ● Indo-Pacific dolphin (ce) <i>Tursiops aduncus</i> ● Bottlenose dolphin (ce) <i>Tursiops truncatus</i> ● Striped dolphin (ce) <i>Stenella coeruleoalba</i> ● Risso’s dolphin (ce) <i>Grampus griseus</i>	Potential impacts ● Underwater noise from construction piling and/or project vessels causing auditory impairment, behavioural disturbance, and / or masking ● Underwater noise from operational wind turbines causing behavioural disturbance and / or masking ● Project activities resulting in changes in prey distribution and abundance (indirect impact) ● Routine discharges and reduced water quality leading to	Statutory Instruments ● EPBC Act Principles of Ecologically Sustainable Development (ESD) ● EPBC Regulations 2000 Part 8 ● Wildlife (Marine Mammals) Regulations 2019 ● General Environmental Duty under the EP Act (VIC) ● South-East Commonwealth Marine Reserves Network Management Plan 2013–23 (DNP 2013) ● Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia’s	● Principles of ESD, Chapter 1, Part 1, Section 3A EPBC Act (refer to requirements described under ‘Listed Threatened Cetaceans’ above) (met by AC1) ● MNES Significant Impact Guidelines 1.1 – Commonwealth marine area (CMA)(met by AC8) An action is likely to have a significant impact on the environment in a CMA if there is a real chance or possibility that the action will: – result in a known or potential pest species becoming established in the CMA – modify, destroy, fragment, isolate or disturb an important or substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a CMA results – have a substantial adverse effect on a population of a marine species or cetacean including its life cycle (for example, breeding, feeding, migration behaviour, life expectancy) and spatial distribution – result in a substantial change in air quality or water quality (including temperature) which may adversely impact on biodiversity, ecological integrity; social amenity or human health – result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, social amenity or human health may be adversely affected.	● AC1: Biological diversity and productivity of the environment is not compromised because of the project. ● AC5: The project will be managed to prevent vessel strike with marine fauna. ● AC6: The project will be managed to prevent pollution from routine and/or accidental discharges to the marine environment. ● AC8: The project will not have a significant impact on Commonwealth Marine Areas as defined in the MNES Significant Impact Guidelines 1.1.

Receptor	Potential impacts/ risks	Source of requirements	Relevant specific requirements	Assessment criteria
•False killer whale (ce) <i>Pseudorca crassidens</i>	changes in marine mammal health / behaviour Potential risks •Risk of vessel strike causing injury / mortality •Accidental hydrocarbon release resulting in fauna oiling •Debris leading to entanglement or ingestion •Accidental discharges and reduced water quality leading to changes in marine mammal health/behaviour	coasts and ocean (Commonwealth of Australia 2018) Guidance Documents: •MNES Significant Impact Guidelines 1.1 – Commonwealth marine areas (Commonwealth of Australia, 2013b) •National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (Commonwealth of Australia, 2017c) •Australian National Guidelines for Whale and Dolphin Watching (Commonwealth of Australia, 2017b)	•Wildlife (Marine Mammals) Regulations 2019 (refer to requirements described under ‘Threatened Cetaceans’ above) (met by AC5). •Threat Abatement Plan (TAP) for the impacts of marine debris on the vertebrate wildlife of Australia’s coasts and oceans (refer to requirements described under ‘Listed Threatened Cetaceans’ above) (met by AC5 and AC6). •National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (refer to requirements described under ‘Listed Threatened Cetaceans’ above) (met by AC5) •EPBC Regulations 2000 Part 8 / Australian National Guidelines for Whale and Dolphin Watching (refer to requirements described under ‘Threatened Cetaceans’ above)(met by AC5) •South-east Marine Region Profile (refer to requirements described under ‘Threatened Cetaceans’ above) (met by AC1, AC5 to AC7, and AC8) •General Environmental Duty requirements of the EPA Act 2017 (Vic)	
Pinnipeds				
Marine-listed pinniped species (EPBC Act) •Australian fur seal <i>Arctocephalus pusillus</i> •New Zealand fur seal <i>Arctocephalus forsteri</i>	Potential impacts •Underwater noise from construction piling and / or project vessels causing auditory impairment, behavioural disturbance, and / or masking •Underwater noise from operational wind turbines causing behavioural disturbance and/or masking •Project activities resulting in changes in prey distribution and abundance (indirect impact) •Routine discharges and reduced water quality leading to changes in marine mammal health / behaviour •Seabed disturbance causing sediment plumes •Electromagnetic interference affecting behaviour or prey distribution Potential risks •Risk of vessel strike causing injury / mortality •Accidental hydrocarbon release resulting in fauna oiling •Debris leading to entanglement or ingestion •Accidental discharges and reduced water quality leading to changes in marine mammal health / behaviour	Statutory Instruments •Wildlife (Marine Mammals) Regulations 2019 •Threat Abatement Plan (TAP) for the impacts of marine debris on the vertebrate wildlife of Australia’s coasts and oceans •National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna •South-east Marine Region Profile •FFG Act Action Statement ¹ Guidance Documents: •MNES Significant Impact Guidelines 1.1 – Commonwealth marine areas (Commonwealth of Australia, 2013b)	•Principles of ESD, Chapter 1, Part 1, Section 3A EPBC Act (refer to requirements described under ‘Listed Threatened Cetaceans’ above) (met by AC1) •MNES Significant Impact Guidelines 1.1 – Commonwealth marine area (CMA) (met by AC8) An action is likely to have a significant impact on the environment in a CMA if there is a real chance or possibility that the action will: – result in a known or potential pest species becoming established in the CMA – modify, destroy, fragment, isolate or disturb an important or substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a CMA results – have a substantial adverse effect on a population of a marine species or cetacean including its life cycle (for example, breeding, feeding, migration behaviour, life expectancy) and spatial distribution – result in a substantial change in air quality or water quality (including temperature) which may adversely impact on biodiversity, ecological integrity; social amenity or human health – result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, social amenity or human health may be adversely affected. •Wildlife (Marine Mammals) Regulations 2019 (met by AC5) – The regulations require the following precautionary measures for vessels around seals and seal breeding colonies: ○ Vessels must not approach within 30 metres of a seal, if the seal is on land or a haul out; or within 5 metres if the seal is on water infrastructure. ○ Aircraft must not fly lower than 300 vertical metres within a 300 metre radius of a seal breeding colony. •Threat Abatement Plan (TAP) for the impacts of marine debris on the vertebrate wildlife of Australia’s coasts and oceans (refer to requirements described under ‘Listed Threatened Cetaceans’ above) (met by AC5 and AC6) •National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (refer to requirements described under ‘Listed Threatened Cetaceans’ above) (met by AC5) •South-east Marine Region Profile (refer to requirements described under ‘Threatened Cetaceans’ above) (met by AC1 and AC5 to AC8) •General Environmental Duty requirements of the EPA Act 2017 (Vic)	•AC1: Biological diversity and productivity of the environment is not compromised because of the project. •AC5: The project will be managed to prevent vessel strike with marine fauna. •AC6: The project will be managed to prevent pollution from routine and/or accidental discharges to the marine environment. •AC8: The project will not have a significant impact on Commonwealth Marine Areas as defined in the MNES Significant Impact Guidelines 1.1.
Marine turtles				
Threatened and migratory marine turtles	Potential impacts •Underwater noise from construction piling and / or	Statutory Instruments	•Principles of ESD, Chapter 1, Part 1, Section 3A EPBC Act (refer to requirements described under ‘Listed Threatened Cetaceans’ above) (met by AC1)	•AC1: Biological diversity and productivity of the environment is not compromised because of the project.

¹ New Zealand fur seals have recently been included on the most recent Flora and Fauna Guarantee Act 1988 Threatened List for Victoria (February 2024), however no Action Statement is currently available.

Receptor	Potential impacts/ risks	Source of requirements	Relevant specific requirements	Assessment criteria
•Leatherback turtle (EN, Mi) <i>Dermochelys coriacea</i> •Loggerhead turtle (EN, Mi) <i>Caretta caretta</i> •Green turtle (V, Mi) <i>Chelonia mydas</i>	project vessels causing auditory impairment, or behavioural disturbance •Underwater noise from operational wind turbines causing behavioural disturbance •Project activities resulting in changes in prey distribution and abundance (indirect impact) •Routine discharges and reduced water quality leading to changes in marine mammal health / behaviour •Electromagnetic interference affecting behaviour or prey distribution Potential risks •Risk of vessel strike causing injury / mortality •Accidental hydrocarbon release resulting in fauna oiling •Debris leading to entanglement or ingestion •Accidental discharges and reduced water quality leading to changes in marine mammal health / behaviour	•Wildlife (Marine Mammals) Regulations 2019 •Threat Abatement Plan (TAP) for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans •South-east Marine Region Profile •Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017a) Guidance Documents: •MNES Significant Impact Guidelines 1.1 – critically endangered and endangered species (Commonwealth of Australia 2013b) •MNES Significant Impact Guidelines 1.1 – vulnerable species (Commonwealth of Australia 2013b)	•MNES Significant Impact Guidelines 1.1 – Critically Endangered and Endangered species. The following relevant criteria apply (met by AC4): – interfere substantially with the recovery of the species. •MNES Significant Impact Guidelines 1.1 – Vulnerable species (met by AC4): •Recovery Plan for Marine Turtles in Australia – the following actions apply (met by AC5 and AC6): – Reduce the impacts from marine debris: ○ Describe and quantify the impact of ingestion of debris on marine turtles, particularly those life phases using the open ocean – Minimise chemical and terrestrial discharge: ○ Ensure spill risk strategies and response programs adequately include management for marine turtles and their habitats, particularly in reference to ‘slow to recover habitats’, e.g. nesting habitat, seagrass meadows or coral reefs. •Threat Abatement Plan (TAP) for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (refer to requirements described under ‘Listed Threatened Cetaceans’ above) (met by AC5 and AC6) •National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (refer to requirements described under ‘Listed Threatened Cetaceans’ above) (met by AC5) •South-east Marine Region Profile (refer to requirements described under ‘Threatened Cetaceans’ above) (met by AC1 and AC4 to AC7) •General Environmental Duty requirements of the EPA Act 2017 (Vic)	•AC4: The project will not have a significant impact on Threatened (Endangered and Vulnerable) Species as defined in the MNES Significant Impact Guidelines 1.1. •AC5: The project will be managed to prevent vessel strike with marine fauna. •AC6: The project will be managed to prevent pollution from routine and/or accidental discharges to the marine environment.

4 CONSULTATION AND ENGAGEMENT

Star of the South has undertaken extensive engagement with a broad range of stakeholders and communities throughout the project's development phase and preparation of the EIS/EES to communicate project information; obtain, understand and discuss feedback; and identify potential issues and opportunities for consideration in the EIS/EES. A summary of this engagement is documented in EIS Attachment II - Consultation Report and EES Attachment II – Consultation Report.

Consultation specific to '*marine mammals and turtles*' has also been undertaken with identified stakeholders to inform this report. A summary of this engagement is provided below.

Engagement activities

Key activities undertaken between 2019 and 2025 to engage with identified stakeholders and communities include:

- Discussions with community members through phone calls, emails or visits to the Gippsland office
- Discussions with key stakeholders through phone calls, emails, meetings, workshops and briefings
- Sharing of information via the project's website, social media and monthly e-news
- Fact sheet containing information about the project's marine environment survey program and site investigations
- Presence at community events and pop-up stalls across Gippsland
- Community Advisory Group
- Community information sessions.

Stakeholders

Key stakeholders identified and engaged on this report include:

- Local environmental / nature conservation / climate campaign groups
 - Phillip Island Nature Park
 - Wildlife Coast Cruises
- Environmental non-government organisations
 - Australian Conservation Foundation
 - Australian Marine Conservation Society
 - Birdlife Australia
 - Environment Victoria
 - Friends of the Earth
 - Humane World for Animals (formerly Humane Society International)
 - Marine Mammal Foundation
 - Sea Shepherd
 - Victorian National Parks Association
- Local community, including local groups, schools and associations
- Latrobe City Council
- South Gippsland Shire Council
- Wellington Shire Council
- Parks Victoria

Table 4-1 lists relevant issues raised by stakeholders and how feedback on these issues have been applied to the assessment of impacts on marine mammals and turtles.

Table 4-1: Summary of consultation issues raised relevant to marine mammals and turtles technical report

Date	Stakeholder / partner and type of response	Issues raised	Response to issues raised and / or were considered within this report or associated appendices.
Experts and / or specialist consultation			
8/05/2017	Parks Victoria	Possible issues with whale and orca migration. Specific concerns relating to the possible impacts on the ecology and biology of marine mammals and turtles have not been raised by Parks Victoria during consultation.	Impacts to marine mammals are considered in Sections 8 to 13. These sections outline impact assessments for cetacean migratory pathways and how mitigation measures will minimise potential impacts.
19/05/2020	Phillip Island Nature Parks – MESP Meeting	Presented project overview including current activities and overview of the MESP. Details on marine survey program included aerial and acoustic surveys and fur seal tagging and pup counts. No issues were raised.	Project has committed to keep stakeholder informed as project progresses.
16/03/2021	DEECA – Survey Design Meeting	Presented on marine mammal survey design and optimisation and preliminary survey results for year one. Also discussed DEECA's Southern Right Whale Project, specifically: - Gippsland sightings and historical data / survey effort - Any southern right whale coastal migration evidence - Emerging survey technologies being used – eDNA, drones. No issues were raised.	Project has committed to keep stakeholder informed as project progresses.
Community and interest groups			
24/09/2019 05/2020 08/2021	Victorian National Parks Association (VNPA) and Friends of the Earth	Concerns were raised about impacts from the project to cetaceans. Specific concerns relating any effects on migration routes, feeding and breeding areas for whales, dolphins, seals, and turtles. Noted the importance of considering underwater noise impacts on marine mammals.	Impacts to marine mammals are considered in Sections 8 to 13. These sections outline impact assessments for cetaceans, including potential impacts on migratory pathways and behaviours such as foraging and breeding occurring within and surrounding the OWFA and how mitigation measures will minimise potential impacts. The impacts of underwater noise on marine mammals are considered in Section 8.1, 10.1, 12, 13, 14 and 15.
16/09/2020	Wildlife Coast Cruises (local whale watching tour operator)	Key issues discussed include: - Operations, seasonality, and historical data - Discussion on potential access to WCC data	Issues regarding operations, seasonality, and historical data were discussed in meeting. No further issues were raised. Wildlife Coast Cruises agreed to provide all its sightings data from 2017 around east side of Wilsons Promontory and Star of the South OWFA.
2019 to 2022	Broader community – phone/email correspondence, information sessions	Concerns over potential impacts including: - Effects of construction and operational noise on marine mammals - Effects of project activities on whale migration (i.e. southern right whale) - Increased vessel movement altering marine mammal distribution - Risk of marine mammal collisions with project vessels or project tower structures - Accuracy of modelling	Impacts to marine mammals are considered in Sections 8 and 10. These sections outline impact assessments for cetaceans, including potential impacts on migratory pathways and behaviours such as foraging and breeding occurring within and surrounding the OWFA and how mitigation measures will minimise potential impacts.

Date	Stakeholder / partner and type of response	Issues raised	Response to issues raised and / or were considered within this report or associated appendices.
		How actual impacts would be monitored, recorded, and reported against modelled projections and approved impacts	

5 ASSESSMENT METHOD

5.1 Overview of method

This section describes the method that was used to assess the impacts and risks of the project from events arising from the development of the project.

The approach used in assessment has been guided by the evaluation framework that applies to the project comprising the regulatory framework (that is, applicable legislation, policy, guidelines and standards) as well as the scoping requirements set by the Victorian Minister for Planning EES scoping requirements, and the Commonwealth EIS assessment guidelines. The process generally aligns with guidance issued by the Australian National Offshore Petroleum Safety and Environment Management Authority (NOPSEMA) for the Environmental Assessment of Major Offshore Infrastructure (Reference: *Environment Management Plan Content Requirement*, 10/10/2020), in lieu of government guidance specific to the environmental assessment of offshore renewable energy infrastructure (not available at the time of report preparation).

Figure 5-1 provides an overview of the assessment method.

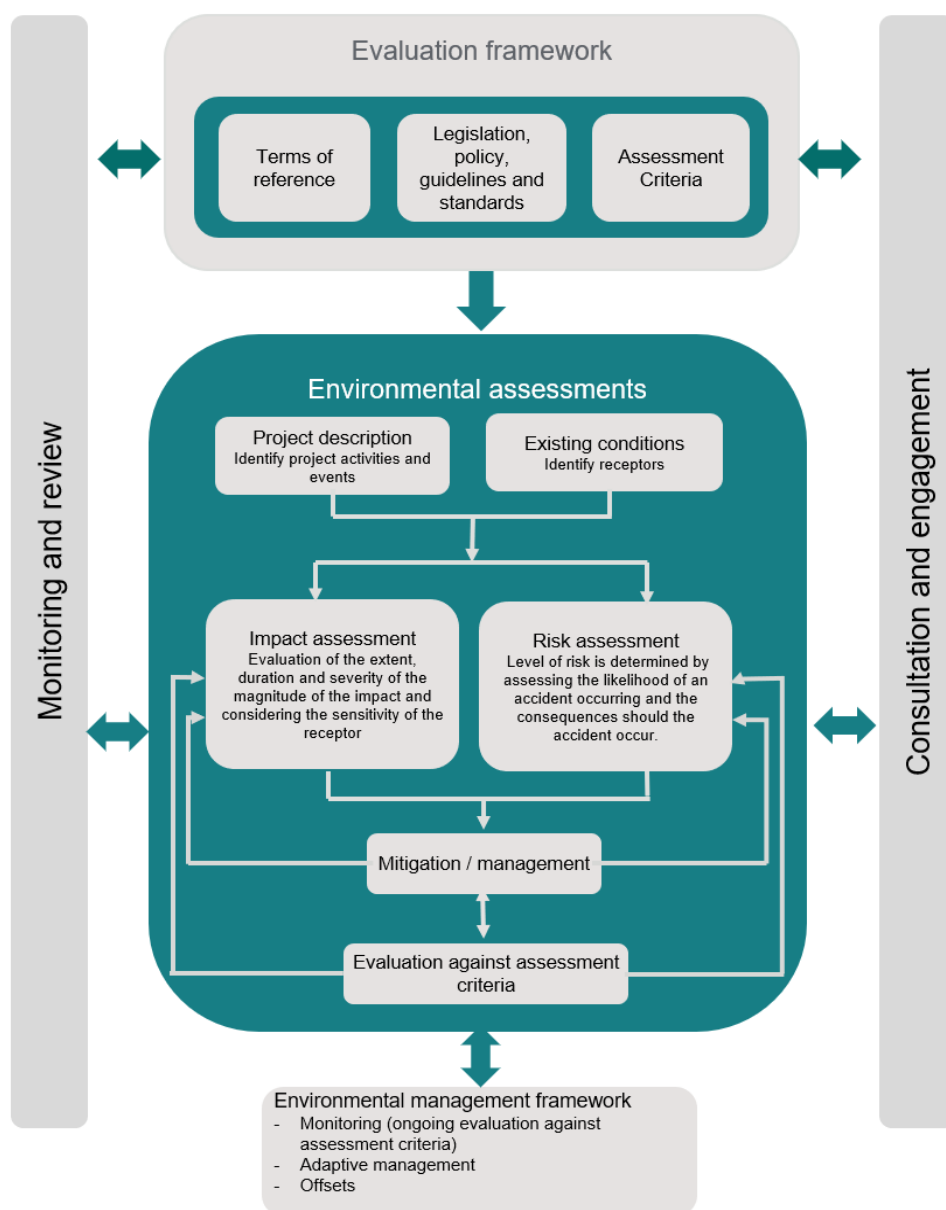


Figure 5-1: Overview of assessment framework

The environmental assessment in relation to marine mammals and turtles was undertaken according to the following steps:

- **Existing conditions:** Characterisation of existing (baseline) environmental conditions and identification of sensitive assets, values and uses that may be affected by construction, operation and / or decommissioning of the project.
- **Project description:** Review of the project description, comprising the key project components and proposed construction, operation activities (in the context of existing conditions) and decommissioning activities to determine the potential project interactions with sensitive receptors (i.e. events). This includes identification of the maximum design scenario for the purposes of impact and risk assessment, considering the parameter range within the project envelope, as described in Chapter 4 – Project description of the EIS for the whole of project assessment across the Commonwealth jurisdiction and Chapter 4 – Victorian works project description of the EES for the Victorian jurisdiction, and selecting the parameter value with potentially greatest impact.
- **Impact assessment:** An assessment of consequences based on the magnitude of the impacts, considering the sensitivity and significance of the affected receptors and considering mitigation measures and their likely effectiveness. The impact assessment methodology is described in Section 5.4.
- **Risk assessment:** An assessment of likelihood and consequence of accidents (i.e. events that are not certain to occur). The risk assessment methodology is described in Section 5.2.
- **Avoid, minimise (mitigate) and manage:** Identification of measures to avoid, minimise, or manage impacts or risks that potentially constitute significant environmental risks.
- **Evaluation against assessment criteria:** Following an impact or risk assessment, evaluation of predicted residual impacts or risks against assessment criteria set out in Section 3.3. If the impact or risk assessment indicated that the environmental assessment criteria are not met, then changes to the project design are made, or further mitigation measures and management are introduced. Residual impacts are then described as those impacts following the implementation of all mitigation measures committed to by the project, considering the expected effectiveness of these measures.
- **Monitoring and review:** As the project is developed, continual checking and revision to project description, impact / risk assessment and mitigation measures is required and will continue to ensure the assessment remains up to date. If the project design envelope changes or legislation changes occur then these changes will be considered and re-assessed as required.
- **Consultation and engagement:** Feedback from community, stakeholders and regulators is needed to ensure the process addresses concerns and meets expectations. Stakeholder consultation and engagement will continue throughout the life of the project.

For impacts (expected events) the likelihood of the event is certain, therefore only an evaluation of consequence is required. For risks (unexpected / accidental events) both likelihood and consequences need to be considered as part of the risk assessment. The evaluation of the consequence for both impacts and risks takes into consideration several factors, including the nature and scale of the impact, the ability to predict its extent, severity and duration, the effectiveness of mitigation / management measures to reduce the consequence, as well as the characteristics of the receptor.

For example, the 'project activity' is construction piling, the 'event' is underwater noise and the 'consequence' would be auditory impairment or disturbance to marine mammals. Underwater noise is an expected event as the emission of underwater noise is a part of construction and cannot be completely avoided as part of the activity. Underwater noise would be detectable across a spatial extent. Marine fauna encountering the underwater noise is expected due to their known presence in the activity area. An example of an unexpected event is where the 'project activity' is vessel presence, the 'event' is 'collision with marine fauna' and the 'consequence' would be auditory impairment or disturbance to marine mammals. This event is unexpected and unlikely to occur but it is still a possibility.

5.2 Study area

The study area is defined as all locations that may potentially be impacted by project activities and are of relevance to marine mammals and turtles. It is informed by the literature review and the Marine Ecology Survey Program (MESp) that identified suitable habitat and presence of marine fauna.

The study area covered by this report encompasses broad geographic areas in which marine mammals and turtles that use the marine environment may be affected by the project. The MESP was designed to answer key questions to inform the assessment of existing conditions and project impacts within this broader study area. Each MESP study has a unique defined study area, which are detailed within the MESP Marine Mammals and Turtles Survey report (refer Section 1.5.1 and Figure 1-3 of Appendix A). These MESP studies have largely been conducted within the pre-feasibility license area (PFLA) plus a ten-kilometre buffer, however additional studies have occurred outside these areas in response to specific objectives, such as to gather contextual information from the broader region, or to study marine mammal populations at their breeding locations (e.g. locally breeding fur seals).

During visual aerial surveys, control transects and transects on the other side of Wilson's Promontory were used for regional context, so that it could be determined whether the OWFA and surrounds were a lesser, similar or more important habitat used compared to other areas of the Gippsland regions (or BIAs for southern right and blue whales) (see description in Appendix A Section 2.4.4.7). The control transects were used as inputs for the species density and abundance models (Appendix A Section 2.4.7) and outputs for this are shown in Appendix A Section 3.1.2.4.1. A description of sightings differentiated by transects including C1 and C2 is included in Section 3.1.2.4 of Appendix A and figures showing all sightings by transect are shown throughout Section 3 of Appendix A. In the event that the monitoring described in Section 15.3 detects changes in relative fauna abundance compared to what was observed during baseline studies and further investigations are required, changes in the OWFA could be compared with any relative changes in control transects. However, currently, as described in the EIA, such changes are not expected.

Field studies that involved fur seal satellite tracking collected data on movement patterns over a broader regional study area encompassing the marine environment of eastern Bass Strait and the continental shelf edge, west to Wilson's Promontory and even as far as King Island, and as far south as Tasmania and beyond, to give wider context for the site-specific data, and to understand the species breeding areas, foraging ranges and migration. This broader area provides a sufficiently large area within which ecological patterns of the fur seals can be understood. For marine mammals, this can be difficult to determine due to their wide-ranging nature. Therefore, whilst the term 'study area' is used in this report, it is broadly defined by the nature of the impact and the wide-ranging movement patterns of the individual receptor groups and the methods that can be reasonably used to survey them for consideration in the impact assessment.

A protected matter search tool (PMST) search was conducted on the Star of the South PFLA plus a ten-kilometre buffer. A ten-kilometre buffer was chosen as a reasonable distance within which mitigation measures proposed in the impact assessment can be implemented for species likely to occur within the OWFA. However, the regional offshore marine mammal and turtle study area was made up of the broader marine environment from west of Wilson's Promontory to the area offshore to Loch Sport, and to approximately 70 kilometres offshore (Figure 5-2). To cover this area, an additional buffer of 100 kilometres was added to this live document, primarily to capture the wide-ranging marine mammal and turtle species that might be present in the water of the wider Gippsland area and the additional transects during the Energy Innovation Fund (EIF) surveys.

Field-based studies and a review of existing information have been undertaken within this broader area to give wider context for the site-specific data, provide a buffer zone to account for impact footprints that extend beyond the direct project footprint (e.g. noise), and to understand some species breeding areas, foraging ranges and migration patterns. The spatial scales at which different taxa are examined is fully described in the MESP Marine Mammal and Turtle Survey report (Appendix A). The survey areas for each of the studies in the MESP varied according to their objectives and practical limitations. Section 6 of this report describes the results of the MESP. Where the survey areas do not overlap with the entire broader study area, the information and data obtained from the literature review have been used to characterise the Existing Environment in those areas. The regional offshore marine mammal and turtle offshore area represents the maximum extent within which cumulative impacts could be expected from the project in combination with other projects. The boundary for the Cumulative Impact Assessment (CIA) is described relevant to the receptor and impact area in Section 14.

5.2.1 Baseline survey area

Baseline marine mammal and turtle surveys were conducted from 2021 to 2023. At the time the surveys were designed, the proposed offshore wind farm area was slightly different to the current area. The originally proposed project area aligned with the Star of the South Exploration Licence, granted in March 2019 for a 496 square kilometre area. The baseline survey area (Figure 5-2) was designed to encompass the waters of this proposed PFLA plus a ten-kilometre buffer and the OECA to the limit of lowest astronomical tide.

Since then, a 58 square kilometre section in the northwest corner of this original project area was removed (because of the Commonwealth declaration of the Gippsland Declared Area in December 2022), and a 148 square kilometre area added to the offshore edge (because of the SOTS Feasibility Licence granted in April 2024). The baseline survey area covers the entire extent of the current SOTS OWFA and is therefore appropriate to inform the impacts and risks outlined in this report (Figure 5-2).

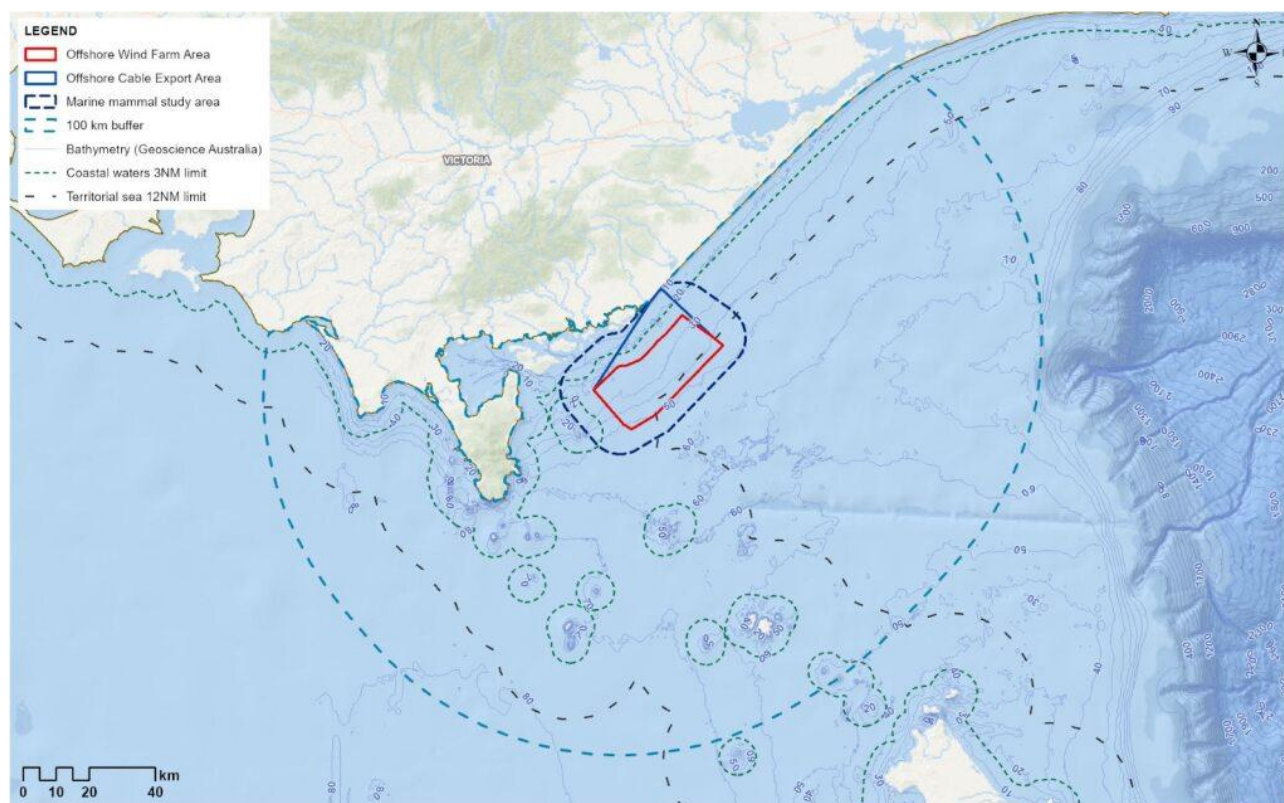


Figure 5-2: Marine mammal study area

5.3 Methods to characterise the existing environment

A comprehensive literature review and an extensive field program were undertaken to identify relevant receptors / groups to inform the environmental impact assessment of the project on marine mammals and turtles including:

- Desktop assessment of biodiversity databases containing relevant marine mammals and turtles' records (outlined in Section 5.3.1)
- Review of relevant published scientific literature and unpublished reports
- Consultation with the Technical Reference Group and other relevant experts and specialists.
- Field surveys and assessments to collect data on the presence and potential usage of the OWFA by cetaceans (Appendix A).

5.3.1 Literature review

A detailed background search is essential to inform a baseline understanding of the species likely to be encountered, evaluate the necessity of surveys and inform survey design (DCCEE 2024a). An initial literature review was completed to inform the design and direction of the MESP program. This literature review, and the resulting MESP baseline report, were updated several times during the development of this technical report i.e. during the two two-year baseline programs both documents were updated with new literature and database searches until their completion in early 2024. After this date (April 2024), both documents ceased being updated and are used to represent a snapshot in time. Therefore, databases and government documents (including species-specific management plans) will be referenced as current to the time of writing, however, new versions may have been released since completion. An updated literature

review was conducted and is presented in this technical report. It considers scientific literature, databases and government documents current to the time of writing.

To obtain information on marine mammals and turtles relevant to the study area, previous species records from within ten kilometres of the OWFA were downloaded from relevant biodiversity databases, including those which are maintained by the Department of Energy, Environment, and Climate Action (DEECA) and the DCCEEW. An additional buffer of 100 kilometres was added to capture the wide-ranging marine mammal and turtle species that might be present in the waters of the wider regional Gippsland area and the additional transects.

The literature review identified relevant BIAs for key life stages (such as migration, calving, breeding, feeding, aggregation), key habitats and associations and known / potential migratory routes. Whilst BIAs do not represent a species' full distribution range, they indicate a high likelihood that a species regularly occurs in an area and displays a particular biologically significant behaviour.

The literature review included a description of the data sets / sources, the spatial (geographical) and temporal (seasonal) extents, and the currency (validity / age) of the data. Any areas of uncertainty in the existing data, such as the robustness of methods used in data collection were identified, as well as key data gaps. These gaps formed the basis of marine fauna studies undertaken during the baseline surveys.

The information sources below were used to collate species information / spatial data for marine mammals and turtles within the study area and wider regional area:

- Peer reviewed scientific papers and studies
- Databases, including but not limited to:
 - EPBC Act Protected Matters Search Tool (PMST) (DCCEEW)
 - Species Profile and Threats Database (SPRAT) (DCCEEW)
 - Victorian Biodiversity Atlas (VBA) (DEECA)
 - Atlas of Living Australia (ALA) (CSIRO)
 - Victorian Government 'State Wide Integrated Flora and Fauna Team' (SWIFFT) for the Southern right whale, blue whale, humpback whale and leatherback turtle
 - South Australian Sea Turtle Project (Deakin University)
 - Australian Marine Spatial Information System (AMSIS) (DCCEEW)
 - Australian Ocean Data Network (IMOS)
- Publications from relevant international, Commonwealth and state organisations, limited to the:
 - Commonwealth Threatened Species Scientific Committee (TSSC)
 - Commonwealth Scientific and Industrial Research Organisation (CSIRO)
 - Australian Institute of Marine Science (AIMS)
 - International Whaling Commission (IWC)
 - Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
 - The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)
- Review of relevant international (International Union for the Conservation of Nature (IUCN)), Commonwealth and Victorian management plans and policies
- Overview of values, uses and activities in Gippsland's marine environment. Offshore Wind Energy Victoria (The State of Victoria Department of Energy, Environment and Climate Action 2024)
- South-east Commonwealth Marine Reserves Network Management Plan 2013-2023
- South-east marine regional profile (DoE, 2015)
- National Environmental Science Program (NESP) study outputs
- State of the Environment Report (DCCEEW)
- Citizen science.

5.3.2 Field assessment

The field survey program provided baseline data to inform an understanding of the occurrence and behaviour of marine fauna within the OWFA, the relative ecological significance of the OWFA to marine fauna compared to areas outside the OWFA, and for fur seals, the population status for those species that may be using the OWFA. The surveys also support the EIA for the project and provided data to inform future monitoring requirements as the project progresses into construction and operations.

The objective of the surveys was to assess the existing environment of the OWFA relevant to marine fauna that were identified during the literature review as having the potential to be present in the OWFA and surrounds, and to inform a subsequent EIA based on key project impact pathways. The survey program was developed to obtain information on the following key aspects:

- Seasonal presence, distribution, abundance / density and behaviours (where possible) of marine mammal and turtle species within the study area and nearby reference sites using visual aerial surveys, passive acoustic monitoring for vocalising marine mammals and opportunistic observations from baseline surveys for other taxonomic groups as well as citizen science networks in the region
- Population counts, body condition assessments and foraging ranges of locally breeding Australian fur seal and New Zealand fur seal breeding colonies
- Background underwater noise characterisation for the OWFA and offshore region.

To obtain information on marine mammal and turtle species presence to establish the baseline environment and inform the impact assessment, a series of studies were undertaken during the MESP. These included: (1) visual aerial surveys over the OWFA and wider Gippsland region, (2) passive acoustic monitoring at fixed sites within the OWFA and further offshore, (3) satellite tracking studies of Australian and New Zealand fur seals, (4) population counts and body condition assessment of Australian and New Zealand fur seals, and (5) collation of other sightings data collected during other MESP studies and seabird digital aerial surveys (DAS). The field assessment program provides some of the first dedicated marine mammal and turtle research in the Gippsland region. The survey program was undertaken between December 2019 and August 2023. Different studies ran for different durations during this period but were for a minimum of two years duration generally.

After the marine baseline program had been completed, the National Guidelines for the Survey of Cetaceans, Marine Turtles and the Dugong (DCCEEW, 2024a) (hereafter referred to as the 'National Guidelines') were published. The survey design and methods were reviewed against the guideline recommendations, which confirmed that they were consistent and that the methods were appropriate for the region and target species.

Details on the methodology and findings for the survey program is included in a separate report (Appendix A). The scope of each of the MESP studies is summarised below.

Visual aerial surveys

Visual aerial surveys were conducted once monthly between December 2019 to and July 2020, increasing to two surveys per month between September 2020 and December 2021. During this period, 42 surveys were undertaken comprising 17 surveys in year one (December 2019 to December 2020) and 25 surveys in year two (January 2021 to December 2021). A further 12 visual surveys were completed across a six-month period from March 2023 to August 2023 as part of the EIF funded survey program. Survey effort per month of the year ranged from three to seven surveys, with the greatest survey effort in June (n = seven) (Appendix A).

The spatial extent covered during visual aerial surveys varied across years, and transect design was optimised over the study period. As the study was the first of its kind in the region the first six months of the program consisted of a pilot survey to determine whether the sampling methods selected were robust for the detection and observation of animals. The total area covered by visual aerial surveys during the MESP ranged from 2,222 square kilometres to 4,036 square kilometres (Appendix A). During the MESP, survey transects covered the spatial extent of the OWFA and further offshore, and from July 2020 to December 2021 also covered an area offshore of Loch Sport, east of the OWFA. Survey transects during the EIF survey program included four transects on the western side of Wilsons Promontory.

For the MESP program, transects were spaced at five kilometres to appropriately target key species ranging from smaller to larger whales. Other species including fur seals and marine turtles were also able to be identified with this design. For the EIF program, transects were spaced at ten kilometres apart, appropriate

for the target species (blue whales and southern right whales) and to allow for a larger area to be surveyed in one flight.

Passive acoustic monitoring

Acoustic data was collected continuously (duty cycle of 6 minutes of every 15 minutes) between March 2020 and March 2022. Data was collected from fixed moorings at five sites: (1) the southwest corner of the OWFA in 25 metres water depth, (2) southeast region of the OWFA in 40 metres water depth, (3) northeast corner of the OWFA in 35 metres water depth, (4) offshore of the OWFA in 55 metres water depth, and (5) offshore of the OWFA in 60 metres water depth (Appendix A).

Consideration was given to the location of sites with respect to differences in detection ranges. For key species, such as blue whales and humpback whales, the detection range or 'listening range' in shallow water was around 1.5 kilometres for blue whale song and 45-50 kilometres for humpback whale song, and in deep water the listening range was around 12 kilometres for blue whale song and around 45 kilometres for humpback whale song (Appendix A). Acoustic recordings from the southwest corner, southeast, northeast and offshore (either in 55 or 60 metres water depth) were fully analysed for baleen whale presence using automated detectors and manual verification.

Satellite tracking of fur seals

Satellite tags were deployed on adult female Australian fur seals (AUFS) and New Zealand fur seals (NZFS) at two breeding colonies in proximity to the OWFA: (1) Rag Island, and (2) Kanowna Island to investigate at-sea movements and habitat use in proximity to the OWFA. At Kanowna Island, 10 tags were deployed on AUFS and 10 tags on NZFS in 2020. At Rag Island, 10 tags were deployed on AUFS in 2020, and another 10 tags were deployed in 2021 (Appendix A). Historical tracking data exists for AUFS and NZFS at Kanowna Island, and therefore only one breeding season of data was required to inform baseline studies.

Satellite tagging is a widely used method for studying seal populations in Australia, the United Kingdom (UK) and Europe and can help identify important habitats (e.g. for foraging), movement between different haul outs (to define population boundaries) and connectivity between specific areas (e.g. offshore wind farm locations) and sites designated to protect seals. Adult females were tagged as they are the most important demographic of a fur seal population due to their polygynous mating system and maternal milk being the sole source of nutrition for pre-weaning pups. Previous research has shown adult male and female AUFS use the same foraging areas for most of the year such that a similar use of the OWFA can be assumed. Females are more amenable for conducting tracking studies and, therefore, were the focus of the baseline studies. NZFS males have been shown to forage mostly on (and beyond) the continental shelf slope and are unlikely to frequent the OWFA, therefore, females were also the focus in NZFS (refer Appendix A for detailed rationale for survey design and survey methods for fur seal studies).

The periods of most interest are winter (when pup demand is greatest and maternal nutritional stress is highest) and the post-weaning period in spring when females depart on long trips to fatten up in preparation for the birth of their next pup.

This information was primarily used to determine whether seals use the OWFA and from which colonies they might be from, therefore any changes observed in habitat use could be linked back to the sources of animals if the impact assessment predicts any significant impacts.

Tracking data was obtained during foraging trips, defined as the period at sea between the departure from, and arrival back to the breeding colony. For AUFS on Kanowna Island, data was obtained during winter (mid / late lactation) and spring (post-weaning), and for AUFS on Rag Island and NZFS on Kanowna Island, data was obtained during winter (mid / late lactation), spring (post-weaning) and summer (early lactation) (Appendix A).

To collate data for modelling at sea-distribution, a grid of cells was defined, covering the area of Bass Strait and surrounds. The spatial resolution of grid cells was increased from a five-kilometre x five-kilometre cell size in the year one analysis (2020 to 2021) to a ten-kilometre x ten-kilometre cell size in year two (2021-2022) to increase the predictive power of the model outputs. The at-sea distribution probability models provided a prediction of the relative usage in each of the grid cells.

Population counts and body condition assessment of fur seals

Capture-mark-recapture methods were used to estimate the population size of NZFS at Kanowna Island. Due to the high potential for disturbance impacts to AUFS, direct counts were conducted at Kanowna Island, and Remote Piloted Aircraft (RPA) surveys were conducted at Rag Island. Estimates of population size were obtained by applying multiplication factors to annual pup production counts at natal colonies.

To assess the body condition of AUFS, images were obtained from RPA surveys at Kanowna and Rag Islands during winter and summer. Due to the small size of the NZFS population and terrain occupied by colonies at Kanowna Island, it was not possible to obtain meaningful body condition estimates for this species.

Population count surveys were timed to occur at the end of the pupping period (December to early February) (Appendix A).

Other sightings data

A number of other marine mammal and turtle sightings in the wider Gippsland region were collated to provide additional context to the observed distribution of marine mammals and turtles. These included incidental observations from other MESP surveys (fish, seabird and benthic boat-based surveys, acoustic logger deployment/retrieval trips, seabird island land surveys and shorebird land surveys), seabird DAS, 'Wildlife Coast Cruises' sight-seeing boat tours and SWIFFT southern right whale sightings (Appendix A).

Fish surveys were completed during June and November 2020, acoustic logger deployment/retrieval trips occurred in September 2020, March and October 2021 and March 2022. Benthic surveys occurred in November/December 2020 and January/February 2022, and seabird surveys occurred between December 2019 and December 2020. Seabird DAS occurred once monthly capturing images within the OWFA plus a four-kilometre buffer area (Appendix A). During other MESP surveys and DAS surveys, marine mammal sightings were opportunistically surveyed.

The Wildlife Coast Cruises tours were conducted between late-August and the end of October between 2017 to 2023 targeting the coastal waters around Wilsons Promontory and to the east, with observers actively searching for marine mammals throughout the tours. Citizen science observations submitted to the SWIFFT database were analysed to determine the temporal and spatial presence of southern right whales in Victorian waters.

5.3.3 Method for determining inclusion of species in EIA

There are 45 species of cetaceans (whales and dolphins), ten pinnipeds and six marine turtles listed as regularly occurring within Australian waters (DCCEEW, 2021a). At the completion of the description of the existing environment, a process of scoping marine mammal and turtle species into or out of the EIA based on the likelihood of their being present in the OWFA and surrounds was completed. This was for the purpose of focussing effort during the impact assessment on those species that have a higher likelihood of occurrence in the OWFA and surrounds and may be affected by the construction, operation and decommissioning of the wind farm, and to reduce focus on those species that are unlikely to utilise the OWFA (risk-based approach).

The process was informed by the literature review and field assessment and included each species being classified by:

- Presence / absence in the PMST database search over the OWFA and ten-kilometre buffer, and a 100-kilometre buffer to incorporate wider ranging species
- Observations recorded in Victorian waters, with a focus on Gippsland region, using the VBA and ALA databases
- Presence during the MESP baseline survey which extended over the Gippsland Region
- Listed EPBC and / or FFG status
- Biologically important areas within / near the OWFA
- Information contained in recovery plans and conservation advice.

The classifications system used to determine whether individual species were included in the EIA was a two-step process. Where species known from Australian waters were not identified as being potentially present either by the outcomes of the PMST search or VBA / ALA databases they were immediately excluded from further investigation. Where species were detected by either the PMST or the VBA / ALA they were considered in the description of the environment and based on literature review (including listing / BIA / recovery plan status and general information about species distributions) and baseline survey results, a determination was made about the likelihood of species presence in the OWF area. Based on this determination each species was categorised into three different levels and either scoped into or out of the EIA, including:

- **Yes, scoped in as an individual species:** Species that have BIAs near or within the OWFA or species that are easily identifiable and were present in high abundance during MESP baseline surveys.
- **Yes, scoped in as part of a taxonomic group:** Species that had one or more of the following characteristics:
 - Detected in baseline surveys
 - Identified in PMST database search and historically sighted in the region or subject to conservation advice
 - Numerous historical sightings in Gippsland region (VAB / ALA)
- **No, scoped out:**
 - Species that are not present in PMST database search, and have no historical sightings in Gippsland region (VBA / ALA), and were not present during MESP baseline survey, **or**
 - Species that are present in the PMST database search but no other presence and not subject to recovery plan or conservation advice, **or**
 - Species that were not identified in PMST search, were present but not common in VBA / ALA databases and their ranges / habitat not found in the Gippsland region (e.g. detected as washed up on the beach or vagrant individuals).
- Where species were scoped in as part of a taxonomic group, the impacts and risks outlined in the EIA will have similar effects on all species within the group according to functional characteristics (e.g. hearing frequency) and therefore they can be considered together. Justification for scoping is outlined in the descriptions of the existing environment in Section 6 with scoping output detailed in Section 6.3.

5.4 Impact assessment method

An impact is where a project activity or activities in any of the project phases (construction, operation or decommissioning) results in a change in the existing environment. Impacts can be positive or negative, direct or indirect and are described within this report following the application of mitigation measures (residual impact). The consequence for environmental receptors depends on the sensitivity of those receptors and the magnitude of the impact.

- **Sensitivity:** The intolerance of a species or habitat to damage from an external factor and the time taken for its subsequent recovery
- **Magnitude:** The severity, extent and duration of an impact.

In addition to sensitivity and magnitude, the assessment criteria (Section 0) also considered in respect to defining consequence:

The impact assessments have considered the potential for combined impacts generated by the project on the one receptor but resulting from different actions. For example, marine mammals and turtles are potentially affected by the noise generated by pile driving as well as noise generated by vessels (referred to as inter-related impacts in the technical reports). The combined impact of these changes is assessed within relevant sections and Section 14.

Additional to inter-related impacts, impacts to the same receptors that may arise from other projects at the same time as those from Star of the South (i.e. 'cumulatively') have been assessed in Section 14. The approach to cumulative impact assessment is outlined in Section 5.7 below.

For the purposes of the impact assessment a project design envelope (PDE) approach was adopted. The PDE comprises ranges for certain design parameters (for example, an upper and lower limit for wind turbine generator heights). This allows for flexibility in the eventual design solution for the project that is necessary within an evolving industry where technology is rapidly changing, while providing confidence that the final design will not exceed the maximum design scenario (MDS). The MDS(s) consist of a defined set of project parameters from within the PDE that could result in the greatest potential impact to an identified sensitive receptor or receptor group. As the MDS is defined based on specific impacts, the MDS(s) assessed will vary between impacts identified for the specialist topics and between assessment topics. See Section 7 for the MDS(s) considered for this assessment.

5.4.1 Assigning a sensitivity level

To assign a sensitivity level, the existing environment is described and ‘receptors’ are identified. For example, a receptor (or group of similar receptors) in the marine environment could include ‘odontocetes’ and more fine-scale groupings within this group could include dolphins and porpoises that will have similar levels of sensitivity but that differ from toothed and beaked whales due to their different hearing frequencies and the frequency ranges emitted from WTG piling installation activities. In addition, sensitivity may be further defined according to listing categories for species under the EPBC Act, whether they have a recovery plan or conservation advice in force, and considering the existing threats and pressures these identify.

A sensitivity level was assigned to the relevant marine mammal and turtle receptors or receptor groups. The sensitivity of each of the receptors has been determined to be either low, medium or high using expert, informed judgements based on specific criteria developed by the specialists undertaking the assessment. The receptor sensitivity descriptions are presented in Table 5-1. Assigning receptor sensitivity includes consideration of the following factors:

- Adaptability
- Tolerance to disturbance of reproduction and survival rates
- Recoverability from impact on reproduction and survival rates
- Protection status.

Table 5-1: Receptor sensitivity marine mammals and turtles

Sensitivity (to impact)	Description
Low	Behaviour unlikely to be significantly affected, therefore migration, foraging, reproduction and/or survival rates are not likely to be affected Tolerant – broadly distributed, seasonally present only, abundant, not sensitive to the defined stressor Protection status – low levels of conservation protection (marine listed)
Medium	Ability to adapt behaviour therefore migration and foraging may be affected but reproduction and survival rates are unlikely to be affected. Some tolerance – important habitat overlapping the area of disturbance, some sensitivity to the defined stressor Protection status – listed species (migratory, threatened)
High	Limited ability to adapt behaviour therefore survival and reproduction rates may be affected. Limited tolerance – listed as Endangered or Critically Endangered, or restricted distributions, or long-lived and low reproductive rates, small population sizes, known sensitivity to defined stressor Protection status – Endangered, Critically Endangered

5.4.2 Initial mitigations

Prior to conducting the initial impact assessment, a full suite of standard industry mitigation and management measures were applied (referred to as ‘initial mitigation measures’). These measures fell into two main categories, engineering and best practice mitigation and management and are listed below with pertinent illustrative examples.

Table 7-3 (see Section 7.4) provides the full suite of initial mitigation measures adopted as part of the impact assessment.

5.4.2.1 Installation Methodology

Shore crossing locations and method: the shore crossing location at Reeves Beach will use Horizontal Directional Drilling (HDD) the most appropriate shore crossing method to reduce disturbance impacts to the shoreline and nearshore habitats that may be used by species in coastal waters, such as southern right whale cow calf pairs.

5.4.2.2 Foundation design

An assessment of feasible foundation options for the project was undertaken to identify available foundation types and installation methods, with full details captured in the Foundations Options Assessment, Appendix A of EIS Chapter 3 - Project development. Options carried through to the EIA were impact piling and vibro-piling of monopile and jacket foundations.

5.4.2.3 Best practice mitigation and management

A range of industry mitigation and management measures captured in government policy and guidance documents were applied before the impact assessment. This included examples such as:

- Application of the National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (Commonwealth of Australia, 2017c)
- Compliance with EPBC Regulations 200, Part 8, the Wildlife (Marine Mammals) Regulations 2019, and the Australian National Guidelines for Whale and Dolphin Watching (Commonwealth of Australia, 2017b) – for the avoidance and minimisation of risk of vessel strike
- Use of prescribed shipping routes and channels to reduce potential vessel related fauna risks.
- Compliance with MARPOL
- Compliance with IMO Revised Guidelines for the Reduction of Underwater Radiated Noise from Shipping to Address Adverse Impacts on Marine Life MEPC.1/Circ.906
- In accordance with Guidance - Key Environmental Factors for Offshore Windfarm Environmental Impact Assessment Under the EPBC Act 1999 (DCCEEW, 2023)
- In accordance with EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales: Industry guidelines (DCCEEW, 2008).

5.4.3 Assigning a magnitude level

The magnitude of the impact on the environment includes consideration of the following factors:

- Extent – site, local, regional or widespread
- Duration – short, medium or long term (also considering frequency and permanence)
- Severity – degree of change from existing condition.

The magnitude of a specific impact (consequence) on marine mammals and turtles is classified based on clear criteria related to the extent, duration and severity of the environmental impact determined by the specialist undertaking the assessment (Table 5-2). A magnitude description is then assigned for the maximum credible consequence by considering how the extent, duration and severity of the impact may result in consequences for receptors (marine mammals and turtles) with consideration of the full suite of initial mitigation and management measures that were applied to the project activities (Table 5-3).

Table 5-2: Magnitude criteria (habitats relevant to marine mammals and turtles)

Terms		Description
Extent	Localised	Within a 2 to 3 kilometres
	Medium scale	Within the Offshore project area (OWFA)
	Large scale	Eastern Bass Strait (Wilsons Promontory to New South Wales (NSW) border)
	Regional	South East Marine Bioregion
Duration	Short-term	Days to weeks
	Medium-term	Less than five years
	Long-term	Greater than five years
Severity	Unlikely to be detectable	Changes are within natural variability
	Reversible and/or manageable	Changes are reversible once the activity has ceased, or with applicable limits / standards
	Substantial	Irreversible change, substantial change to the value

Table 5-3: Magnitude description (marine mammals and turtles)

Magnitude	Description
Negligible	The impact is localised and short-term, and changes to the receptor are unlikely to be detectable above natural conditions.
Low	The impact is within the Offshore Project Area (medium scale) and is medium-term, and results in reversible changes to the receptor once the activity has ceased.
Medium	The impact extends to the Offshore Project Area (large scale) and is medium-term, and results in reversible changes to the receptor once the activity has ceased.
High	The impact extends to the Offshore Project Area (large scale) and long-term, and results in reversible changes to the receptor once the activity has ceased.
Very high	The impact is regional and long-term, and results in substantial and possibly irreversible change (permanent) to the receptor.

5.4.4 Assigning a consequence level

Consequence is the potential outcome of an event affecting a receptor. It is determined by combining magnitude of the impact and sensitivity of the receptor. The consequence level is assigned based on the receptor sensitivity level and magnitude level using the matrix in Table 5-4.

Consequences are assigned based on the maximum credible impact for each pathway. Where uncertainty exists, additional mitigations, monitoring and / or adaptive management will be adopted to ensure the level of impact meets the defined assessment criteria. The approach to adaptive management has been described in Section 5.6.4. The consequence level descriptions in Table 5-4 and Table 5-5 are based on the assessment criteria (Table 3-5) and were used to determine if the predicted impacts are within allowable limits, or if additional mitigations are needed.

Table 5-4: Consequence level matrix

Magnitude	Sensitivity Low	Medium	High
Negligible	Negligible (E)	Negligible (E)	Minor (D)
Low	Negligible (E)	Minor (D)	Moderate (C)
Medium	Minor (D)	Moderate (C)	Major (B)
High	Moderate (C)	Major (B)	Severe (A)
Very high	Major (B)	Severe (A)	Severe (A)

Table 5-5: Consequence level description (marine mammals and turtles)

Consequence level	Description
Severe (A)	Permanent impact on the viability of population(s) of high or medium sensitivity species.
Major (B)	Long-term disruption of the behaviour and function of a proportion of the population of high or medium sensitivity species, with potential reduction in breeding success in individuals, but no impact on population viability. Permanent impacts on individuals within a population of high or medium sensitivity species that may influence individual survival, but with no impact on population viability. Permanent impact on the viability of population(s) of low sensitivity species.
Moderate (C)	Medium-term disruption of the behaviour and function of a proportion of the population of high or medium sensitivity species, with no impact on population viability. Unlikely to impact breeding success or survival of individuals. Long-term disruption of the behaviour and function of a proportion of the population of low sensitivity species, with no impact on population viability. Permanent impacts on individuals within a population of low sensitivity species, that may influence individual survival, but with no impact on population viability.
Minor (D)	Short-term and / or intermittent and temporary disruption of the behaviour and function of a proportion of high or medium sensitivity species, with no impact on population viability. Highly unlikely to impact on breeding success or survival of individuals. Medium-term disruption of the behaviour and function of a significant number of individuals in a population of low sensitivity species, with no impact on population viability. Unlikely to impact breeding success or survival of individuals.

Negligible (E)	No disruption of the behaviour and function of individuals of a high or medium sensitivity species, with no impact on population viability. No impact on breeding success or survival of individuals. Short-term and / or intermittent and temporary disruption of the behaviour and function of a proportion of low sensitivity species, with no impact on population viability. No impact on breeding success or survival of individuals.

Note: population viability refers to 1) permanent loss of critical or high-usage feeding/breeding habitats, 2) permanent displacement from confined migratory corridors, and 3) reduction in population abundance below baseline level.

5.4.5 Residual impacts

While there are clear steps in the assessment process, it may not always follow a linear progression. Typically, assessment requires multiple iterations of impact evaluation considering the assessment criteria and application of mitigation measures as the technical studies progress and additional information becomes available to ensure that the predicted residual impacts are within allowable limits. For consequence ratings arising from the initial impact assessment of Negligible (E) or Minor (D), no further action was deemed necessary. Ratings of Moderate (C) and higher, prompted the application of additional mitigation and management measures to further reduce the residual impact. In cases where additional impact reduction was required, a residual impact assessment process was followed until the consequence rating was Minor (D) or Negligible (E).

The completed impact and risk assessments (Sections 8 to 14 and Appendix B and Appendix C) for the full impact and risk assessment results include both the initial and final mitigation measures that will be implemented, and therefore describe the predicted residual impacts together with any areas of uncertainty in the impact assessments. The residual impacts constitute the predicted consequences following the implementation of the mitigation measures and also taking into account the expected effectiveness of these measures.

5.5 Risk assessment method

A risk is where a project activity or activities could result in an unexpected (accidental) event in any of the project phases (construction, operation or decommissioning) that causes a change to the existing environment.

The level of risk is determined by combining the likelihood of an accident occurring and the consequences should the accident occur. The assignment of consequence level follows the process outlined above.

The following steps were undertaken to identify, analyse and evaluate risks:

- Develop a risk matrix based on the likelihood of an accident occurring and the consequences, should the accident occur.
- Identify controls and requirements to mitigate identified risks.
- Assign likelihood and consequence ratings for each risk to determine risk ratings considering design, proposed activities and mitigation.

5.5.1 Assigning a likelihood level

Likelihood is the probability of an unexpected (accidental) event occurring. The likelihood criteria range from 'rare' where the event may occur only in exceptional circumstances to 'almost certain' where the event is expected to occur in most circumstances.

Likelihoods are assigned with consideration of mitigation and management measures according to the levels presented in Table 5-6.

Table 5-6: Guide to likelihood levels

Level	Description
Rare	The event may occur only in exceptional circumstances
Unlikely	The event could occur but is not expected
Possible	The event could occur
Likely	The event will probably occur in most circumstances
Almost certain	The event is expected to occur in most circumstances

5.5.2 Risk matrix

Risk is defined as combination of the likelihood of an event occurring (using Table 5-6) and the consequence of that event occurring (using Table 5-4).

A risk rating is then determined by these factors using the risk matrix, presented in Table 5-7.

The level of detail of the assessment undertaken for each risk pathway is proportionate to the identified level of risk (i.e. risk ranking).

Table 5-7: Risk matrix

Likelihood rating	Consequence				
	Negligible (E)	Minor (D)	Moderate (C)	Major (B)	Severe (A)
Rare	Very low	Very low	Low	Medium	Medium
Unlikely	Very low	Low	Low	Medium	High
Possible	Low	Low	Medium	High	High
Likely	Low	Medium	Medium	High	Very high
Almost certain	Low	Medium	High	Very high	Very high

5.5.3 Residual risk

The residual risk assessment assigns a risk level based on implementation of both initial and final mitigation measures. An evaluation against the assessment criteria is undertaken on the residual risk rating, describing any areas of uncertainty in the assessment (as discussed above in Section 5.5.2) and the expected effectiveness of mitigation measures. Where uncertainty remains high, additional mitigation measures and adaptive management may be adopted.

5.6 Avoidance, mitigation and management

It is recognised that there are opportunities to avoid and minimise / mitigate environmental impacts and risks during the many stages of project development. During project inception and early design development stages of the project, decisions on the location of the project, its design and construction techniques have enabled impacts and risks to be significantly avoided and mitigated in accordance with the hierarchy presented in Figure 5-3.

Avoidance and minimisation of social and environmental impacts are central to the decision-making for the project and as such, the project would continue to be refined in response to technical requirements and potential environmental and social impacts identified during the development phase. This has culminated in the preparation of a project description, which is found in Section 2 Project description. A description of how avoidance of impact has informed the design in relation to marine mammals and turtles can be found in Section 5.6.1.

Once avoidance and minimisation measures have been exhausted, the next step is management of the residual impacts and risks. In the case of risks, the mitigation measures can be applied prior to the event occurring and / or after the event. The residual impacts and risks are evaluated against the assessment criteria to ensure impacts and risk are not significant. In the event that impacts cannot be mitigated or managed to below significant levels, offsets will be developed for the project.

All mitigation measures will be included in the project Environmental Management Framework, or sub-plans, as per OEI Act management plan requirements.

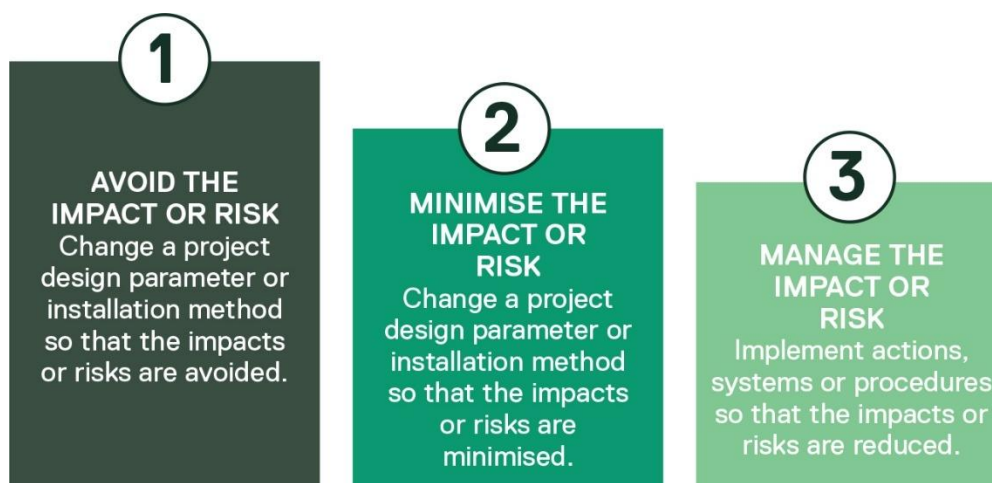


Figure 5-3: Mitigation hierarchy

The assessment results (in Sections 8 to 13) describe the impacts and risks with all the mitigation measures implemented, i.e. with both initial and final mitigations. Initial mitigation measures are defined as the standard suite of mitigation measures that will be implemented by the project such as measures required under legislation, national or international standards and standard measures implemented on similar projects. Final mitigation measures are any additional mitigation measures adopted to address the findings of impact / risk assessments to further reduce impacts and risks. The completed registers of the impact and risk assessments for this technical report are presented in Appendix B and Appendix C and show the reduction in consequence that occurs between the initial rating and final rating due to the application of final mitigation measures.

5.6.1 Avoid

Impacts were avoided through consideration of a range of factors in project siting, including shipping lanes, Marine Protected Areas and Ramsar wetlands for the final Gippsland offshore wind farm area declared by the Minister.

The following measures have been adopted in relation to the design, construction and operation of the project to avoid impacts to marine fauna:

- The decision to design the shore crossings without directly impacting coastal surface areas (through the use of trenchless shore crossing).
- Reduction of the maximum number of WTGs from 400 (as described in the Commonwealth EPBC Act referral and Victorian EE Act referral in April 2020) to 147, resulting from a removal of the smallest turbines from the original PDE, resulting in lower density and more space between WTGs.
- Reduction in the number of export cables from 13 to 8.

These project design decisions are documented in EIS Chapter 3 - Project development and EES Chapter 3 - Victorian works project development.

5.6.2 Minimise

Adopt measures that reduce the extent, severity and/or persistence of impacts that cannot be completely avoided in the step above.

The following measures have also been adopted in relation to the design, construction and operation of the project to minimise impacts to marine mammals and turtles:

- Reduction of the maximum number of WTGs from 400 (as described in the Commonwealth EPBC Act referral and Victorian EE Act referral in April 2020) to 147, resulting from a removal of the smallest turbines from the original PDE, resulting in lower density and more space between WTGs.

- Reduction in the number of export cables from 13 to 8.

These design decisions are documented in EIS Chapter 3 - Project development and EES Chapter 3 - Victorian works project development.

In relation to installation techniques, the Foundations Options Assessment (Appendix A of EIS Chapter 3 Project Development) and Attachment I - Underwater Noise Modelling determined that the feasible installation options were monopiles installed using impact or vibro-piling methods. Underwater noise modelling determined that concurrent piling increased the ranges to important noise thresholds for low-frequency cetaceans and so was ruled out of the project design. Similarly, sensitivity testing of the influence of pile diameter on noise ranges resulted in the largest diameter tested being ruled out (i.e. maximum diameter was reduced from 13.5 to 11.8 m.) In addition, pile diameter is now an optimised option that will be varied in accordance with the depth of piles.

While the installation of pin piles for jacket foundations resulted in smaller behavioural disturbance noise ranges due to their inherently smaller diameters, when modelling included the installation of four consecutive installations, as would be needed for jacket installation, the ranges at which thresholds that could cause hearing impairment were reached were similar to ranges for the installation of the larger monopiles. However, the duration of the installation time for four pin piles was at least six times longer (~15 hours) than the minimum duration for the installation of a single monopile (2.5 hours), during which time behavioural disturbance would be occurring. For this reason, and also because monopiles are commonly installed in the same depths of water globally, SOTS has more confidence in the feasibility of the installation techniques (including mitigations) to ensure that environmental outcomes will be met. Jackets or monopiles may be used for the offshore substations.

While the EP Act is not assumed to apply to the project within the CMA, mitigations measures for the entire project will be assessed in terms of practicality and effectiveness consistent with the Victorian General Environmental Duty as set out in the EP Act. The following factors will be considered when assessing practicability of mitigation measures: elimination, likelihood, degree/ consequence, knowledge, availability and suitability and cost, consistent with the EP Act and EPA Publication 1856. Impacts and risks will be assessed out to 12NM offshore and will provide consideration of protection of human health and the environment from pollution and waste consistent with Environmental Reference Standard (No S245 Gazette 26 May 2021).

5.6.3 Management

Once avoidance and minimisation measures have been exhausted, the next step is management of the residual impacts and risks. In the case of risks, the mitigation measures can be applied prior to the event occurring and / or after the event. The residual impacts and risks are evaluated against the assessment criteria to ensure impacts and risk are not significant.

If impacts cannot be confidently mitigated or managed to below significant levels using management and mitigations, offsets will be developed for the project. Management measures are identified in this report and in the Marine Mammals and Turtles Monitoring and Management Plan.

5.6.4 Monitoring and adaptive management

The EIS scoping guidelines for the project require adaptive management measures to be identified to address residual uncertainty and manage risk. The guidelines go on to describe examples of areas of uncertainty as follows:

“.....limitations of predictions or assumptions, knowledge gaps in scientific understanding and baselines status of the environment, and the timing, effectiveness, or capacity to implement, maintain, operate and enforce management measures.”

The assessment of impacts and risks within this technical report identifies areas of uncertainty relevant to the marine mammals and turtles and describes adaptive management.

5.7 Cumulative impact assessment

Cumulative impacts arise when the effects of a single project on a single receptor are considered alongside the effect of other projects on the same receptor. The project has considered the potential for cumulative

impacts associated with other proposed projects. It is noted that projects that are operational are considered as part of the baseline environment, and the cumulative impact assessment focuses on proposed or future actions.

A staged approach to cumulative impact assessment has been adopted. This approach is split into four stages:

- Stage 1 Identifying projects or actions with the potential for cumulative impacts
- Stage 2 Shortlisting identified projects or actions
- Stage 3 Gathering information
- Stage 4 Assessment.

This approach is focused on the assessment of potential adverse cumulative effects on receptors or similar groups of receptors, as relevant. The availability of information necessary to conduct a cumulative impact assessment depends on the status of the proposed project or action within the planning and approval regulatory steps. Therefore, a level of certainty reflecting the availability of detail and information necessary for the assessment is assigned to each proposal:

- Tier 1 High certainty – Project planning application / EIS / EES has been submitted to regulators, or the project has been approved, or the project is under construction
- Tier 2 Medium certainty – Project referrals have been submitted to the regulators
- Tier 3 Low certainty – Project is in the proposal stage and little information is publicly available.

The cumulative impact assessment has followed a staged approach (as shown in Figure 5-4) and described in detail in EIS Chapter 6 – Assessment Framework and EES Chapter 6 - Assessment Framework.

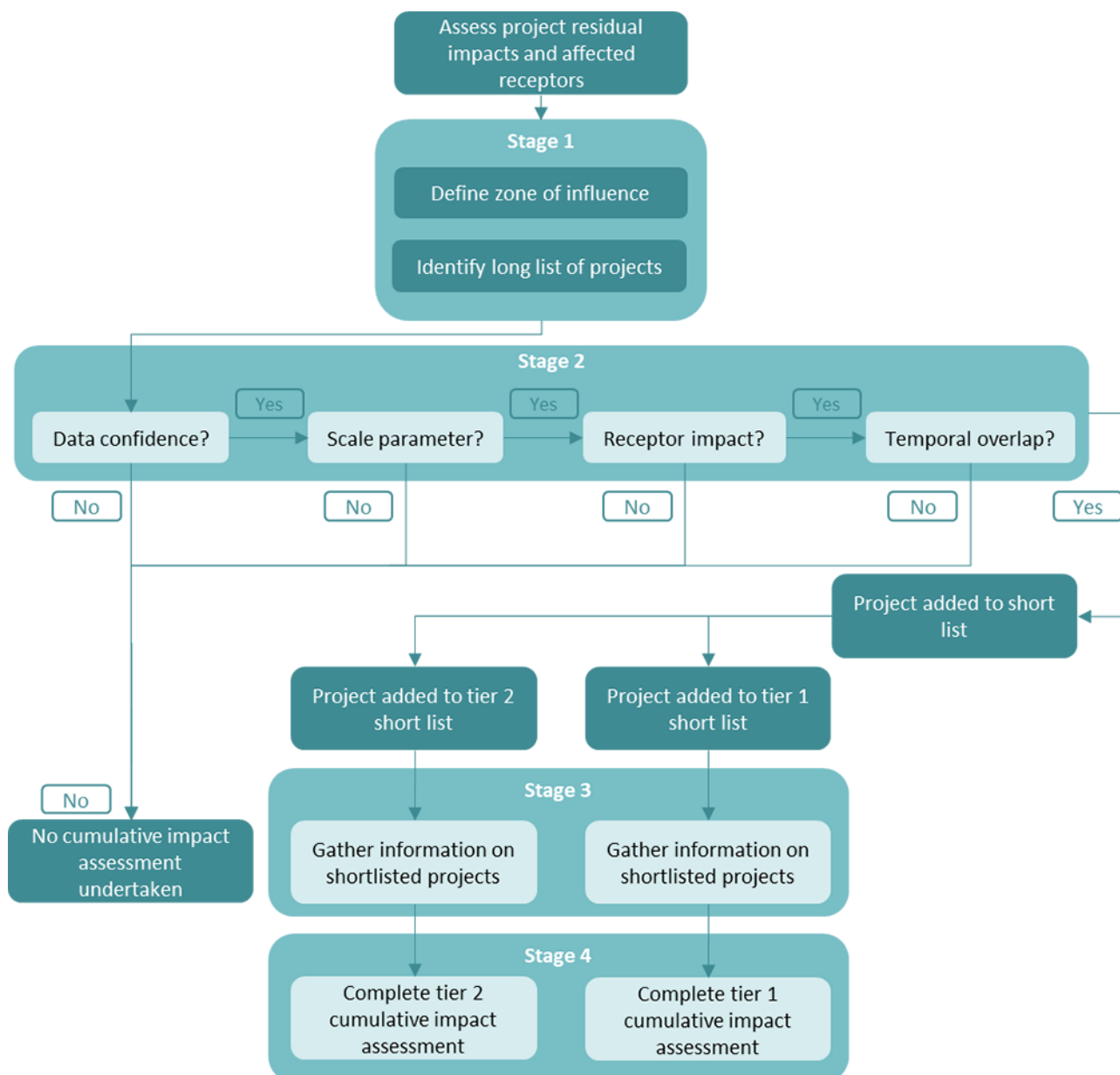


Figure 5-4: Cumulative impact assessment process

5.8 Limitations, uncertainties and assumptions

The following limitations, uncertainties and assumptions apply to this assessment:

- There is a high degree of variability in the marine environment, both spatially and temporally. However, as the existing conditions for this technical report are based on an extensive field program of 44 months of visual aerial surveys, passive acoustic monitoring, populating and tagging studies supplemented with opportunistic data collected from digital aerial surveys, boat-based observations, and citizen science, it is representative of the proposed development area for the purpose of impact assessment. Furthermore, a range of supplementary data sources have been examined such as published literature public observation databases, and government guidance material to understand likelihood of species occurrence, seasonality and potential responses to offshore wind farm construction, operation and decommissioning. Baseline survey data limitations are described the Marine Mammal and Turtle Marine Ecology Survey Report (see Appendix A) and include:
 - Aspects of the evolution of visual and acoustic survey design

- Survey restrictions due to COVID-19
- Limitations with species identification.
- For the purposes of this assessment, information and database records for relevant marine mammal and turtle species have been drawn from a variety of pre-existing third party sources and from investigations undertaken specifically for the project. Pre-existing records are included where they are documented in publications and reports that have been subject to, or available for peer review. RPS therefore relies on the accuracy of relevant third-party fauna databases such as those listed in Section 5.3.1. Some databases have time lags between submission of records and their inclusion on searchable versions. This is usually due to time required for their internal expert scrutiny and subsequent acceptance of records
- A confidence or uncertainty category is assigned to the final evaluation of residual impacts against assessment criteria for each impact and risk assessment. The categories assigned were based on a confidence score based on the underlying evidence available to undertake assessment. The categories were adapted from an approach used to categorise the sensitivity of receptors based on the robustness of the underlying evidence and was developed for assessments based on expert judgement (Tyler-Walters et al., 2023). The evidence is based on the two parameters:
 - Quality of evidence (information sources)
 - Applicability of evidence.

Table 5-8: Confidence level

Confidence Level	Quality of evidence	Applicability of evidence
High	Based on peer-reviewed papers (observational or experimental) or grey literature reports by established agencies (give number) on the feature (habitat, its component species, or species of interest).	Assessment based on the same pressures acting on the same type of feature (habitat, its component species, or species of interest) in country of assessment
Medium	Based on some peer-reviewed papers but relies heavily on grey literature or expert judgement on the feature (habitat, its component species, or species of interest) or similar features	Assessment based on similar pressures on the feature (habitat, its component species, or species of interest) in other areas.
Low	Based on expert judgement	Assessment based on proxies for pressures e.g. natural disturbance events

Monitoring may be proposed where practicable to address confidence / uncertainty in impact and risk assessments. Uncertainties relevant to this scope are provide in Table 5-9.

Table 5-9: Aspects of the impact and risk assessments that have uncertainty

Aspect of the impact assessment	Uncertainty
Activity Using the PDE approach and selection of the MDS	<i>Size of vessels – extent DP (e.g. 10% - 70% power)</i> <i>Site specific/ Geotech</i>
Pathway	<i>Requires acoustic modelling and therefore monitoring is required to validate the modelling predictions</i> <i>Novel/ untested methodology</i> <i>Knowledge gaps</i> <i>Limitations on assumptions</i>
Receptor	<i>Paucity of data, scientific</i> <i>No thresholds</i> <i>Lack of studies of relevance</i> <i>Minimal baseline data</i> <i>Behaviour of species uncertain</i> <i>Unknown sensitivity</i>
Mitigation measure	<i>Novel approach - DBBC</i>

Unproven technology
Unknown effectiveness and timing
Capacity to implement, maintain, operate and enforce management measures
Mitigating high impact (needs certainty)/ mitigation effectiveness-adaptive management if not working

The assumptions and limitations underpinning the underwater noise modelling and foundations assessment are described in Attachment I - Underwater noise modelling (RPS, 2025a) and summarised below.

- Seabed parameters: during the first and second round of underwater noise modelling detailed geotechnical information such as porosity and grain size measurement with depth below the seafloor were not available and therefore there was some uncertainty regarding the geoacoustic properties of the seabed, largely the deeper geological layers, and the impact this has on the driveability profile of the pile. Instead, the seabed geoacoustic model used in the underwater noise modelling was based on a site-specific sound propagation study carried out by McCauley (2021) during the MESP passive acoustic monitoring program. These measurements were able to provide a higher level of confidence in the reflectivity (sound propagation potential) of the upper geological layers (shallower than approximately 20 m below seabed level), however there was continued uncertainty of the reflectivity of the deeper layers to full pile penetration depth. Subsequent rounds of modelling (3 and 4) used geotechnical data collected for the project area as input data for the modelling, therefore reducing uncertainty for this aspect.
- Vessel source level: vessel source levels were estimated from measurement study of a surrogate vessel in Victorian waters considering operational activity, maximum continuous power rating, number of thrusters, and overall vessel size. These parameters were scaled up to represent a typical large offshore installation vessel.
- Vessel thruster power: modelling has considered noise profiles for 50% thruster power as this is likely to represent a worst-case operating scenario during marginal weather conditions. The measurement study referred to above suggested thruster power did not exceed 10% of installed power during offshore operations in the Gippsland region.

5.9 Linkages to other technical reports

This report has interdependencies with the following technical reports:

- Technical Report A: Coastal Processes and Sediment Transport
- Technical Report B: Benthic Ecology
- Technical Report C: Fish and Invertebrate Ecology
- Attachment I – Underwater noise modelling
- Attachment II – Oil Spill modelling summary

The specialists undertaking this assessment worked collaboratively to evaluate these potential impacts and design suitable mitigation and management measures to be adopted by the project.

6 EXISTING ENVIRONMENT

6.1 Regional overview

The OWFA is situated in marine and coastal waters off the central Gippsland coast of Victoria, between 140 to 200 kilometres east of Melbourne within the Southeast Shelf Transition bioregion of the South-east Marine Region (SEMR) (DNP, 2013). The SEMR encompasses Commonwealth waters from southern New South Wales, Victoria, Tasmania and west to Kangaroo Island, South Australia between 3 and 200 nm and covers nearly 1.1 million square kilometres (Commonwealth of Australia, 2015b). The Southeast Shelf Transition, which is a transitional bioregion located over inshore shelf waters on the south-east margin of Australia, is made up of mosaic rocky reef and soft sediment habitats. Further offshore, the Southeast Transition Bioregion includes the edge of the continental shelf (or shelf break), around 120 to 150 kilometres to the east-north-east of the project site and the deep waters over the edge of the continental shelf (Commonwealth of Australia, 2015b).

The continental shelf is relatively shallow in the southern area of Gippsland Basin, with the water depth within the OWFA ranging from 17 to 53 metres. The waters are strongly influenced by the warm and cool coastal currents that run across and nearby the shelf. The Gippsland region is composed of a series of massive sediment flats, interspersed with small patches of reef, bedrock, and consolidated sediment. The coastline consists of long sandy beaches broken by rocky headlands and numerous coastal lagoons.

Wilsons Promontory is a peninsula that forms the southernmost point of the mainland of Australia. The geography consists of intertidal mudflats, granite cliffs, beaches, and sheltered coves. The promontory was made a Marine National Park in 1898 and is home to a diverse range of terrestrial and marine wildlife. The promontory is bordered by several small islands including the Glennie Group, Anser Island, and Rabbit Island.

Small islands are scattered throughout Bass Strait, thought to have once formed part of a 'land bridge' from Wilsons Promontory, connecting Victoria to Tasmania. These islands include the Hogan Group, Curtis Island, and the Kent Group. These islands and the islands surrounding Wilsons Promontory provide important habitat for seabirds and marine mammal species, such as breeding colonies of the Australian and New Zealand fur seals. Further, the waters surrounding these islands provide key foraging areas for those nearby breeding colonies.

6.1.1 Physical processes

The marine processes characterising the OWFA and surrounding marine environment are described in Technical Report A: Coastal Processes and Sediment Transport (RPS, 2021) and summarised here. Routinely, current regimes in the eastern portion of Bass Strait are largely driven by tidal activity and prevailing winds with strong seasonal variation (RPS, 2021). During the winter months, the influence of the South Australian Current extends from the Great Australian Bight to the western edge of Bass Strait. The prevailing westerly and south-westerly winds during this time also drive the South Australian current (SAC) further east, resulting in an eastward flowing extension that moves through Bass Strait (RPS, 2021). Finally, the winter months also bring cold, nutrient-rich subantarctic surface water (SASW) entering the Bass Strait from the south.

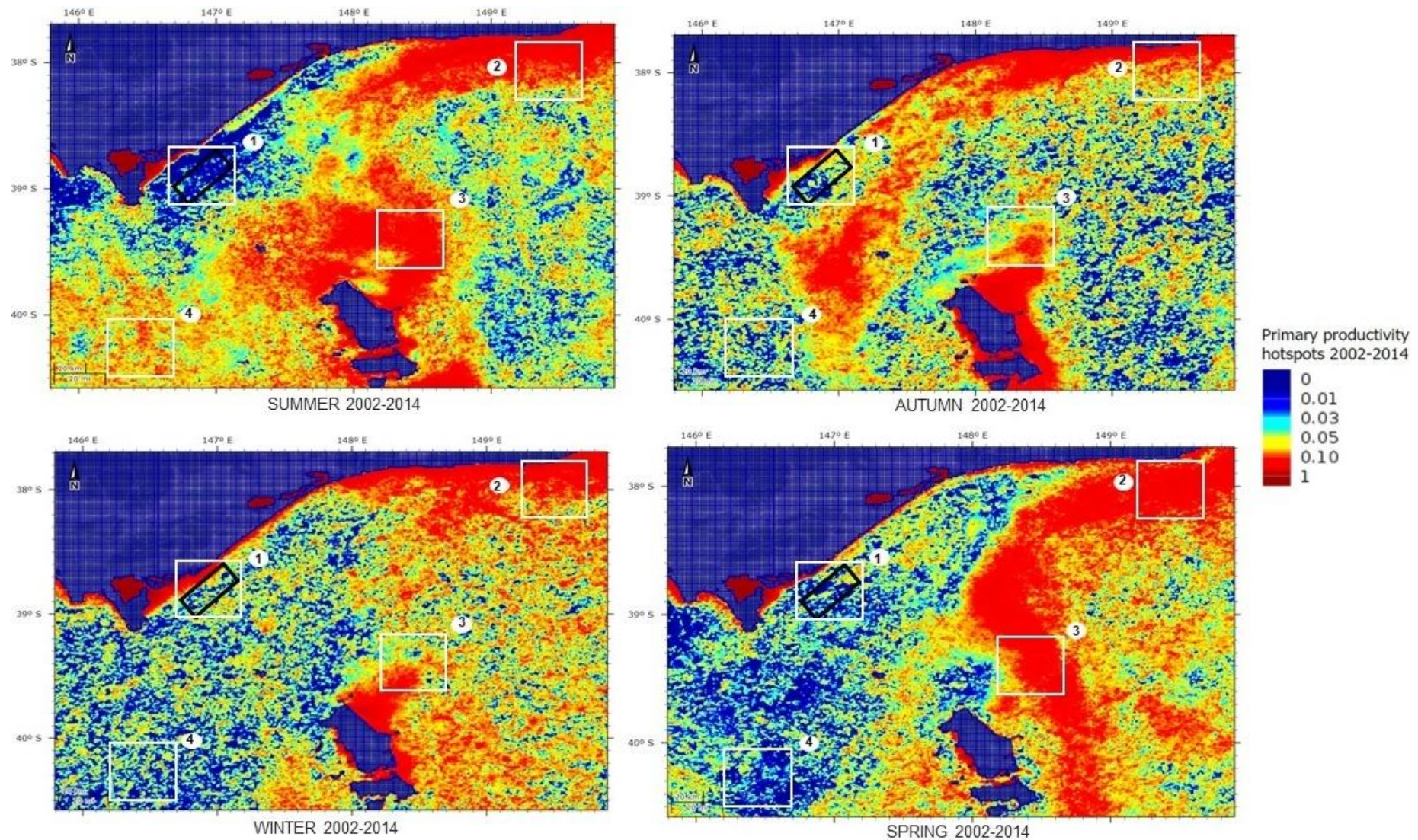
During the summer, the East Australian Current (EAC) is at its strongest, moving warm, relatively salty water southward. A north-east, poleward flowing current occurs along the inner shelf of the Gippsland Basin, while an extension of the EAC flows to the south of Gabo Island, off Mallacoota, resulting in the formation of large-scale eddies along the eastern shelf slope. The wave activity throughout Bass Strait is typically driven by the strong prevailing westerly winds resulting in a high wave-energy environment.

The three major currents that flow into the Bass Strait and Gippsland Basin (SAC, SASW and EAC) influence local marine ecosystems by bringing varying levels of nutrients, temperature, and salinity, and influencing local processes like upwelling. The productivity of the region changes spatially, seasonally, and annually based on the environmental variables of these major currents, and in turn, affecting prey availability and reproductive success of the seabird populations in Bass Strait. From winter to spring each year the nutrient and chlorophyll levels peak within the Bass Strait (Condie and Dunn 2006), providing enhanced foraging opportunity for marine fauna in the area. The East Australian Current is pushed further south in La Niña events, bringing warmer and less productive waters further south, and creating warm water eddies in Bass Strait (Commonwealth of Australia, 2015b).

Ocean productivity largely refers to the production of organic matter by phytoplankton (single-celled plants), which attracts zooplankton (multi-celled animals), a major food source for marine mammals. While the South-east Marine Region has relatively low productivity, it contains high productivity features along shelf edges and canyons, including upwellings that occur along the east coast. Ocean circulation on the Gippsland shelf is mainly influenced by Tasman Sea currents, namely the EAC and the Subantarctic Current (Global CCS Institute, 2016). These subantarctic waters reach the east and west entries of Bass Strait, bringing in nutrient-rich water, stimulating phytoplankton production. These include the Bonney Upwelling approximately 480 kilometres west of the OWFA, a key ecological feature (KEF) known as one of the largest and most predictable upwellings in south-eastern Australia (Nieblas, et al., 2009). A large range of species utilise the productivity generated by the Bonney Upwelling, including blue whales (Butler et al., 2002; Möller et al., 2020). The OWFA also lies between approximately 100- and 200-kilometres south-west of the Upwelling East of Eden, Big Horseshoe Canyon and the Bass Cascade KEFs (Figure 6-2).

Based on analysis of seasonal productivity hotspots in the Gippsland region, the OWFA has some of the lowest likelihoods of productivity in the whole region (Figure 6-1), and there is a clear distinction between potential productivity hot spots within the OWFA to areas of upwelling and shelf areas (Huang and Wang, 2019). Initial assessment also demonstrates a lack of influence of the Upwelling East of Eden KEF and the shelf edge areas on the productivity of the OWFA; however, due to the proximity of these highly productive areas and their ebb and flow seasonally by currents, it is possible productivity could occur in the area, or it could accommodate marine species travelling through to areas richer in phytoplankton.

The Gippsland region has been recognised as an important foraging area for various cetacean species as they travel through the area to the Bonney Upwelling (DoE, 2015). The location of the OWFA between the Bonney Upwelling and the Upwelling East of Eden KEFs means that the area may also intersect with migration pathways for marine mammals moving between these upwelling areas (refer to Section 6.2 for information on migration routes and timing).



Black box indicates Star of the South pre-feasibility license area. White numbered boxes indicate- 1) the Star of the South Pre-feasibility license area and surrounds, and core areas within- 2) Upwelling east of Eden, 3) eastern Bass Strait continental shelf waters and 4) central Bass Strait shelf waters.

Figure 6-1: Likelihood of productivity hotspots seasonally between June 2002 and August 2014 in the Gippsland region (Seamap Australia, 2022)

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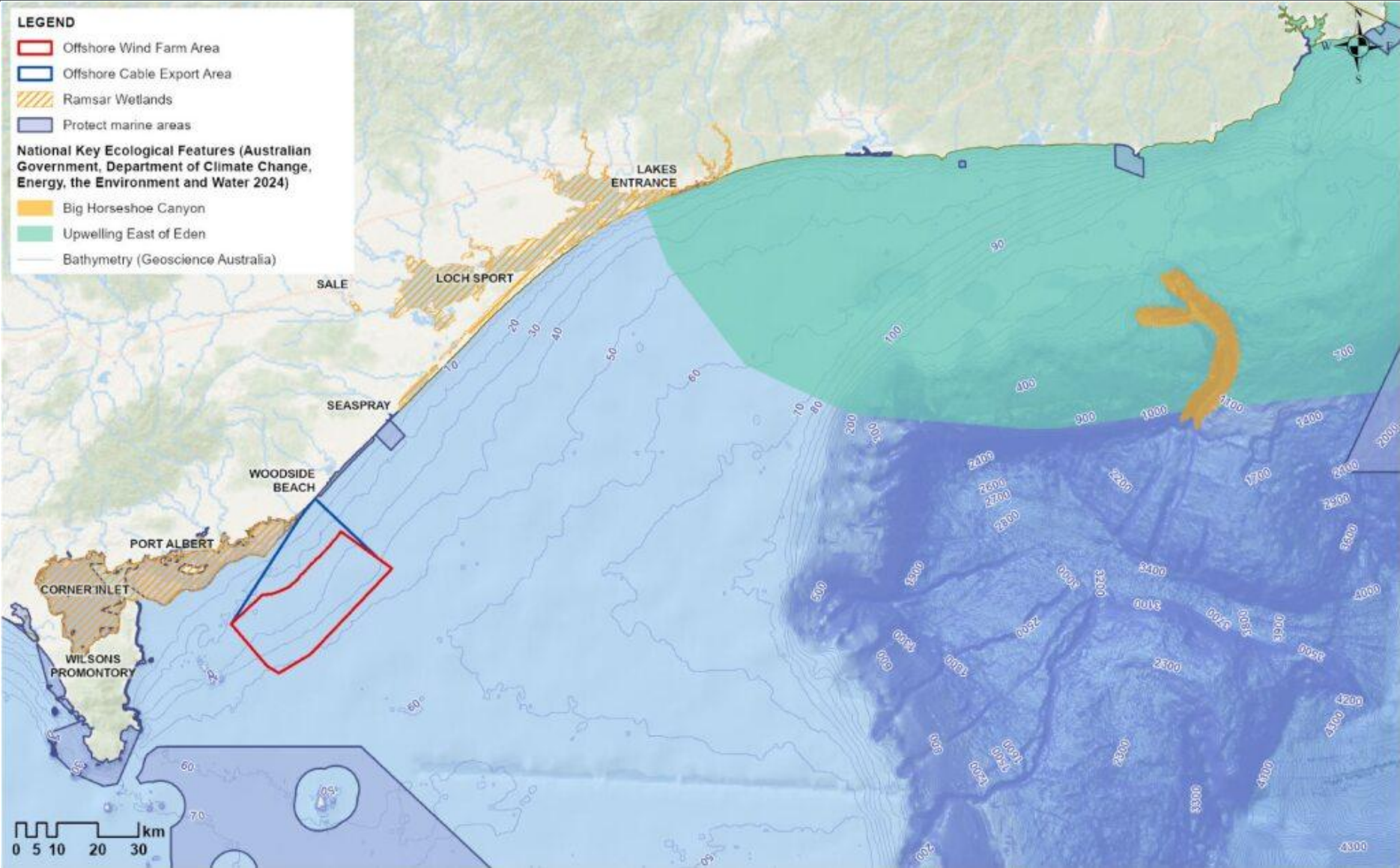


Figure 6-2: National Key Ecological Features in proximity to the offshore project area. The Bass Cascade is not spatially defined, however occurs on the continental slope of the Bass Canyon

6.1.2 Anthropogenic uses

Anthropogenic uses within the broader marine environment of the OWFA, central Gippsland and Bass Strait include oil and gas extraction, shipping, and commercial and recreational fishing activities. These all contribute to the existing ambient noise and activity levels of the wider regional Gippsland area. The impact assessment has been undertaken considering the current anthropogenic uses of the Gippsland region.

Ambient noise was included in the baseline data studies and is described in Section 8.1.1. There is a major shipping lane around seven nautical miles (approximately 12.5 kilometres) south of the OWFA through which around 300 ships per month pass. Most of these vessels will visit one of Victoria's main ports (Port of Melbourne, Geelong, and Portland), while some may be travelling to or from ports in South Australia (SA), Western Australia (WA) or Tasmania. A smaller number of ships are coastal trading vessels transporting goods to and from domestic ports.

The Gippsland Basin has been an important region for oil and gas since production commenced in the 1960s, and the region contains some of the largest offshore oil and gas fields in Australia (Geoscience Australia 2022). Bass Strait contains approximately 23 offshore platforms and installations associated with this industry, as well as associated subsea infrastructure and pipelines. These industries bring seismic surveys, vessel and helicopter movements, and artificial light to the region to support their activities. Offshore service vehicles (OSVs) regularly transit the OWFA between Barry Beach Marine Terminal (BBMT) / Port Anthony in Corner Inlet and the oil and gas installations in eastern Bass Strait (the most direct route). Within the offshore export cable area (OECA), commercial vessels transit from Corner Inlet to the oil and gas area-to-be-avoided (ATBA), with an average of one to two movements recorded from Automatic identification system (AIS) per day (AMSA, 2021). Beyond oil and gas, shipping movement and defence operations are present. All these uses will have changed the baseline conditions for marine mammals and turtles in the area. Pinnipeds are known to haul out on oil and gas platforms in the region.

The OWFA and broader area is subject to commercial and recreational fishing, including eight Commonwealth-managed fisheries and 12 Victorian-managed fisheries (Technical Report N: Commercial and recreational fisheries). Marine mammal visual aerial surveys conducted in 2020 to 2021 sighted an average of 17 recreational fishing or charter fishing vessels in and around the OWFA per survey day. They were most concentrated to the northwest of the OWFA, closer to the entrance to Corner Inlet and Port Albert. The most active fishery within the OWFA is the demersal gillnet sector of the Commonwealth Southern and Eastern Scalefish and Shark Fishery (SESSF), with up to 13 fishers utilising the area per year (Technical Report N: Commercial and recreational fisheries). Incidental catch or bycatch from fisheries represents one of the most significant sources of anthropogenic mortality in marine mammals (Luck et al., 2020; Peltier et al., 2016). Interactions with gillnets are the principal threat to many endangered cetacean and pinniped species (Reeves et al., 2013; Brownell et al., 2019). The incidence of fur seal entanglements in the Bass Strait and around Tasmania is a potential threat to seal populations, with exact implications unable to be determined until entangled animals reach breeding age (Pemberton et al., 1992; Page et al. 2003, 2004).

The marine environment of the Gippsland region is also used for recreational and tourism activities such as fishing, cruising, whale watching (targeting humpback whales, southern right whales, common dolphins, bottlenose dolphins, and fur seals), and SCUBA diving. Vessels used within the Gippsland coastal region include recreational sailing (yachts), motor cruising, jet skis, kayaks, and canoes (Technical Report K: Business and Tourism). Tourism operators in the region offer dolphin and whale watching cruises off Wilsons Promontory, and tours of locally breeding fur seal colonies on nearby islands. These tourism operations can provide valuable information on marine mammal seasonal presence and distribution, and habitat use in an area.

In the late 1700s to mid-1800s fur seals in the Bass Strait were exploited by sealing operations, leading to population decline, abandoned colonies and populations retreating south (Burleigh et al., 2008). Sealer settlements were established on islands throughout Bass Strait, such as the Kent group, to exploit locally breeding fur seal colonies. In the first six years of sealing operations, 133,000 fur seal-skins passed through Sydney, representing only a portion of the total kill (Merry et al., 2000). Some seal species were hunted near to extinction, with the New Zealand fur seal believed to be eliminated entirely from the waters of north-eastern Bass Strait (Warneke and Shaughnessy 1985). Furthermore, extensive sealing led to the disappearance of seal colonies in specific locations, such as at Sealers Cove on Wilsons Promontory, where seals no longer occur. This over-exploitation of seals in the area led to the industry becoming uneconomical, and it gradually declined. Over the last 60 years legislation protecting these species has allowed fur seal numbers to increase and their range to extend back into previously abandoned areas (Burleigh et al., 2008). The population experienced consistent growth between 1980 and the late 2000s (McIntosh et al., 2018),

however, since then several of the larger colonies experienced significant reductions in annual pup production and a stagnation of overall population growth (McIntosh et al., 2022). While the population has recorded substantial inter-annual variation in annual pup production (Arnould et al., 2021), results show that there has not been a consistent temporal trend since late 1990, when monitoring commenced (Arnould and Lippman, 2000).

Commercial whaling operations in Victoria commenced in the 1830s, with whaling stations established along the Gippsland coast and a large station operating out of Refuge Cove on Wilsons Promontory (DELWP, 2021). The species targeted by whalers in this region include the humpback whale, southern right whale, and killer whale, with both adult and calves targeted. This extensive, indiscriminate whaling of adult and juvenile animals severely depleted populations of species, particularly the southern right whale, which were a target species, and due to their slower ability to rejuvenate. A total of approximately 58,000 southern right whales were estimated to have been killed in south-east Australian and New Zealand waters, with 80 per cent of these kills concentrated between 1830 and 1849 (Carroll et al., 2014). This resulted in the commercial extinction of the southern right whale, with as few as 300 individual animals remaining in the southern hemisphere by 1920, resulting in limited numbers of animals present and returning to this region of Victoria to the present day (Chamberlain, 1990; Carroll et al., 2014; DCCCEW, 2022). A study by Pirzl (2008) identified an influence of historic whaling on current and likely ongoing distribution of southern right whales in Australian waters, with those areas of previous exploitation (i.e. whaling grounds) influencing current spatial use patterns of the animals. Whilst commercial whaling had largely ceased in Victorian waters in the 20th century due to declines in catch from overexploitation, it was not until 1986 when whaling was completely banned due to the adoption of the global moratorium on commercial whaling.

6.1.3 Conservation areas

6.1.3.1 Australian marine protected areas

6.1.3.1.1 Beagle Australian Marine Park

Beagle Marine Park is an Australian Marine Park (AMP) covering 2,928 square kilometres in Bass Strait, near Flinders Island with its north-western edge abutting Victorian waters south-east of Wilson's Promontory. It is one of 14 reserves currently under the South-east Commonwealth Marine Reserves Network Management Plan (DNP, 2013). The reserve was established in 2007 and located approximately 20 kilometres south of the OWFA.

It is a shallow-water reserve surrounding a collection of Bass Strait islands including the islands of Kent Group National Park and the Hogan and Curtis Island groups. These islands support important breeding colonies for many seabirds and for the Australian fur seal and the waters of the reserve provide an important foraging area for those species breeding nearby. In turn the rich marine life also attracts top predators, such as the great white shark and killer whales. Wilsons Promontory Marine National Park is located to the north-east. The reserve comprises an area of shallow continental shelf ecosystems in depths of about 50 to 70 metres, and the sea floor that it covers formed part of a land bridge between Tasmania and Victoria during the last ice age 10,000 years ago. The key values, habitats and communities within Beagle Marine Park include small shallow reefs that support invertebrate assemblages and deep reefs that provide habitat and food for a diversity of species. Major conservation values associated with the AMP include that it is an important migration and resting on migration area for southern right whales as well as an important foraging area for Australian fur seals and killer whales. The marine park is within the foraging biologically important area (BIA) for blue whales and the migration BIA of southern right whales.

As a multiple use zone, the Beagle AMP is subject to human-induced pressures such as noise, oil and light pollution from vessels and construction or mining activities, establishment of invasive marine species and diseases brought in on vessels and extraction of living species and by-catch associated with commercial fishing, recreational fishing, and illegal, unregulated, and unreported fishing. The impacts associated with climate change are also a threat to the conservation of the marine park, with rising sea levels and sea temperatures, ocean acidification and extreme weather events putting pressure on a number of species and ecological communities (DELWP, 2020). The management plan in place aims to reduce and manage these pressures.

6.1.3.2 Victorian marine protected areas

The Victorian Government created a system of 13 Marine National Parks and 11 smaller Marine Sanctuaries to ensure that representative samples of Victoria's diverse, distinctive, and amazing marine environment are conserved for future generations. These parks and sanctuaries protect 5.3 per cent of Victoria's coastal waters, safeguarding important marine habitats and species. There are six state marine protected areas in the Gippsland region, three of which are within proximity to the OWFA and may be impacted by the Project. The values of these marine protected areas include marine mammals.

6.1.3.2.1 Wilson's Promontory Marine National Park

Wilson's Promontory Marine National Park is Victoria's largest marine protected area, encompassing several offshore islands of the Anson Group (Anson Island, Kanowna Island, Wattle Island and Anderson Islets). The marine national park (MNP) reaches across 45 kilometres of coastline, from Norman Bay on the west coast of Wilsons Promontory and extends 4.78 nautical miles offshore to 300 metres from the Low Water Mark of the Glennie Group islands, around the coast to Cape Wellington in the east. Wilsons Promontory is located approximately 25 kilometres from the OWFA. Wilsons Promontory marks the boundary for many animals that prefer the warm waters of eastern Victoria to the colder waters to the west. Wilsons Promontory Marine National Park holds great environmental value to a range of marine flora and fauna including hundreds of fish species, invertebrates (sponges, ascidians, sea whips and bryozoan), seagrass, as well as a number of marine mammal and seabird species (Parks Victoria, 2006). The offshore islands support several colonies of Australian fur seals, and Kanowna Island is one of the four breeding colonies of Australian fur seals in Victoria. Seals have pups each year from November to January. From April to October, humpback and southern right whales migrate from the cold Antarctic waters to their calving grounds off the Australian Coast passing through Wilsons Promontory Marine National Park on this route.

The granite habitats within the MNP are unique to Victoria and support high exposure subtidal reefs in the west and south regions and low exposure subtidal reefs in the east of the MNP, both with two distinct assemblages. Granite cliffs below the surface create underwater caves, which shelter extensive sponge gardens, while intertidal rocky shores, sandy beaches and seagrass beds within sheltered bays and subtidal soft substrates exist within the MNP, hosting distinct assemblages of species (Barton et al., 2012).

As the MNP area exists as the distribution limit for many species, it is particularly vulnerable to the effects of climate change, with rising sea levels and temperatures having the potential to cause loss of habitats, decreases in productivity and changes in the reproduction and distribution of species (DELWP, 2022). The use of recreational vessels within the MNP also has the potential to impact several species through the introduction of invasive marine species from ballast water; damage to seagrass beds and mudflats through propeller scour or anchorage; mortality, injury or disruption to fur seals breeding colonies and penguins through oil or chemical spills, vessel strike or vessel noise.

6.1.3.2.2 Corner Inlet Marine National Park

Corner Inlet Marine National Park (1,150 ha) is located within the sheltered waters of Corner Inlet behind Wilson's Promontory, approximately 25 kilometres from the OWFA. Corner Inlet is the most easterly and consequently the warmest, of Victoria's large embayments is made up of two separate sections with a channel between them. Granite Island borders the boundary of the northern section while Bennison Island borders the boundary of the southern section. The park protects a wide variety of marine habitats ranging from deep channels to extensive shallow seagrass beds, tidal sand and mud flats, sandy beaches, and some rocky reefs, mangroves, and saltmarsh. Corner Inlet is the only place in Victoria where the broad-leaved seagrass (*Posidonia australis*) forms large meadows. Seagrass beds are a crucial habitat as a nursery for many important recreational and commercial fish species, in stabilising the sediment, and in providing shelter and food for many other creatures. Seals and dolphins are known to be present in the park, utilising the shallow protected waters. In addition, there are historical sightings of southern right whales within Corner Inlet. The Corner Inlet Marine National Park Management Plan (Parks Victoria, 2005) notes that increased turbidity from higher sediment loads may negatively affect the ecological communities and hydrodynamic processes of the area. Likewise chemical pollution or accidental hydrocarbon releases could have significant negative impacts on park values, particularly on seabirds, seagrass, and intertidal areas. The park is also susceptible to a number of other threatening processes, including invasive marine species and physical disturbance (for example anchoring and propeller scouring).

6.1.3.2.3 Ninety Mile Beach Marine National Park

Ninety Mile Beach Marine National Park, located approximately 26 kilometres from the OWFA, is a huge subtidal sandy expanse characteristic of the area. The MNP covers five kilometres of protected Ninety Mile Beach coastline and extends offshore to the limit of Victorian waters, covering 2,750 hectares of coastal waters in total. The MNP has a sandy bottom with intermittent reef areas and reaches up to approximately 30 metres in depth. The coast does not have any rocky headlands or platforms, and offshore there are only a few ribbons of reef which are periodically covered by sand. These formed as shorelines or sand dunes during ice-ages when the sea level was lower than today. Marine mammals are not commonly sighted in the marine park.

The Ninety Mile Beach Marine National Park is threatened by climate change, with increasing water temperatures and rising sea levels having impacts on productivity, a driver in species distribution (McInnes, 2009). Introduction of invasive marine species through ballast water or hull fouling is of particular concern as there are currently no pests recorded within the MNP. Likewise, the introduction of pathogens from fishing bait used in areas adjacent to the MNP or accidental hydrocarbon releases from surrounding vessels could have serious effects on the health of the marine fauna and flora. The Gippsland Plains and Strzelecki Ranges Conservation Action Plan (Parks Victoria, 2021) covers the Ninety Mile Beach MNP and lists the priority threats to the conservation assets in the MNP as; inappropriate fire regimes, altered hydrology/reduced water quality, terrestrial weeds, diseases, and pathogens, introduced herbivores, introduced predators, marine pests, recreation/natural resource extraction, extreme weather events and climate change.

6.2 Conservation values and sensitivities

The marine fauna species potentially occurring within the OWFA were identified using a variety of scientific and government information sources detailed in Section 5.3.1, and any additional species recorded during the MESP.

A total of 45 cetacean, ten pinniped and six marine turtle species are found in Australian waters ([DCCEEW - Species found in Australian waters](#)). A PMST search of the OWFA plus a ten-kilometre buffer was used to identify EPBC-protected species predicted to be potentially present in the OWFA. Occurrence records in Victoria found within the ALA and VBA databases and citizen science records were also investigated. For these reviews, a ten-kilometre buffer was initially chosen to provide a focus of on species that were likely to occur in the OWFA, whilst a wider buffer of 100 kilometres was added later to account for predicted areas of impact for underwater noise emissions from the project. For regionally data deficient species, data from the adjacent marine environments (Otway Basin, Tasmania, and New South Wales (NSW) / Victoria border) were examined (for example humpback whale feeding aggregations in Eden, NSW). FFG-listed species were identified. Data collected during the baseline survey programs included a total of 15 marine mammal and turtle species. this included 11 cetaceans, two pinnipeds and two marine turtles that may occur within or migrate through the OWFA and wider Gippsland marine region (Appendix A). Seven of the identified marine fauna species are listed under the EPBC Act as 'threatened', 10 are listed as 'migratory' and / or 'marine', and a further 11 were listed as 'cetacean'. In addition, three cetaceans, one pinniped and one marine turtle species are listed as 'threatened' under the Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act). The seasonal presence and likelihood of occurrence of marine fauna within the OWFA is provided in the Marine Mammal and Turtle Study Report, Appendix A.

BIAs are spatially defined areas where aggregations of individuals of a species are known to display biologically important behaviour such as breeding, foraging, resting or migration. BIAs are identified, defined and mapped by the Australian Government's Department of Climate Change, Energy, the Environment and Water (DCCEEW), using expert scientific knowledge about species' distribution, abundance, and behaviour in the region (DCCEEW, 2023). The areas link closely to specific actions and objectives within species Recovery Plans. The identification of species for which BIAs are selected is informed by the availability of scientific information, the conservation status of listed species and the importance of the region for the species. For some BIAs, the areas encompassed may be based on a limited number of data points and so they can be viewed as a conservative estimate of importance. Marine mammal and turtle BIAs of relevance to the project are shown in Figure 6-3 for blue whales, Figure 6-5 for southern right whales and Figure 6-7 for humpback whales.

The literature review conducted to inform the design and content of the MESP program was drawn from defined BIAs and recovery / conservation management plans at the time of writing. These have since been updated by DCCEEW. For the MESP program, literature has been kept relevant to the time of writing, while

the technical report references and uses current documents and BIAs for each species. The OWFA and its surrounds overlap with BIAs for two whale species: (1) a 'foraging' BIA for blue whales (AMSIS, accessed November 2024)) and (2) 'reproduction' (approx. May to September) and 'migration' (approx. April to October) BIAs for southern right whales (DCCEEW, 2024a). A 'migration' BIA for the humpback whale commences northeast of the OWFA, beginning at Eden, NSW, and extending along the coastline to as far north as Bundaberg, QLD. BIAs for marine turtles are not found in the area.

Details of the MESP program studies are provided in Section 5.3.2.

6.2.1 Blue whale

Blue whales (*Balaenoptera musculus*), the largest of all whale species, are found in every ocean except the Arctic Ocean. There are two recognised subspecies of blue whale in the southern hemisphere: Antarctic 'true' blue whale (ABW) (*B. m. intermedia*) and pygmy blue whale (pygmy blue whale) (*B. m. brevicauda*). These subspecies are characterised by differences in morphology, distribution, genetics and vocal behaviour (Commonwealth of Australia, 2015a; McDonald et al., 2006b).

Blue whales are protected at global, national, and local scales. Under the International Union for Conservation of Nature (IUCN) Red List of Threatened Species, ABWs are classified as 'critically endangered' (Reilly et al., 2008), and pygmy blue whales are listed as 'data deficient'. The ABW and the pygmy blue whale are protected under both national and state legislation. The two subspecies are listed as 'endangered' and 'migratory' under the EPBC Act and are managed under the Blue Whale Conservation Management Plan (Commonwealth of Australia, 2015a). In Victoria, the blue whale is listed as 'threatened' under the FFG Act (DELWP, 2019).

6.2.1.1 Antarctic blue whale

The ABW feeds in Antarctic circumpolar waters during the austral summer and likely breeds during winter months in lower latitudes of the Indian and Pacific Oceans, and perhaps also the Atlantic Ocean (Möller et al., 2020). ABWs are found along the western and southern coast of Australia, as well as the west coast of South Africa, Africa, Namibia and Angola (Balcazar et al., 2017; Branch et al., 2007; Commonwealth of Australia, 2015a; McCauley et al., 2018). The ABW circumpolar population was estimated at 2,280 individuals (based on data collected between 1992 / 93 to 2003 / 4), although there is no estimate of numbers in Australian waters (Commonwealth of Australia, 2015a).

The presence of blue whales in Australian waters varies. ABW calls have been detected along the entire southern Australian coast (McCauley et al., 2018). Acoustic detections of ABW are recorded off Portland, Victoria, approximately 480 kilometres from the OWFA (McCauley et al., 2018). However, it is unlikely that ABWs would occur in the OWFA as the Gippsland region lies at the extremity of their known range. While no Antarctic blue whale vocalisations were detected during the MESP, for the purposes of project mitigations, all blue whales will be treated the same.

The Blue Whale Conservation Management Plan (Commonwealth of Australia, 2015a) identifies climate variability and change as the highest (very high risk) threat to ABW. Whaling, seismic surveys and vessel collisions are identified as high risks. Other sources of anthropogenic underwater noise, habitat modification, and Antarctic krill fishing are low to moderate risks for ABW.

6.2.1.2 Pygmy blue whale

In Australian waters, the pygmy blue whale subspecies is further divided into two populations; the Australian ('Eastern Indian Ocean' (EIO)) pygmy blue whale and the New Zealand (NZ) pygmy blue whale (McDonald et al., 2006). These populations have been distinguished by differences in songs (McDonald et al., 2006). Therefore, it is easier to determine blue whale subspecies and / or population acoustically rather than visually (McDonald et al., 2006).

Records of blue whales in the Victorian Biodiversity Atlas (VBA) and Atlas of Living Australia (ALA) databases, a collection of verified sightings made by third parties (ALA, 2019; VBA, 2021), have been low in the Gippsland region (Figure 6-3). However, it is noted that no dedicated studies for blue whales had been conducted in this region prior to the MESP. In Australia, there are two main feeding areas for blue whales: the Perth Canyon on the west coast, and the Bonney Upwelling region off southern Australia, between Robe, South Australia to Portland, Victoria. The OWFA lies at the eastern extent of the blue whale 'foraging' BIA (Figure 6-3).

EIO pygmy blue whale vocalisations have been detected along the western and southern coast of Australia, west of Bass Strait (McCauley et al., 2018; McDonald et al., 2006), and NZ pygmy blue whale calls have been detected along the eastern coast of Australia, predominantly east of Bass Strait, although recent detections of calls off Portland suggests a westward exploration (Balcazar et al., 2015; McCauley et al., 2018). All three call types have been detected in central Bass Strait (Balcazar et al., 2015; McCauley et al., 2018). McCauley et al. (2018) note that central Bass Strait has low ambient noise relative to the surrounding open-ocean and may act as a resting area where subspecies and populations intermix.

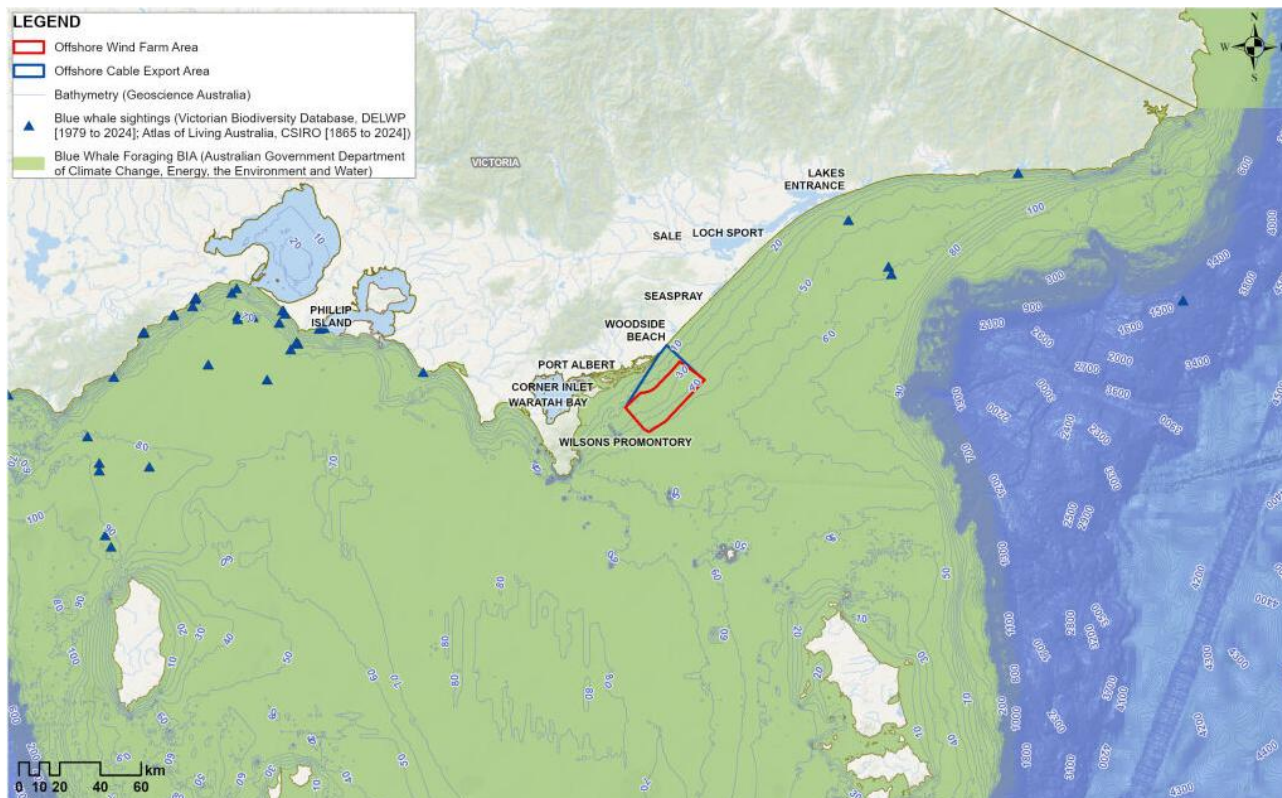


Figure 6-3: Blue whale BIAs (Commonwealth of Australia, 2015a) and sightings in south-eastern Victorian waters from the Victorian Biodiversity Database, DEECA (1979 to 2011), Atlas of Living Australia and CSIRO (1865 to 2011)

Only one blue whale was recorded throughout the SOTS marine baseline visual survey period, which was during the additional EIF program on 4 April 2023. The adult blue whale, suspected to be a pygmy blue whale, was sighted at 11:13 not far offshore from the OWFA. This was the first blue whale sighting since the Star of the South surveys began in December 2019. The whale was almost stationary, unusual in blue whales, which rarely stop moving (Gill, 2023). It showed signs of moderate emaciation as its vertebral column was pronounced, a sign of low physical condition. No krill or other potential prey was sighted within 18 nautical miles of the whale. No blue whales were observed in visual aerial surveys between December 2019 and December 2022, or during the 'Wildlife Coast Cruises' sight-seeing boat tours, other MESP surveys (fish, seabird and benthic boat-based surveys, acoustic logger deployment/retrieval trips, seabird island land surveys and shorebird land surveys) and the DAS targeting seabirds. The Wildlife Coast Cruises tours are conducted between late August and the end of October, targeting the coastal waters around Wilsons Promontory and to the east, with observers actively searching for marine mammals throughout the tours. During other MESP vessel surveys, marine mammal sightings were opportunistic, and no dedicated surveys were conducted. Therefore, it is acknowledged that outside of dedicated MESP visual surveys, the opportunity for blue whale sightings was low.

During the MESP, New Zealand pygmy blue whale calls were detected in acoustic recordings on one day in April 2020 and sporadically from May 2021 to February 2022 (Figure 3-36 in Appendix A). No EIO pygmy blue whale calls were detected in acoustic recordings in 2020; however, in 2021, calls were detected sporadically in May to June and again in September, with peak presence in June (Figure 3-36 in Appendix A). The timing of presence suggests it is possible that the calling whales moved north up the east Australian coast before returning south again. However, there were no detections of EIO pygmy blue whale songs at the New South Wales IMOS site off Tuncurry (McCauley et al., 2018).

All detections of the pygmy blue whale song (both subspecies) were for short periods only, a few hours to days, and there was no evidence that either of the subspecies persisted in the area (Appendix A). All blue whales probably transited the region, either as single animals or small pods passing through across several days. Blue whales are usually solitary, though they are occasionally found in small feeding aggregations where krill is abundant.

A relationship has been identified between upwelling events and blue whale presence (Attard et al., 2010; Barlow et al., 2018; Branch et al., 2007; Gill et al., 2011; Gill, 2016; Möller et al., 2020). This relationship stems from the high productivity that accumulates from upwelling events, promoting the development of krill aggregations, which are the primary food source for blue whales. There is a temporal lag between upwelling events and blue whale presence, ranging from two weeks (Barlow et al., 2021) to several months (Gill, 2016; Gill et al., 2011).

The OWFA and surrounding waters have relatively low productivity with negligible influence from surrounding upwelling areas (Huang and Wang, 2019). Huang and Wang (2019) analysed monthly upwelling characteristics (sea surface temperature, Chlorophyll-a ratio and upwelling speed) over 14 years and 4500 km section of coast in south-east Australia and found that the OWFA had a low likelihood (<10%) of experiencing upwelling conditions. Several surface krill swarms were sighted during the MESP (Appendix A); however, almost all swarms were reported as 'small' by observers. Research suggests that blue whales will only feed in areas of high-density krill patches, needing greater than 100 krill per cubic metre to benefit from the exertion of lunge feeding (Branch et al., 2007; Croll et al., 2005; Hazen et al., 2015; Morrice, 2014). However, given the proximity of these highly productive areas (approximately 100 kilometres east at the Upwelling east of Eden and greater than 500 kilometres west at the Bonney Upwelling), blue whales may transit the OWFA and surrounding waters on their way to areas richer in phytoplankton and krill.

Little is known about the migratory routes for pygmy blue whales off the east coast of Australia. Strandings of blue whales have occurred on the east coast, though it is not clear which population the stranded whales were associated with. Until the MESP study, there had been no detection of EIO pygmy blue whale songs in underwater noise recordings in the eastern Bass Strait. There were no detections of EIO pygmy blue whale song at the New South Wales Integrated Marine Observing System (IMOS) site off Tuncurry, suggesting that the species does not migrate north along the coast (McCauley et al., 2018). Möller et al. (2020) deployed satellite tags on 13 adult pygmy blue whales in the Bonney Upwelling region. Tags transmitted between 21 January 2015 and 20 March 2016, for a mean of 116 ± 114 days (range three to 382 days) (Möller et al., 2020). In general, whale movements ranged mostly from eastern South Australia, over the continental shelf south of Kangaroo Island, to between mainland Australia and Tasmania (i.e. Bass Strait (Möller et al., 2020)). None of the tagged whales moved east of Wilsons Promontory towards the OWFA. More is known about the west coast migration route than the east coast migration route (Figure 6-4).

Typically, blue whales occupy deeper waters and are not expected in inshore shallow waters of the OWFA. For example, in the Bonney Upwelling, foraging blue whales are predominantly seen between depths of 50 to 150 metres, though sightings have been recorded in waters as shallow as 26 metres and as deep as 1,548 metres (Gill et al., 2011). During migration from the Bonney Upwelling, pygmy blue whales were found to move along continental shelf waters (Möller et al., 2020). On the west coast of Australia most EIO pygmy blue whales migrate in waters 100 kilometres off the coast along the shelf edge, in water depths of around 1,000 to 1,500 metres (Double et al., 2014; McCauley and Jenner, 2010; Thums et al., 2022), but do occasionally travel in relatively shallow water less than 20 metres water depth (Salgado-Kent et al., 2014).

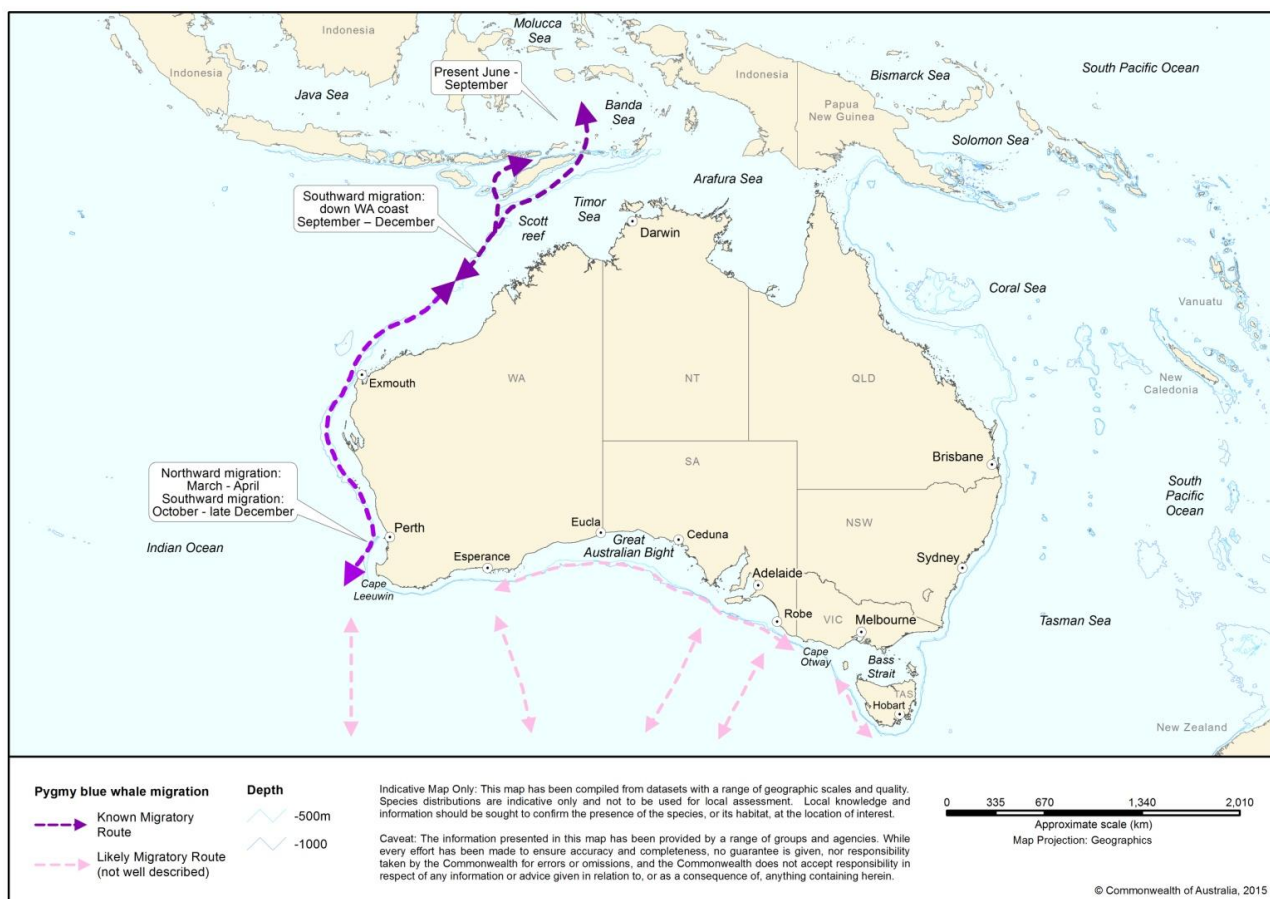


Figure 6-4: Pygmy blue whale migration routes (Commonwealth of Australia, 2015a)

The OWFA does not appear to represent a productive foraging habitat for pygmy blue whales. The short period of presence, along with the low likelihood of productivity, suggests that whales were unlikely to persist in the area to forage. Migrating pygmy blue whales are known to occupy deeper waters than those of the OWFA, though they are known to come into shallower waters along the 30-metre depth contour (Salgado-Kent et al., 2014). All detections of pygmy blue whale song were sporadic, and therefore although it is possible for pygmy blue whales to be present in the OWFA and surrounding waters and will need to be accounted for in the impact and risk assessment, their presence is likely to be limited to occasional transient individuals, pairs, or small pods possibly in late-autumn to winter as indicated by the baseline survey data.

The Blue Whale Conservation Management Plan (Commonwealth of Australia, 2015a) identifies climate variability and change, and seismic surveys as the highest (very high risk) threats to pygmy blue whales. Whaling and vessel collisions are identified as high risks. Other sources of anthropogenic underwater noise, habitat modification, and Antarctic krill fishing are moderate risks for pygmy blue whales.

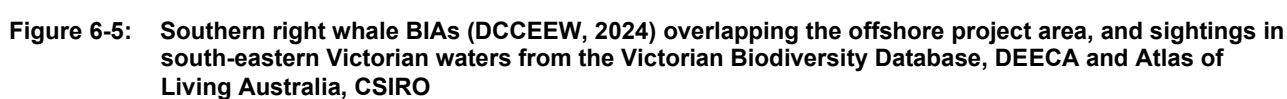
6.2.2 Southern right whale

Southern right whales (*Eubalaena australis*) migrate annually from southern feeding grounds in the subantarctic to northern coastal aggregation grounds to breed, calve and rest during the Austral winter. In Australia, southern right whales (southern right whales) are divided into two subpopulations or management units: 'eastern' and 'western'. The 'eastern' subpopulation is found along the south-eastern coast, as far south as Tasmania but rarely further north than Sydney, and the western subpopulation occurs predominantly between Cape Leeuwin in Western Australia and Ceduna in South Australia (DCCEW, 2024b). These subpopulations are considered genetically distinct from one another (Carroll et al., 2011); however, there is uncertainty surrounding the degree of separation, with 2.5 per cent of identified southern right whales in Australia sighted in both the south-west and south-east areas (Evans et al., 2021). Therefore, it is difficult to determine whether these sightings represent an exchange of individuals between the two subpopulations, or the movement of individuals from east to west (Evans et al., 2021).

Sightings of southern right whales off the Victorian coast have been documented since 1985 by the Department of Energy, Environment, Land, Climate Action (DEECA) and the State Wide Integrated Flora and Fauna Teams (SWIFFT) network as a part of the southern right whale south-east Australia monitoring program (SWIFFT, 2019). The areas of highest southern right whale density are far west of the OWFA at Portland, Port Fairy, and Warrnambool (Logans Beach), Port Campbell and Peterborough, in the Otway region (SWIFFT, 2019; DCCEEW, 2022). Anecdotal sightings of southern right whale between 1980 and 2020 include areas around the Wilsons Promontory coast and inside Corner Inlet, as well as scattered observations in inshore coastal areas adjacent to the OWFA including Port Albert, McLoughlin's Beach and Woodside Beach (Figure 6-5). Stamation et al. (2020) reported a 7 per cent increase in southern right whales using the south-east Australian coastline (South Australia–Victoria border to Sydney, including Tasmania and Flinders Island) from 1985 to 2017.

The OWFA is within the coastal range for the eastern subpopulation of southern right whales. The OWFA and adjacent coastal waters do not represent a recognised aggregation area for southern right whales: however, the area overlaps with BIAs for 'migration' and 'reproduction'. The reproduction BIA is also identified as a habitat critical to survival (HCTS) for the southern right whale. The reproduction BIA and HCTS encompasses the entire southern Australian coastline from Bundaburg in QLD to north of Bunbury in WA, including the Gippsland coast, and extending out to three kilometres from the coastline. There is an additional section of the reproduction BIA located off the Ningaloo Coast and Exmouth Gulf in WA. The migration BIA is larger again (AMSIS, accessed November 2024) extending from the southwest corner of Western Australia (Cape Naturaliste) to the border of New South Wales and Victoria, encompassing the entire Economic Exclusion Zone and the Continental shelf limits south of Tasmania. A smaller section extends up both the east coast up to Hervey Bay, and the west coast up to Exmouth Gulf, extending five kilometres from the coastline.

Historically, two shore-based whaling stations were located at Wilsons Promontory; one at Refuge Cove operating from 1841 to 1843, and the other at Sealers Cove operating in 1840 (Pirzl, 2008). These areas were classified as possible but not probable calving areas (Pirzl, 2008). During systematic aerial surveys of southeastern Australia in 2014, nine southern right whales were sighted at Sealers Cove, including three female and calf pairs (Watson et al., 2015). Opportunistic sightings collected by the Wilsons Promontory wildlife coast cruise reported two female and calf pairs at Waterloo Bay, nearby to Sealers and Refuge coves, between 2017 and 2021 (Appendix A). Pirzl (2008) found the strongest determinant of whale distribution within calving grounds to be the location of conspecifics, suggesting persistent use of 'new' locations (i.e. areas not currently recognised for aggregation) is unlikely to occur if not supported by philopatric and aggregative tendencies. Southern right whales in the southeast were extirpated through whaling, and as a result have been effectively excluded from re-establishment of suitable habitat due to a restricted memory of calving areas (Pirzl, 2008).



A recent population estimate for the eastern subpopulation was 268 individuals (Stamation et al., 2020). This population is estimated to be increasing at a rate of 4.7 per cent per year; however, there has been no significant increase in the numbers of reproductive females using the only recognised established south-east Australian calving ground at Logans Beach (Stamation et al., 2020). Female southern right whale can reach sexual maturity by age five years, although the mean age of sexual maturity is nine years (Charlton et al., 2022). Watson et al. (2021) report a 3.5 ± 0.2 years' mean calving interval for southern right whale at Logans Beach (1980 to 2018, $n = 34$). At the larger established aggregation area at Head of Bight (HOB), South Australia, Charlton et al. (2022) report a mean calving interval of 3.3 ± 0.2 years (1991 to 2016, $n = 186$), although the authors note a significant increase in calving interval to four years in 2015 to 2016, which is also supported by the results from O'Shannessy et al. (2025) and Grundlehner et al. (2025). Female southern right whale displays high site fidelity to calving grounds; however, shifting of selected calving habitat (Watson et al., 2021) and re-establishment of former calving grounds (Charlton et al., 2019b, O'Shannessy et al. 2025)) have been reported. Despite this, recent publications reporting longer term trends in the larger western population consider that population recovery has slowed or ceased, and that recovery to pre-whaling numbers will not be reached (O'Shannessy et al. 2025, Grundlehner et al. 2025).

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Images suitable for southern right whale photo-identification collected during MESP surveys were searched for in the Southeast Australia Southern Right Whale Photo Identification Catalogue (SEA southern right whale PIC; 2015 to 2018) and Australian Right Whale Photo Identification Catalogue (ARWPIC; 1985 to 2018). Two adult females (one female and calf pair in September 2020 and one unaccompanied adult in June 2021) were successfully ‘matched.’ The individual sighted in September 2020 (ARWPIC #2163) is a known breeding female in the eastern subpopulation, previously sighted in far south coast New South Wales with a calf in August 2010 and 2013. In 2020, this same whale was sighted with a calf in Byron Bay, New South Wales, in July and Merimbula, New South Wales, in August (Marshall, pers. comm. 2022). The second individual sighted in June 2021 (ARWPIC #2930) is also a known breeding female but belongs to the western subpopulation. This whale was born at the HOB in 2006 and sighted again at HOB in 2016 with a calf. Although the individual was sighted during the June visual survey as an unaccompanied adult, it was later sighted with a calf in Fowlers Bay in late July 2021. This indicates that the Gippsland can provide a habitat for individuals from both the eastern and western subpopulations, including female and calf pairs and pregnant females, and animals entering the region may move along the south-eastern and south-western Australian coastlines.

Southern right whale social calls (upcalls and gunshots) were searched for in underwater noise recordings collected during the MESP; however, no upcalls were detected. Possible gunshot calls were detected, however, differences in the identified seasonal presence of southern right whales indicate it is probable these signals were produced by another species (Appendix A). It is possible that southern right whales in the OWFA are resting and, therefore, did not produce calls (Clark, 1982) or that there were too few southern right whales and, therefore, individuals were silent (Clark, 1982). Southern right whale female and calf pairs are known to produce vocalisations at a very low rate (Cusano et al., 2019; Nielsen et al., 2019), possibly to reduce the risk of alerting predators (Nielsen et al., 2019). As southern right whale social calls have a relatively low source level (Nielsen et al., 2019), it is also possible that calls were not identified in underwater noise recordings if whales were within the ten-metre depth contour close to the coast, due to greater attenuation in shallow water and a greater distance from the recorder (i.e. beyond detection range).

Southern right whales could occur in the OWFA and surrounding waters, most likely between March to December (particularly May to November), and this will need to be accounted for in the impact and risk assessment. However, given the known movement of photo-identified animals and lack of resights of southern right whales, it is unlikely that they will persist in the area. The exact migratory movements, including the direction of travel of southern right whales in Gippsland (i.e. movement from offshore waters or along the coastal corridor reproductive BIA), are not able to be predicted.

The National Recovery Plan for the Southern Right Whale (Commonwealth of Australia, 2024) identifies climate variability and change as the highest (very high risk) threat to the eastern southern right whale population. Entanglement in fishing/aquaculture equipment and habitat degradation due to the development of coastal and offshore infrastructure also rated very high risk. Whaling and overfishing of prey are identified as high risks. Various sources of anthropogenic underwater noise, vessel collisions, and pollution are low to moderate threats for southern right whales.

6.2.3 Humpback whale

Humpback whales (*Megaptera novaeangliae*) occupy all oceans globally. Two populations of humpback whales are found in Australian waters; the western population, known as Breeding Stock D, and the eastern population, known as Breeding Stock E1 (Schmitt et al., 2014). Individuals in the western population are not expected to occur in the east coast waters. Humpback whales were recently delisted from the threatened species list due to increasing population numbers (Bejder et al., 2016; TSSC, 2022), although the species is still listed as ‘migratory’ under the EPBC Act. In Victoria, the species is listed as ‘Critically Endangered’ under the FFG Act (DELWP, 2022).

Humpback whales from the eastern population migrate annually along the east coast of Australia to calving grounds off north QLD (Andrews-Goff et al., 2018). The main migratory route of the eastern population is east of Bass Strait. VBA records between 1979 to May 2022 and ALA records between 1975 to 2021 indicate consistent sightings of humpback whales in East Gippsland in June, and off Wilsons Promontory (approximately 45 kilometres west of the OWFA) from July to the end of October (2003 to 2010 data from DELWP, 2019). A recent study documented the movement of humpback whales close to shore in the Gippsland region in November during their southern migration (Andrews-Goff et al., 2018). Animals were shown to exhibit ‘search’ behaviour and may have been foraging (Andrews-Goff et al., 2018). There are no

BIAs for humpback whales near the OWFA. A 'migration' BIA for the species begins off Eden, NSW and extends along the eastern coastline to as far north as Bundaberg, QLD (AMSIS, accessed November 2024). Despite this, VBA and ALA records indicate consistent sightings of humpback whales in East Gippsland in June and off Wilsons Promontory (approximately 45 kilometres west of the OWFA) from July to the end of October (Figure 6-7).

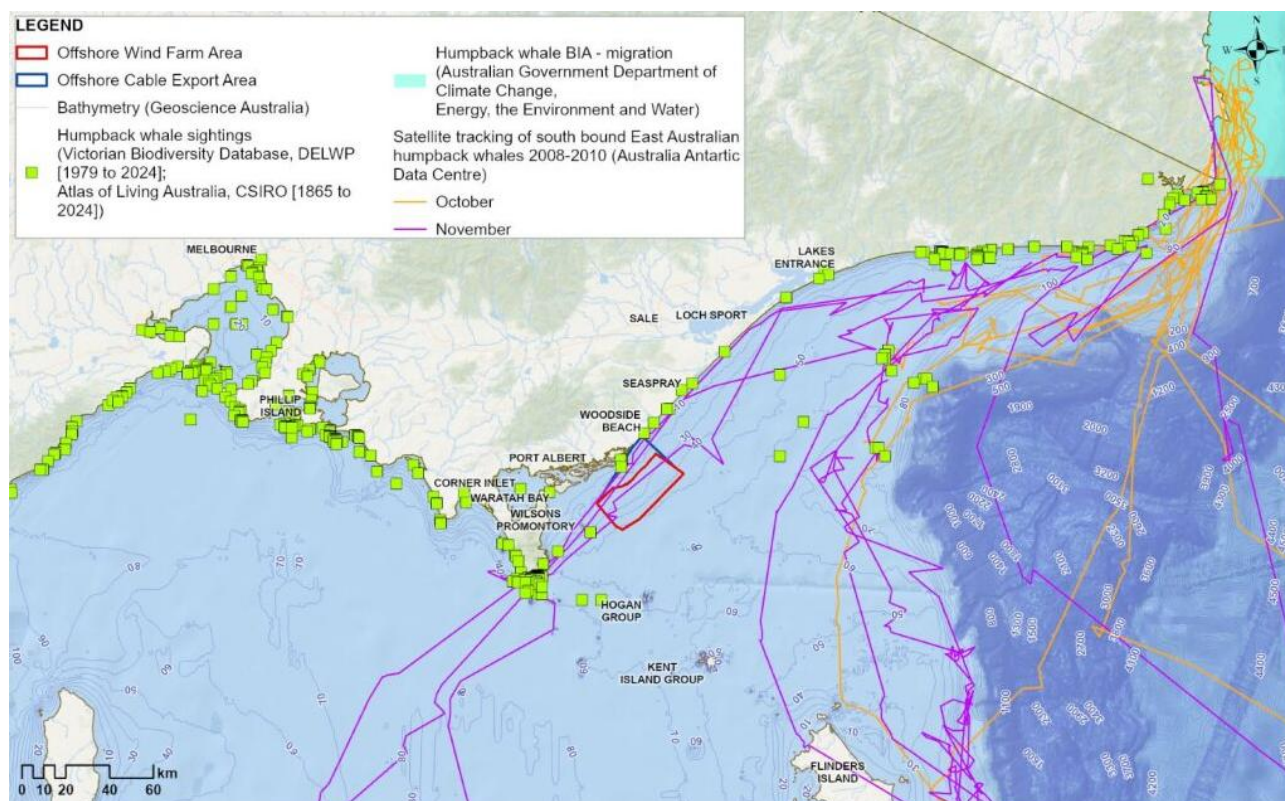


Figure 6-7: Humpback whale sightings data in the Gippsland region and tracking data (source: Andrews-Goff et al., 2018)

Humpback whales were the most observed mysticetes during the baseline survey program. Visual observations were recorded offshore of the OWFA in April and June to December. Sightings across the survey area generally occurred closer to shore, on the shallower edge of the OWFA (Figure 6-6). This is consistent with the literature, which suggests that humpback whales travel further offshore during their northward migration and closer inshore during their southern migration while travelling with calves (Noad et al., 2011). Humpback whale vocalisations (songs) were detected primarily in deeper waters offshore of the OWFA in underwater noise recordings (Appendix A).

A total of 314 humpback whales were sighted during 179 sighting events during the MESP (Figure 6-6), with a maximum of 52 individuals observed in a single survey in October (Appendix A). Humpback whales were often sighted in groups, including female and calf pairs with an escort. A much greater number of humpback whales were sighted during surveys during their southbound migration, with an increased number of sightings between September and November (Appendix A). Humpback whale calves were sighted in October and November 2020, with 11 and five calves, respectively. No humpback whale calves were sighted during the EIF program in 2023, the survey period not aligning with the species' southern migration when the species travels to their Antarctic feeding grounds. Abundance modelling indicated that up to 185 humpback whales may have been present in the OWFA and surrounding waters on any one day (highest abundance in October), and during their southbound migration, an estimated 10,864 humpback whales may be present (Appendix A). This is equivalent to about 27 per cent of the eastern humpback whale population based on a population estimate of 40,000 individuals (Noad et al., 2019). In underwater noise recordings, humpback whale presence was greatest in October, though increased singing activity was detected in August (Appendix A).

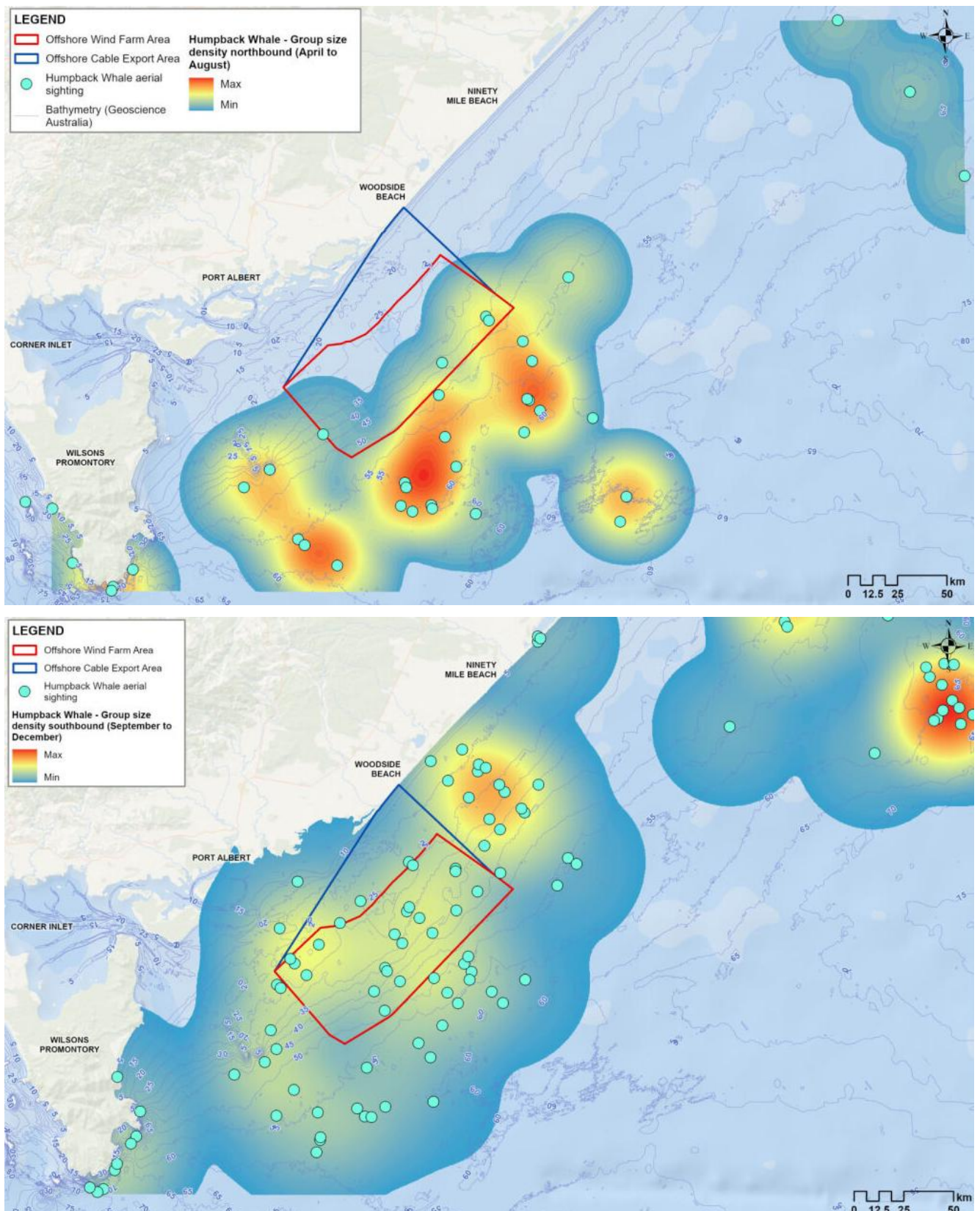


Figure 6-8: Humpback whale density by month: *top* April to August (northern migration), *bottom* September to December (southern migration) (historical data ranges from 2019 – 2021).

Almost half of all humpback whale sightings observed individuals travelling, with most moving in a westward direction (southbound migration). Other individuals were observed feeding and displaying social behaviours (Appendix A). Mysticetes, including humpback whales, typically adopt a 'feast or famine' approach to migration, fasting when not occupying feeding grounds (Chittleborough, 1965). However, it is suggested that supplemental feeding (i.e. feeding on breeding grounds or during migration to and from feeding grounds) may occur when energy requirements for migration are not being met. Eisenmann et al. (2016) suggest supplemental feeding may be a common strategy for the eastern Australia humpback whale population, and opportunistic feeding on southbound migration while still in Australian waters has been recorded since 1996 (Gill et al., 1998; Owen et al., 2017).

In waters off eastern Australia, humpback whales have been documented feeding on krill aggregations (presumably *Nyctiphanes australis*) and small schooling baitfish (e.g., baitballs) (Stockin et al., 2005; Owen et al., 2015; 2017; Pirotta et al., 2021). Owen et al. (2015) report that humpback whales encountering baitballs spent considerably less time feeding than those encountering surface swarms of krill. During visual aerial surveys, humpback whales were observed feeding on 14 occasions, including five feeding events on krill, one feeding event on baitfish and eight feeding events on unidentified prey species. An additional six 'possible feeding' events were observed. Feeding events were primarily sighted in the spring months (September to November), though occasionally as early as April (krill) and June (baitballs). This indicates that humpback whales will also feed opportunistically while on their northbound migration at the start of their winter 'fasting' period. Possible feeding was also reported in early June and between September and November. Surface krill swarms were primarily sighted in waters offshore of the OWFA, and all humpback whale feeding events were sighted outside of the OWFA, including along control transects northeast of the OWFA (Appendix A).

Humpback whales, including females with calves, were present in the OWFA and surrounding waters during the austral winter to spring months. The presence of migrating humpback whales in spring likewise aligns with peak upwelling seasons for surrounding areas, with the potential for increased productivity in the north-eastern Gippsland region around the Bass Canyon during this time. Humpback whales, including calves, were present more frequently in the OWFA during their southern migration (September to early December) than their northern migration (April to August) but have the potential to be in the OWFA for both migration journeys.

6.2.4 Other Mysticetes (baleen whales)

Other mysticete species observed in the Gippsland region as per the VBA and ALA database are shown in Figure 6-9.

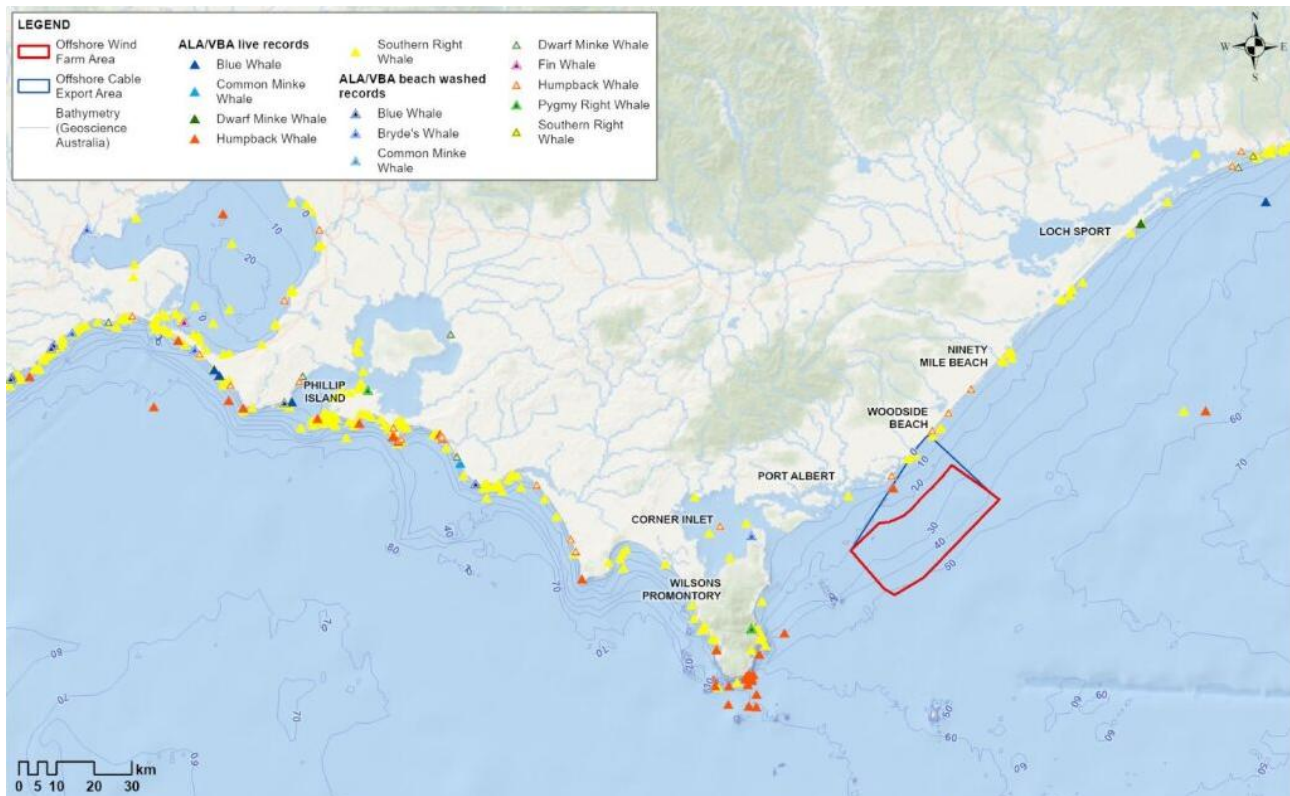


Figure 6-9: Historic sightings of other mysticete species in Bass Strait and in proximity to the offshore wind farm area and offshore export cable area (historic sightings range from 1760 – 2021)

6.2.4.1 Sei whale

Sei whales (*Balaenoptera borealis*) can be found in most oceans globally ranging from polar to tropical latitudes and tend to inhabit deep offshore waters (Perrin et al., 2009). Sei whales move through Australian waters between subantarctic feeding areas (e.g. the Southern Ocean Subtropical Front) and lower latitude winter breeding grounds, completing long annual seasonal migrations. However, details of this migration and whether it involves the entire population are unknown (TSSC, 2015b). There are no sei whale population estimates for Australian waters, nor is it known if there are any known mating or calving areas in Australian waters (TSSC, 2015b). Sei whales typically travel in small groups of three to five animals, with some segregation by age, sex, and reproductive status (Horwood, 1987).

Sei whales have been sighted west of the Gippsland region in areas such as the Bonney Upwelling off South Australia (Miller et al., 2012), where opportunistic feeding has been observed between November and May (Gill et al., 2015). Gill et al. (2015) reported a mean depth distribution of 160 ± 137 metres for sei whales in the Bonney Upwelling, suggesting they occupy offshore deep waters. A small number of sei whale females and calves have also been observed about 40 kilometres south of Hobart, Tasmania (Ensor et al., 2002). There is only one record for the sei whale in the ALA, located in far southwest Victorian waters, and no sei whale records are documented in the VBA.

Sei whales are not expected to occur within the OWFA due to the shallow water depths (up to 56 metres depth) and because there were no visual sightings or acoustic detections of sei whales during the baseline surveys. Sei whales are predicted to be potentially present in or near the OWFA only from a PMST search. For the EIA, the sei whale will be considered in a category with other mysticetes that are unlikely to be but could be present.

6.2.4.2 Fin whale

The fin whale (*Balaenoptera physalus*) is a baleen (mysticete) whale that occurs globally from polar to tropical waters. Fin whales usually occur in offshore waters and are rarely sighted in inshore coastal areas. Due to heavy industrial whaling pressure, the global fin whale population is estimated to have declined by over 70 per cent since 1929, with little recovery (TSSC, 2015a). Fin whales are thought to undertake long

migrations from higher-latitude summer feeding grounds to lower-latitude winter breeding grounds (Bannister, 2008). Three subspecies of fin whale are currently recognised: *B. p. physalus* in the North Atlantic Ocean, *B. p. velifera* in the North Pacific Ocean, and *B. physalus quoyi*, which is found in oceans of the southern hemisphere, including Australian waters (Committee on Taxonomy, 2021; Aulich et al., 2022). Fin whales are listed as 'vulnerable' and 'migratory' under the EPBC Act. Currently, fin whales are not listed under the FFG Act in Victoria.

There are no live records of fin whales in Victorian waters documented in the ALA or VBA database. Gill et al. (2015) reported fin whale presence in the deep waters of the Bonney Upwelling (greater than 450 kilometres west of the OWFA), with a mean depth distribution of 162 ± 90 metres. Recent studies utilising passive acoustic monitoring data across 15 locations from 2002 to 2019 have identified the seasonal distribution and migratory pathways of the fin whale in Australian waters from East Antarctic waters (Aulich et al., 2019, 2022). The long-term, seasonal acoustic presence of the animals was identified on both the east and west coasts of Australia from May to October (Aulich et al., 2022). On the east coast, the animals first arrive from Antarctica in waters off Tasmania in May (approximately 500 kilometres south-west of the OWFA), before migrating along the coast to as far north as Tuncurry, NSW, (approximately 900 kilometres north of the OWFA) (Aulich et al., 2019, 2022). The fin whales arrived in June and were present until late September to October each year in waters off Tuncurry (Aulich et al., 2019). The Tuncurry and Tasmania sites are suggested as travelling zones, with the animals not lingering in these areas (Aulich et al., 2022).

In Portland, 500 kilometres west of the OWFA, and Kangaroo Island, 800 kilometres northwest of the OWFA, fin whale vocalisations were limited and inconsistent, occurring from July to October throughout the years of the study (Aulich et al., 2022). The authors surmise that this low vocal presence recorded at these locations may indicate that fewer animals are migrating along the southern coastline of Australia (Aulich et al., 2022).

Given the identified acoustic presence and migratory movement of fin whales in the east coast region of Australia, fin whales may pass offshore of the Gippsland project area on their migration routes north and south along the east coast. However, there are no records of fin whale sightings within the area (DELWP, 2019), no fin whales were visually observed or acoustically detected in the MESP, and fin whales are not expected to occur within the OWFA due to the shallow water depths (generally less than 50 metres depth). However, for the purposes of the EIA, the fin whale will be considered in a category with other mysticetes that are unlikely to be but could possibly be present.

6.2.4.3 Minke whale

Minke whales inhabit all oceans, including tropical as well as polar waters (Risch et al., 2019). There are two species currently recognised: common minke whale (*Balaenoptera acutorostrata*) and Antarctic minke whale (*Balaenoptera bonaerensis*). Common minke whales are further split into two subspecies: Scammon's minke whale (*Balaenoptera acutorostrata scammoni*) and dwarf minke whale (*B. a.* unnamed subspecies). Common minke whales and Antarctic minke whales are known to occur in Australian waters (Risch et al., 2019). Minke whales may occur broadly from Victoria to northern Queensland between March and October (Minke Whale Project, 2018).

6.2.4.3.1 Dwarf minke whale

Dwarf minke whales regularly aggregate at the northern Great Barrier Reef (GBR) between March and October, with peak sightings in June and July (Minke Whale Project, 2018). Small numbers of calves (usually one to two individuals) are recorded at the northern GBR from May to July, suggesting these waters may represent a minor nursery area for the species (Sobtzick, 2010). Scattered sightings and strandings from southern QLD and northern NSW early (May to June) and late (September) in the season suggest a migration route along the east Australian coast, but records are too few to document movements of the whales (Minke Whale Project, 2018). However, Birtles et al. (2015) analysed satellite tracking data of dwarf minke whales tagged in the northern GBR and found that six of the tagged whales spent considerable time (greater than 1.5 weeks) moving around the Bass Strait, especially in an area between 30 to 180 kilometres east of King Island, potentially foraging. A solitary dwarf minke whale was reported at the HOB in July (Ward, pers. comm.), and therefore, dwarf minke whales may also occupy waters along the southern Australian coastline during the winter period.

Dwarf minke whales appear to be coastal, occupying shallow waters between 4 to 200 metres deep (Zerbini et al., 1997). While migrating south from the GBR, dwarf minke whales occupied a mean distance from shore of 22 kilometres. Along the east coast of Australia, the shelf break is uniformly close to shore, and all tagged dwarf minke whales rarely ventured out past the shelf break after departing the GBR (Birtles et al., 2015).

During their southern migration, dwarf minke whale swim speeds were nearly twice as fast as swim speeds while moving within the GBR (Birtles et al., 2015).

During the MESP, three solitary dwarf minke whales were observed outside the OWFA during visual aerial surveys in April, May and August, and a 'like dwarf minke whale' was sighted in September (Figure 6-6; Appendix A). A solitary dwarf minke whale was sighted near the OWFA during opportunistic boat-based surveys in April, and Wildlife Coast Cruises recorded two sightings of dwarf minke whales, one sighting with three individuals in August and one individual in September, and a possible minke whale observed in October around Wilsons Promontory (Appendix A). Dwarf minke whale vocalisations were detected in acoustic recordings between March to November, with peak occurrence seaward of the OWFA during late April to late May (Appendix A). The appearance of dwarf minke whale calls in underwater noise recordings was sporadic, never lasting more than a few days, indicating that whales travelled past the area relatively quickly. The median number of dwarf minke whale callers was greater offshore than within the OWFA, indicating larger pods travelled in deeper waters seaward of the OWFA (Appendix A). The single dwarf minke whale visually sighted in April was observed feeding on surface krill swarms in approximately 60 metres water depth offshore of the OWFA (Appendix A).

Given the few dwarf minke whales seen during the multi-year duration of the baseline survey program, it is not likely that the OWFA provides important habitat for dwarf minke whale populations, and their presence is expected to be limited to occasional transient individuals or small groups in waters along the seaward boundary of the OWFA and further offshore. However, given that whales could potentially be present in the vicinity of the OWF, for the EIA, the dwarf minke whale will be considered in a category with other mysticetes that are unlikely to be but could be present.

6.2.4.3.2 Antarctic minke whale

Antarctic minke whales (*Balaenoptera bonaerensis*) occupy primarily offshore and pelagic habitats throughout the southern hemisphere, including feeding grounds from 55°S to the Antarctic ice edge, and breeding grounds at mid-latitudes between 30 °S and 10 °S (Perrin et al., 2002). The migratory behaviour of Antarctic minke whales is thought to be complex, with part of the population undertaking a seasonal northbound migration during February to March and continuing into the winter months, while another part remains in Antarctic feeding grounds year-round (Filun et al., 2020). There are no Antarctic minke whales recorded in the VBA database and just one stranding record in western Victoria in the ALA database. However, as the species is sympatric with dwarf minke whales in much of their range (Acevedo et al., 2011), some visual-based information can be ambiguous or inaccurate due to potential misidentification.

Antarctic minke whale vocalisations were detected sporadically in acoustic recordings from July to March, with increased presence detected in acoustic recordings from a logger situated on the eastern (seaward) boundary of the OWFA. In 2020, the species was first detected from early July onward, with the latest detection in February 2021. In 2021, the animals had a limited presence in March at the northeast site, then returned consistently singing from July, with the last detection in February 2022. Antarctic minke whale presence in January to March was not expected as whales were thought to occupy Antarctic waters during this time. The peak calling occurrence was consistently over late August to late September. Almost all instances of Antarctic minke whale calling were produced by a single animal, although there were occasions where up to three singers may have been present at any one time. A single 'like Antarctic minke whale' was sighted during visual aerial surveys in June 2021 seaward of the OWFA in around 45 metres' water depth (Figure 6-6).

While Antarctic minke whales are known to occur in Australian waters and the result of this baseline survey program are consistent with this, their distribution patterns and seasonal presence is uncertain. It is not likely that the OWFA provides an important habitat for populations of this species, given the acoustic detections recorded and as only one individual was seen over approximately two and a half years of surveys. The presence of Antarctic minke whales is expected to be limited to occasional transient individuals or small groups, predominantly in deeper waters seaward of the OWFA. However, for the EIA, the Antarctic minke whale will be considered in a category with other mysticetes that are unlikely to be but could be present.

6.2.4.4 Bryde's whale

Bryde's whales (*Balaenoptera edeni*) occur in temperate to tropical waters, both oceanic and inshore (Bannister et al., 1996). Although this species was not listed in the PMST search, it has been included here, given the historical sightings in the area and a sighting during the MESP survey. Bryde's whales are not well surveyed in Australian waters. For many years, sei whales were recorded as Bryde's whales, and therefore,

historical sightings data may not be accurate (DoEE, 2019). There were just five Bryde's whale sightings in Victoria documented in the VBA database between 1968 and 2017, including one at Wilsons Promontory, though all sightings were of beached deceased whales (DELWP, 2019). Four Bryde's whales were recorded as stranded in Victoria between 1920 and 2016, including a single immature female at Corner Inlet, approximately 25 kilometres northwest of the OWFA, in October 1992 (Foord et al., 2019).

A single Bryde's whale was sighted in October 2020 during visual aerial surveys of the MESP located just outside the surf zone in coastal waters (Figure 6-6; Appendix A). A possible explanation for this near-shore sighting could be that it was feeding on schools of baitfish along the surf zone, although they were not seen near the whale. A probable Bryde's whale was also sighted and reported in a local newspaper in August 2022 in the shallow waters of Ninety Mile Beach (Gippsland Times, 2022), located northeast of the OWFA.

Unlike most other mysticetes, Bryde's whales do not undertake large-scale migrations to productive high-latitude waters, instead foraging in less productive temperate to tropical waters (Bannister, 2018). Bryde's whales can be found in inshore and offshore waters in depths ranging from 12 metres to over 200 metres (Wiseman et al., 2011). Bryde's whales usually swim alone or in pairs, though there have been reports of up to 20 whales loosely grouped in feeding areas (NOAA, 2024).

Given the above, it is not expected that the OWFA provides critical habitat for populations of Bryde's whales, however, there is the potential for Bryde's whales to be present in or near the OWFA, and if so, this will likely be in the form of occasional transient individuals or small groups. For the EIA, the Bryde's whale will be considered in a category with other mysticetes that are unlikely to be but could be present.

6.2.4.5 Pygmy right whale

Pygmy right whales (*Caperea marginata*) are found in temperate and subantarctic waters in both oceanic and inshore locations. Little is known about pygmy right whale migration patterns. Records of pygmy right whales in Australian waters are distributed between 32° S and 47° S but are not uniformly spread around the coast (Kemper, 2002). The majority of sightings have occurred around the entrance of the gulfs in South Australia, Tasmania, and the western coast of Victoria (Kemper, 2002). The northern distribution of pygmy right whales on the east coast is thought to be limited by the warm, south-flowing EAC (Kemper, 2002).

Pygmy right whales have primarily been recorded in areas associated with upwellings and with high zooplankton abundance, particularly copepods and small euphausiids which constitute their main prey (Sekiguchi et al., 1992; Kemper, 2002). Gill et al. (2008) documented a group of pygmy right whales in the Bonney Upwelling in 150 metre water depth. Individuals have also been seen in sheltered shallow bays, but it appears that these are predominantly juveniles and sub-adults (Kemper, 2002).

The majority of sightings in Victorian waters occurred on the western coast of the State near Portland, approximately 500 kilometres west of the OWFA. Between 1986 and 2006, sightings in Victorian waters occurred between September and February and consisted of six live sightings and 35 carcasses. On the east coast of Victoria, in closer proximity to the OWFA, just five pygmy right whale sightings have been recorded, all carcasses. The largest group that has been sighted (more than 100) was near Portland and occurred in June 2007 (Gill et al., 2008). There are few confirmed sightings of pygmy right whales at sea (Bannister et al., 2008).

The PMST report predicts that foraging, feeding or related behaviour may occur within the OWFA due to the presence of suitable habitat. There were no sightings of pygmy right whales during the MESP, and given the low number of sightings in Victoria, it is unlikely that pygmy right whales would be present in the OWFA. As a conservative approach, for the EIA, the pygmy right whale will be considered in the category with other mysticetes that are unlikely to but could be present in the OWF area and surrounds.

6.2.5 Odontocetes (dolphins)

Odontocete (dolphin) species observed in the Gippsland region as per the VBA and ALA database, are shown in Figure 6-10.

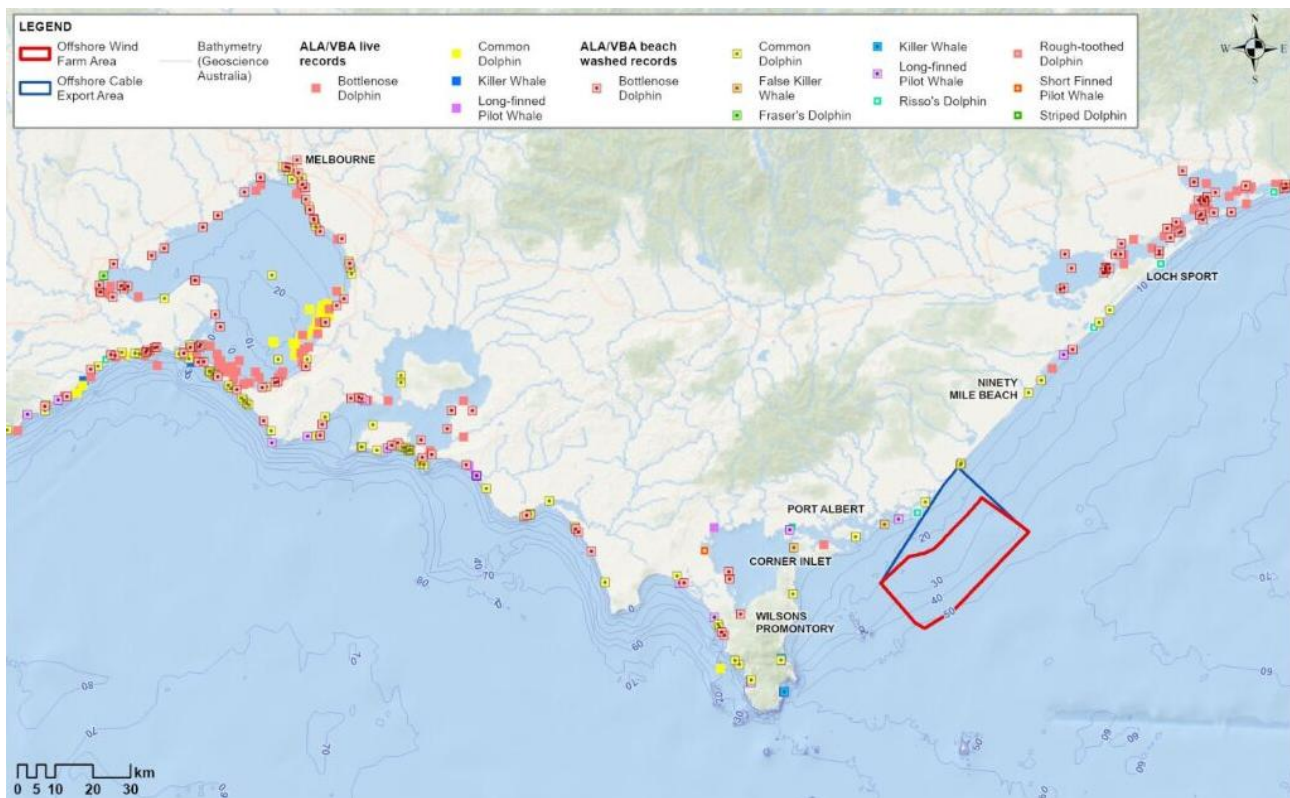


Figure 6-10: Historic sightings of odontocetes including dolphin species in Bass Strait and in proximity to the offshore wind farm area and offshore export cable area (historic sightings range from 1760 – 2021)

6.2.5.1 Common dolphin

Short-beaked common dolphins (*Delphinus delphis*), hereafter referred to as ‘common dolphins’, are a globally abundant species, widely distributed from tropical to cool temperate waters. Common dolphins are generally considered an offshore species, known to inhabit open ocean shelf and pelagic waters, particularly in regions with complex bathymetry or high productivity (Mason et al 2016; Perrin et al 2009). However, they can be found closer to shore and in shallower waters, for example, at Port Phillip Bay, approximately 170 kilometres west of the OWFA (Mason et al., 2016). Stranding records suggest common dolphins are active in the Bass Strait year-round.

A population genetic analysis of common dolphins from shelf, coastal, gulf and embayment waters of southern and southeastern Australia identified six distinct populations, including one located east of Wilsons Promontory (Bilgmann et al., 2014). The study suggests that common dolphin spatial variation may be driven by geography (ocean basins), upwellings and productivity and / or prey distribution, which has also been previously suggested by Möller et al. (2011). The OWFA and surrounding waters have relatively low productivity with negligible influence from surrounding upwelling areas (Huang and Wang, 2019). However, given the proximity to productive areas (e.g. Upwelling East of Eden KEF located approximately 100 kilometres north-east of the OWFA) is possible that common dolphins may transit the OWFA and surrounding waters to areas of high productivity.

There are no estimates of population size or information on population trends for common dolphins in Australian waters. Common dolphins, including ‘like common’ dolphins, were the most abundant marine mammal species observed during visual aerial surveys of the MESP sighted during every month of the year (Appendix A). Dolphin whistles were detected in underwater noise recordings during all months of the year, though they were not identified down to species level (Appendix A). Abundance modelling indicated that up to 1,247 common dolphins may be present in the OWFA and surrounding waters at any point in time, with the highest estimated abundance in September and the lowest estimated abundance in October of just seven individuals (Appendix A). Visual sightings of common dolphins and consequently estimated density were lowest closest to shore where depths were shallow and increased with depth (Figure 6-11).

Common dolphins are often sighted in groups of 20 individuals to hundreds and thousands of individuals (Evans, 1994). During the MESP, the mean group size was 17 individuals, though large pods of around 300

individuals were sighted on two occasions in approximately 60 to 65 metres water depth offshore and north-east of the OWFA (Appendix A). Most sightings from the visual aerial surveys recorded behaviour as travelling (61 per cent) followed by feeding (23 per cent) and resting / milling (6 per cent) (Appendix A).

Common dolphins are likely to be present in waters offshore of the OWFA year-round and may also be present in the OWFA year-round.

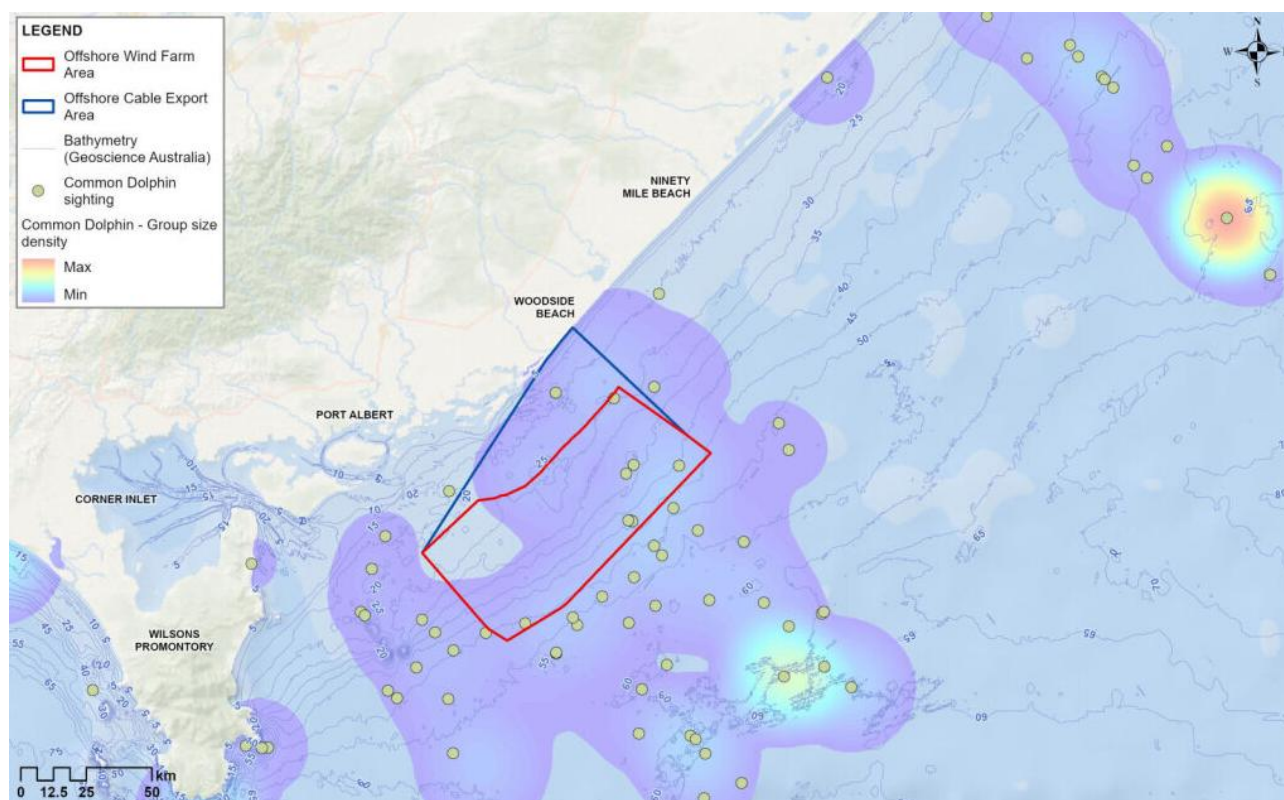


Figure 6-11: Density of common dolphins during visual aerial surveys (December 2019 to December 2021).

6.2.5.2 Bottlenose dolphins (Indo-Pacific and common)

Bottlenose dolphins (*Tursiops sp.*) have a worldwide distribution in tropical to temperate waters and can be found in a wide range of habitats, including coastal, estuarine, pelagic and oceanic waters. There are two species of bottlenose dolphin currently recognised: common bottlenose dolphin (*T. truncatus*) (including the Burruran dolphin) and Indo-Pacific bottlenose dolphin (*T. aduncus*). Indo-Pacific bottlenose dolphin distribution is restricted to shallow waters, while common bottlenose dolphins can be found in nearshore and offshore waters (Möller et al., 2001).

In Australia, common bottlenose dolphins are usually found offshore in waters deeper than 30 metres (Hale et al., 2000; Ross, 2006) but also appear to be found in some coastal areas (Hale et al., 2000; Kemper, 2004). It is considered likely that the species is common in offshore waters of southeastern Australia (Peddemors & Harcourt, 2006, pers. comm. via Commonwealth of Australia, 2024). This is supported by sightings along the Gippsland coast from Wilsons Promontory to Mallacoota (northeast and southwest of the OWFA, respectively) (DELWP, 2019). In contrast, the Indo-Pacific bottlenose dolphin is restricted to inshore areas such as bays and estuaries, nearshore waters, open coast environments, and shallow offshore waters, including coastal areas around oceanic islands (Hale et al., 2000; Möller and Beheregaray, 2001).

During the MESP, observations of bottlenose dolphins were not identified down to species level. Bottlenose dolphins, including 'like' bottlenose dolphins, were the second most abundant marine mammal species observed during visual aerial surveys of the MESP sighted during every month of the year (Appendix A). Dolphin whistles were detected in underwater noise recordings during all months of the year, though they were not identified down to species level (Appendix A). Abundance modelling found that dolphin abundance was greater in January to June, with up to 342 individuals present in the OWFA and surrounding waters at any point in time during the season, and 277 individuals between July to December (Appendix A). Visual sightings of bottlenose dolphins and consequently estimated density was highest north-east of the OWFA and closer to the coast and decreased away from the coast (Figure 6-12).

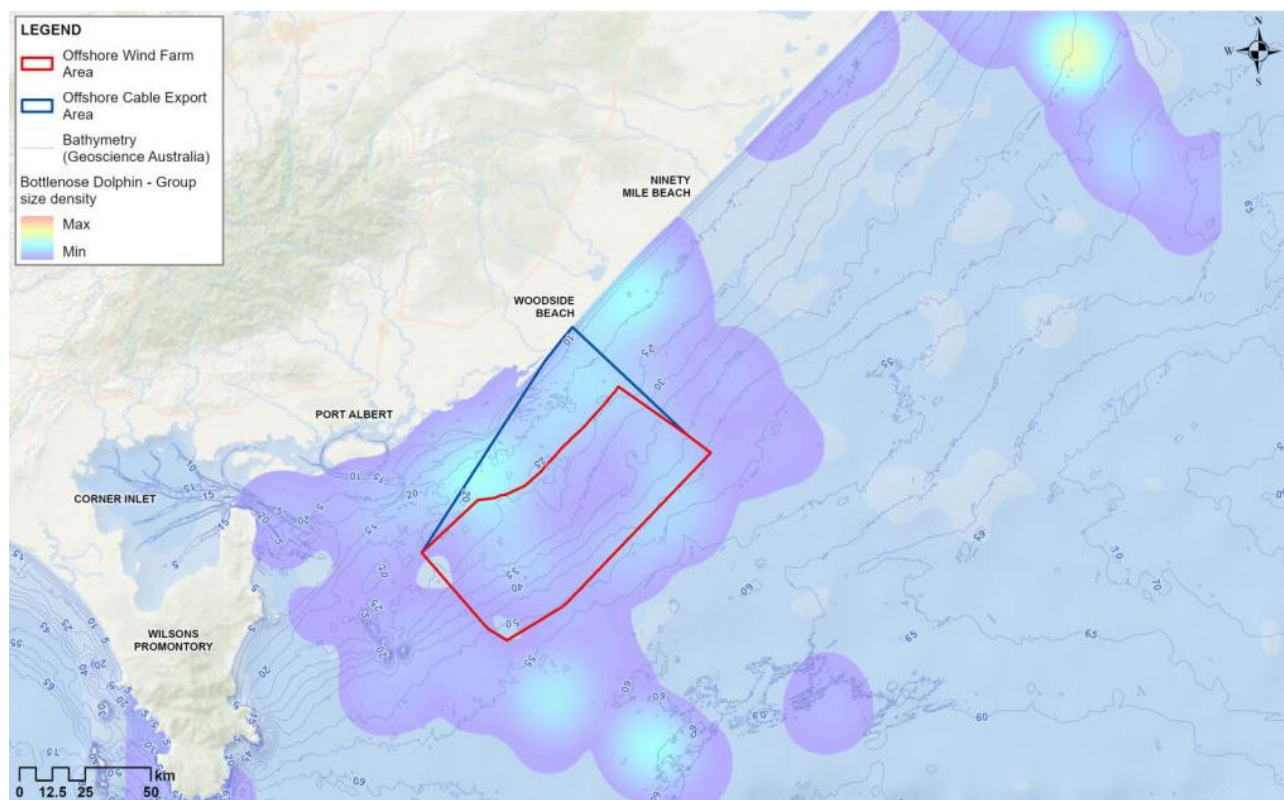


Figure 6-12: Density of bottlenose dolphins during visual aerial surveys (December 2019 to December 2021).

Bottlenose dolphins live in fission-fusion societies where groups move between larger and smaller units (Connor et al., 2000), with group sizes ranging from two up to about greater than 100 individuals (Saayman et al., 1973). During the MESP, the mean group size was ten individuals, though larger pods of around 50 to 70 individuals were sighted on six occasions (Appendix A). Most sightings from the visual aerial surveys recorded behaviour as travelling (60 per cent) followed by resting / milling (17 per cent) and feeding (13 per cent). Other behaviours included socialising and logging. (Appendix A). Bottlenose dolphin calves were sighted on five occasions (Appendix A).

Bottlenose dolphins were present in the OWFA year-round, with a higher presence in the first half of the year.

6.2.5.3 Striped dolphin

Striped dolphins (*Stenella coeruleoalba*) are known to inhabit pelagic and oceanic waters (deeper than 1000 metres) and are most frequently found in warm tropical and temperate waters where the sea surface temperature exceeds 25 °C (Au et al., 1985). There have been 14 sightings in Victorian waters documented in the ALA database between 2011 and 2017, 11 of which were strandings and none of which occurred in the OWFA or surrounding waters. There are no abundance estimates for striped dolphins in Australia (Bannister et al., 1996).

Although the striped dolphin was not predicted as having the potential to be present in the OWFA from the PMST search, two 'like striped dolphins' were observed just outside the NE corner of the OWFA in September 2021, reportedly feeding amongst a group of common dolphins and near feeding humpback whales. Given the shallow water depths of the OWFA, the presence of striped dolphins is expected to be limited to highly occasional individuals. For the EIA, the striped dolphin will be considered in a category with other odontocete-dolphins that could be present.

6.2.5.4 Risso's dolphin

Risso's dolphin (*Grampus griseus*) occurs in all habitats from coastal to oceanic, with a strong range-wide preference for mid-temperate waters of the continental shelf and slope between 30° and 45° latitude with depth of waters around 180 to 200 metres; however, they have also been found in shallow coastal waters (Jefferson et al., 2014). Risso's dolphins prefer warm temperate to tropical waters with depths greater than

1,000 metres, although they do sometimes extend their range into cooler latitudes in summer (Bannister et al., 1996).

In Australia, Risso's dolphins have been recorded in all states and territories 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). Risso's dolphins are predicted to be potentially present in or near the OWFA from the PSMT search, but the only records from the VBA near the OWFA are of two beached individuals in April 1986 and November 2014 (DELWP, 2019). Risso's dolphins are usually gregarious, living in groups of 25 to several hundred individuals, although they have also been observed as solitary individuals (Leatherwood and Reeves, 1983). There are no known calving areas in Australian waters.

There were no visual sightings of Risso's dolphins during the MESP. Dolphin whistles were detected in underwater noise recordings, though they were not identified down to species level. For the EIA, Risso's dolphin will be considered in a category with other odontocete-dolphins that could be present.

6.2.5.5 Killer whale

Killer whales (*Orcinus orca*) have been reported in all Australian state and territory waters with an increase in sightings off southern Australia, from southern New South Wales (Merimbula) to western Victoria (Portland) (Mustoe, 2008) and off Western Australia (Salgado Kent et al., 2020). In Australia, Antarctic Type B and Type C killer whales, and a third form closely representing Antarctic Type A killer whales have been sighted (Donnelly et al., 2021; Wellard et al., 2015). Antarctic Type C killer whales were recently recorded for the first time in Victorian waters (Thomas and Fistic, 2022). Killer whales are most common in cold, deep waters; however, they are also often observed along the continental slope and shelf, particularly near seal colonies (Bannister et al., 1996).

There are no known aggregations or migratory routes of killer whales in Victorian waters; however, they have been reported to move seasonally to areas of food supply (Morrice, 2004). In Victoria, sightings have been reported to peak in mid-winter (June to July), where they have been observed feeding on sharks, sunfish, and Australian fur seals (Mustoe, 2008). Off coastal Victoria, there is a paucity of data between Wilsons Promontory and Lakes Entrance (encompassing the OWFA), likely due to the poor coastal access and absence of human habitation (Mustoe, 2008). However, Mustoe (2008) reported that killer whales from Victoria almost certainly occupy home ranges that extend into southern New South Wales and, therefore, likely include the OWFA.

Killer whales were predicted to be potentially present in the OWFA from the PMST search and two killer whales were sighted during MESP visual aerial surveys in July, with a possible third like-killer whale sighted in April (Appendix A). A single sighting of three killer whales just off the point of Wilsons Promontory was reported by the Wildlife Coast Cruises tour operators in December.

Killer whales may be present in the OWFA; however, their presence is expected to be limited to occasional transient individuals or small groups. For the EIA, the killer whale will be considered in a category with other odontocete-dolphins that could be present.

6.2.5.6 False killer whale

False killer whales (*Pseudorca crassidens*) have a worldwide distribution and are found in deep tropical and temperate waters (Odell and McClune, 1999). In Australia, false killer whales are considered to have a pelagic distribution (Baird, 2009) and are widely distributed, with strandings reported in every state and territory (DCCEEW, 2024). There are no estimates of the false killer whale population size, either globally or for Australia, so the proportion of the global population in Australian waters is unknown (DCCEEW, 2024).

False killer whales occur in socially cohesive groups of about 20 to 50 animals (Ross, 2006). There have been no live sightings of false killer whales in the Gippsland or broader Victorian region. However, two false killer whale strandings occurred on the Victoria coastline (Bannister et al., 1996; Chatto et al., 2000), one of which occurred at Port Albert, directly adjacent to the OWFA (DELWP, 2019).

Although false killer whales were predicted to be potentially present in the PMST search, there were no visual sightings or acoustic detections of false killer whales during the MESP. For the purposes of the EIA the killer whale will be considered in a category with other odontocete-dolphins that could possibly be present.

6.2.6 Odontocetes (whales)

Odontocete whale species observed in the Gippsland region as per the VBA and ALA database are shown in Figure 6-10.

Although no odontocete (whales) were identified as possibly being present in the OWF area from the PMST search, several species were identified as possibly being in the OWF area from the VBA / ALA databases. and so were taken through to the second step of the scoping process. Species that were not ruled out in the first step of the scoping process included sperm whales, pygmy sperm whales, dwarf sperm whales, long and short-finned pilot whales, Cuvier's beaked whale, and the strap-tooth beaked whale. All were, however, ruled out for inclusion in the EIA due to their low likelihood of occurrence because of low numbers of database records, of which the majority were deceased, beached individuals (Appendix A), and their predicted habitat use patterns, which is a preference for deeper, oceanic waters at the edge or off the continental shelf where they predominantly feed on epipelagic (upper ocean zone) schooling and mesopelagic (middle ocean zone) teleost fishes, squids and other cephalopods, crustaceans and benthic invertebrates (DCCEEWS PRAT database).

During the baseline surveys, a stranded sperm whale measuring 11 metres in length was observed during visual aerial surveys washed up at Flamingo Beach, approximately 45 kilometres northeast of the OWFA in January 2021. A second sperm whale measuring 16 metres in length was reported stranded at Forrest Caves, Phillip Island, over 120 kilometres northwest of the OWFA in March (Dexter, 2021). The cause of death of both whales is unknown. There was no observation of any other species of odontocete whales identified above during baseline surveys.

Sperm whales (*Physeter macrocephalus*) have been recorded in all Australian state and territory waters (Bannister et al., 1996). There are no recognised calving areas in Australian waters, and it is likely their presence is limited to foraging individuals. Like the other odontocete whales identified above, sperm whales typically forage in waters over 400 metres deep along continental slopes and ridges, in coastal upwellings of cold-nutrient rich waters, and in areas of high primary productivity (Jaquet et al., 1996; Pirodda et al., 2011). The closest known foraging BIA for sperm whales is located south of Kangaroo Island in SA, far west of the OWFA. The sperm whale was not predicted to be present in the area from the PMST search.

Victorian strandings records from 1920 to 2009 report 34 stranding events of sperm whales comprising 70 individuals, 33 of which were of a single animal, with one mass stranding of 37 individuals at Phillip Island in February 1972 (Foord et al., 2019). Sperm whale strandings were predominantly recorded in the Otway region west of the OWFA, with just five strandings reported east of Wilsons Promontory in the Gippsland region between 1920 and 2016, including one at Ninety Mile Beach, approximately 90 kilometres northeast of the OWFA (Foord et al., 2019). Sperm whale strandings were recorded in most months of the year, excluding May and July, with the highest number of strandings reported during January (n = five), followed by October and December (n = four) (Foord et al., 2019).

Given the absence of BIAs and shallow water depths of the OWFA, healthy live sperm whales are not expected to occur. Even though two whales were seen during baseline surveys, the presence of sperm whales in the OWFA and surrounds is expected to be limited to rare, stranded individuals as has been determined for the other odontocete (whales) that were taken through to the second step of the scoping process. Subsequently, sperm whales were not considered to have the potential to be affected by the construction, operation, and decommissioning of the OWF and were not included in the EIA.

6.2.7 Pinnipeds

The DCCEEWS website notes that five otariid (eared seals) and five phocid (earless or 'true' seals) species are found in Australian waters. Of the otariid family, this includes the Australian fur seal (*Arctocephalus pusillus*), New Zealand fur seal (*Arctocephalus forsteri*), Australian sea lion (*Neophoca cinerea*), Antarctic fur seal (*Arctocephalus gazella*), and the subantarctic fur seal (*Arctocephalus tropicalis*). Seals from the phocid family found in Australian waters include the southern elephant seal (*Mirounga leonina*), leopard seal (*Hydrurga leptonyx*), crab-eater seal (*Lobodon carcinophaga*), Weddell seal (*Leptonychotes weddellii*), and Ross seal (*Ommatophoca rossii*). None of the members of the phocid family were identified as being potentially present in the PMST database search for the OWFA, although the southern elephant seal (eight records in the last 50 years), leopard seal (42 records in the last 50 years) and crab-eater seals (two records in last 25 years) have been observed in the Gippsland region as recorded in the VBA and ALA databases (Figure 6-13). Leopard seals primarily inhabit Antarctic pack ice, but vagrants are seen irregularly offshore from all the southern continents. No phocids were sighted during the two-year MESP baseline survey. Due to

the limited likelihood of seals from the phocid family being present in the OWFA and surrounds, they were not included in the EIA.

Of the otariid seals, Australian sea lions and subantarctic fur seals were identified to be potentially present in the OWFA from the PMST database search, though they were not seen during the MESP baseline surveys. These species have been observed in Victorian waters and, therefore, have been recorded in the VBA and ALA databases; however, the Australian sea lion sightings only occurred west of Phillip Island, and subantarctic fur seal sightings were rare. The Antarctic fur seal was not identified as having the potential to be present in the OWFA from the PMST search, was not detected during the MESP baseline surveys, and no sightings have been recorded in the VBA or ALA. Subsequently, these three species were not considered in the EIA.

Australian and New Zealand fur seals were present in the PMST database search, are regularly sighted in the Gippsland region according to VBA and ALA database records, and were also commonly sighted during the MESP baseline surveys. Subsequently, these two species are highly likely to occur in the OWFA and surroundings during the construction, operation, and decommissioning of the OWF and were, therefore, included in the EIA. To support the EIA, further background information for these two species is described below.

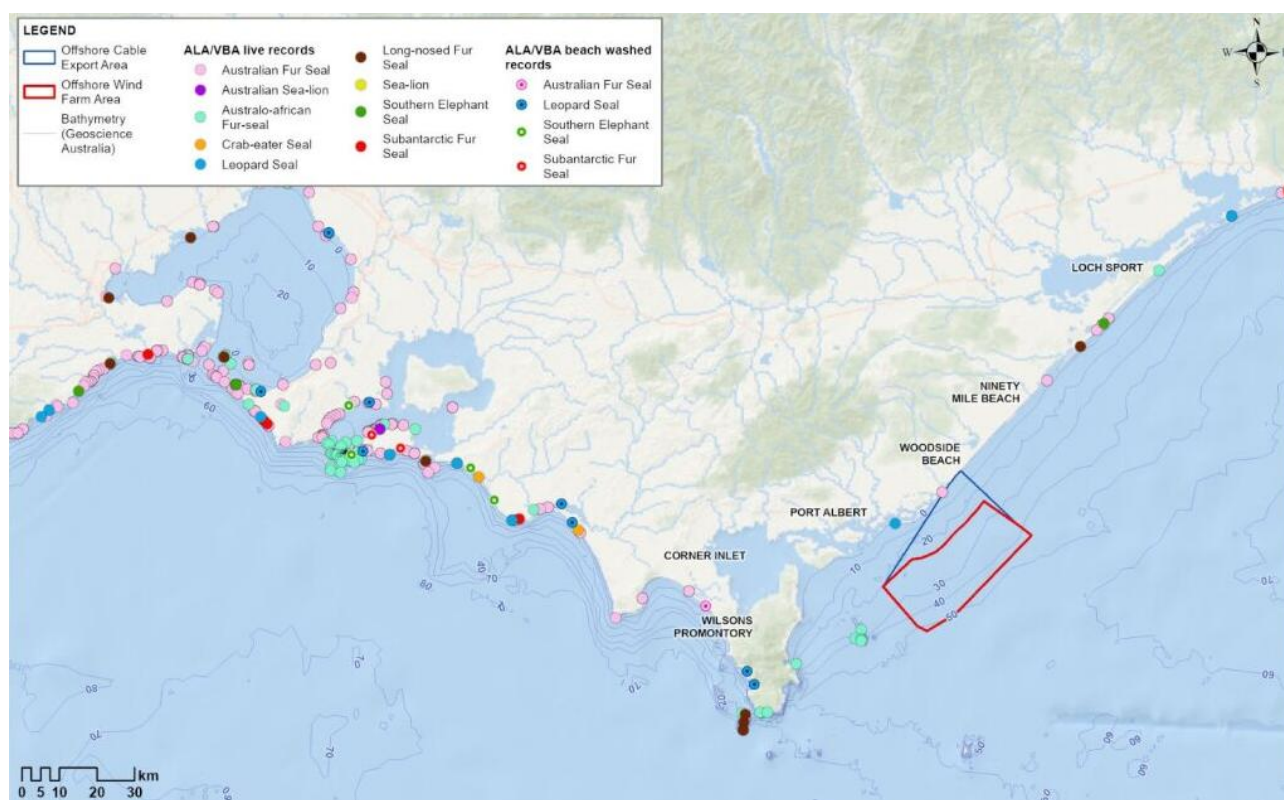


Figure 6-13: Historical pinniped sightings in Bass Strait and in proximity to the offshore wind farm area and offshore export cable area (historic sightings range from 1760 – 2021)

6.2.7.1 Australian fur seal

The Australian fur seal (AUFs) is endemic to southeastern Australia, with breeding restricted to the continental shelf of Bass Strait between mainland Australia and Tasmania (Kirkwood et al., 2005; 2010). Preferred habitats, especially for breeding, are rocky islands with boulder or pebble beaches and gradually sloping rocky ledges. Ten established AUFs breeding colonies are restricted to islands in the Bass Strait: six off the coast of Victoria and four off the coast of Tasmania. The largest established colonies are at (Deen Maar) Lady Julia Percy Island (26 per cent of the breeding population) and at Seal Rocks (25 per cent of the breeding population), which is west of Wilsons Promontory in Victoria (McIntosh et al., 2018). The nearest breeding colonies to the OWFA are Rag Island (approximately 12.5 kilometres southwest of the OWFA) and Kanowna Island (approximately 50 kilometres southwest of the OWFA) (Kirkwood et al., 2010; McIntosh et al., 2018; Sorrell, 2018).

Adult females are the most important component of a fur seal population due to their polygynous mating system and maternal milk being the sole source of nutrition for pre-weaning pups. Pups begin to forage in June to July and are generally weaned by September to October (Shaughnessy, 1999). In spring, females depart on long foraging trips to forage and store energy in preparation for the birth of their next pup.

The deep-diving behaviour of foraging AUFS indicates that they are benthic foragers, with up to 95 percent of dives to the sea floor (Speakman et al., 2020). Both male and female AUFS tracks have shown that they do not ever venture beyond the continental shelf-edge of Bass Strait when foraging (Kirkwood et al., 2006; Arnould and Kirkwood, 2008; Arnould et al., 2015), with most dives in the 65 to 85 metre range (Arnould and Hindell, 2001; Hoskins et al., 2017).

Several AUFS studies have revealed high overlap in foraging areas between the sexes (Kirkwood et al., 2006; Arnould and Kirkwood, 2008; Kernaléguen et al., 2015; Salton et al., 2019). While individuals from Seal Rocks (central northern Bass Strait) and Kanowna Island tend to utilise different regions of the Bass Strait, both sexes within each colony generally overlap in foraging areas for most of the annual cycle (Arnould and Kirkwood, 2008). The only time when foraging areas segregate is when some adult males extend their range down the east and west coast of Tasmania, before and after the breeding season (Knox et al., 2017; Salton et al., 2019), potentially to exploit areas of higher food resources in preparation for, and recovery from, fasting during territorial tenure at the breeding colony (Boyd and Duck, 1991; Arnould and Duck, 1997). Similarly, a recent study of the at-sea movements of juvenile AUFS found that juveniles returned to the colony less frequently than adult females, although their foraging ranges were similar and overlapped substantially (Salton et al., 2019).

6.2.7.1.1 Kanowna Island colony

The foraging trip durations and at-sea movements of adult female AUFS from Kanowna Island observed in the MESP from tagging studies (Appendix A) are consistent with numerous previous reports from this colony (Arnould and Hindell, 2001; Littnan and Arnould, 2002; Arnould and Kirkwood, 2008; Kirkwood and Arnould, 2011; Arnould et al., 2015; Hoskins et al., 2017). Many individuals focused on foraging activities within central Bass Strait, with some individuals resting at haul-out locations and other colonies during foraging trips. Some of the high habitat use areas (i.e., foraging “hot spots”) identified are similar to those reported in previous studies (Arnould and Kirkwood, 2008; Kirkwood and Arnould, 2011; Arnould et al., 2015). AUFS individuals from Kanowna Island undertake extended trips to sea during the post-weaning period, considerably longer than during lactation (Arnould et al., 2021a). Previous studies have also found that individuals at Kanowna Island and other AUFS colonies undertake longer trips post-weaning, including some trips to different regions than those utilised when provisioning their pup (Kirkwood and Arnould, 2011).

The foraging range of AUFS in early lactation is usually more restricted than in mid-lactation due to the reduced fasting capacity of young pups (Verrier et al., 2011). Previous preliminary studies have shown that the foraging area of AUFS at the Kanowna Island colony during summer is like that in winter (Arnould and Hindell, 2001). It is, therefore, highly likely that the at-sea distribution of female AUFS from Kanowna Island observed from animals tagged in 2020 for AUFS surveys during winter (mid to late lactation) is indicative of their summer (early lactation) behaviour.

None of the tracked AUFS individuals from Kanowna Island entered the OWFA, and only one hauled out at Rag Island during foraging trips (Figure 6-14). In contrast, several previous studies have recorded adult AUFS from Kanowna Island hauling out at Rag Island and/or travelling through the OWFA towards oil/gas infrastructure areas and beyond in eastern Bass Strait (Kirkwood and Arnould, 2011; Arnould et al., 2015; Hoskins et al., 2015; Kernaléguen et al., 2015). The broadly dispersed nature of habitat use during foraging trips by female AUFS from Kanowna Island suggests the OWFA does not represent an important foraging zone for the population at this colony.

The observed annual pup production of AUFS at Kanowna Island (Arnould et al., 2021a) (Table 6-1) was within the range (1,575 to 2,913) previously reported for the site (Gibbens and Arnould, 2009; Kirkwood et al., 2010; Arnould unpubl. data). Direct counts of newborn pups have been conducted at Kanowna Island since 1997, and while there has been little overall trend in this period, the large inter-annual variation is driven by various environmental factors (Arnould et al., 2021a).

The spatial distribution of AUFS was determined using at-sea density models developed using the satellite tracking data obtained from adult AUFS females. The highest probabilities of at sea usage for AUFS females from Kanowna Island were found near Kanowna Island and Bull Rock, with relatively dense hot spots of activity in central Bass Strait to the southwest of Kanowna Island (Figure 6-15). The estimated number of AUFS from Kanowna Island in the OWFA at any given time ranged from 3.0 to 3.5 individuals (Appendix A).

Table 6-1: Population counts of Australian fur seals at Kanowna Island

Colony	Year	Number of pups	Estimated colony size
Kanowna Island (MESP)	2021	2,096 ± 11	-
Kanowna Island (MESP)	2020	1,924 ± 18	14,805 ± 139
Kanowna Island	2013	2,430	-
Kanowna Island	2007	2,913	15,000

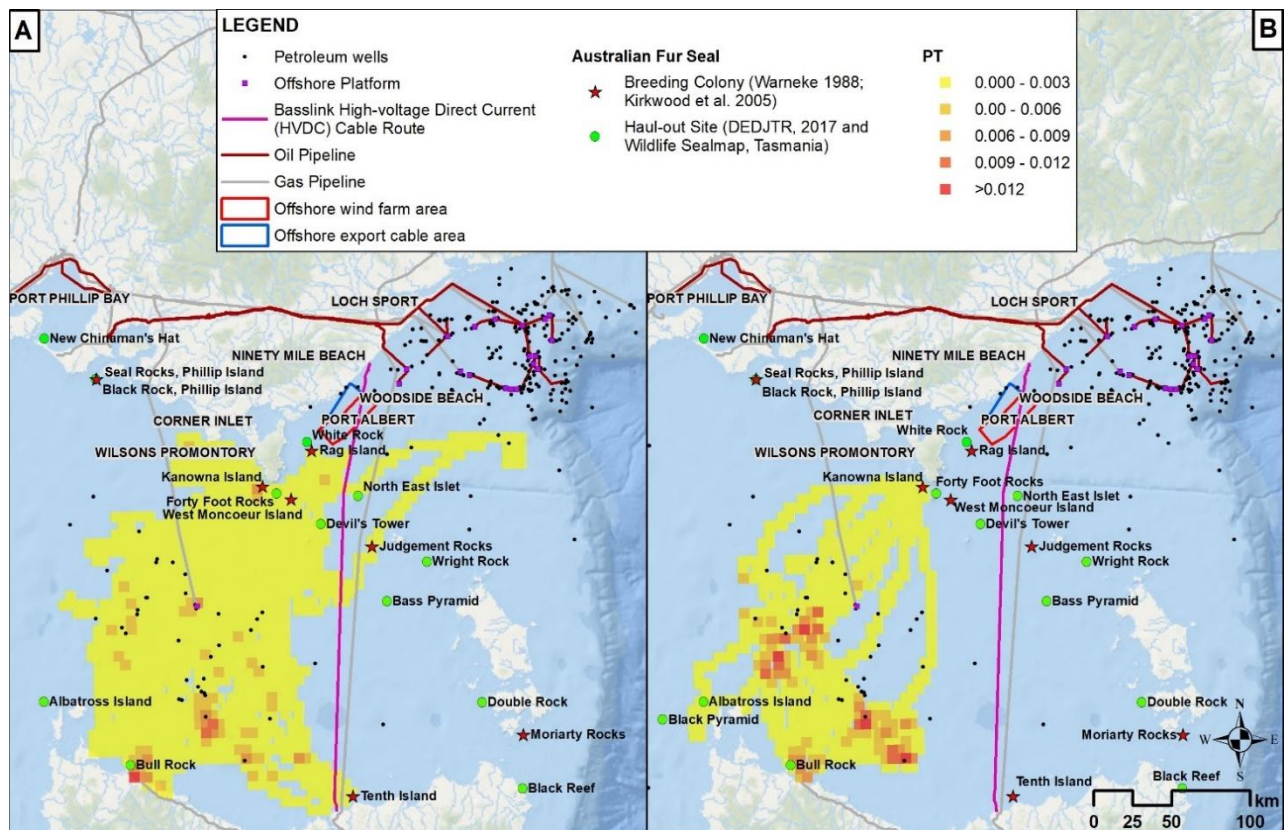


Figure 6-14: Proportional time-spent-in-area (5 km × 5 km grid cells) habitat use by tagged adult female Australian fur seals from Kanowna Island in winter (mid to late lactation) 2020 (left) (n=18) and spring (post-weaning) 2020 (right) (n=3). Pre-feasibility license area shown which was used during the MESP survey.

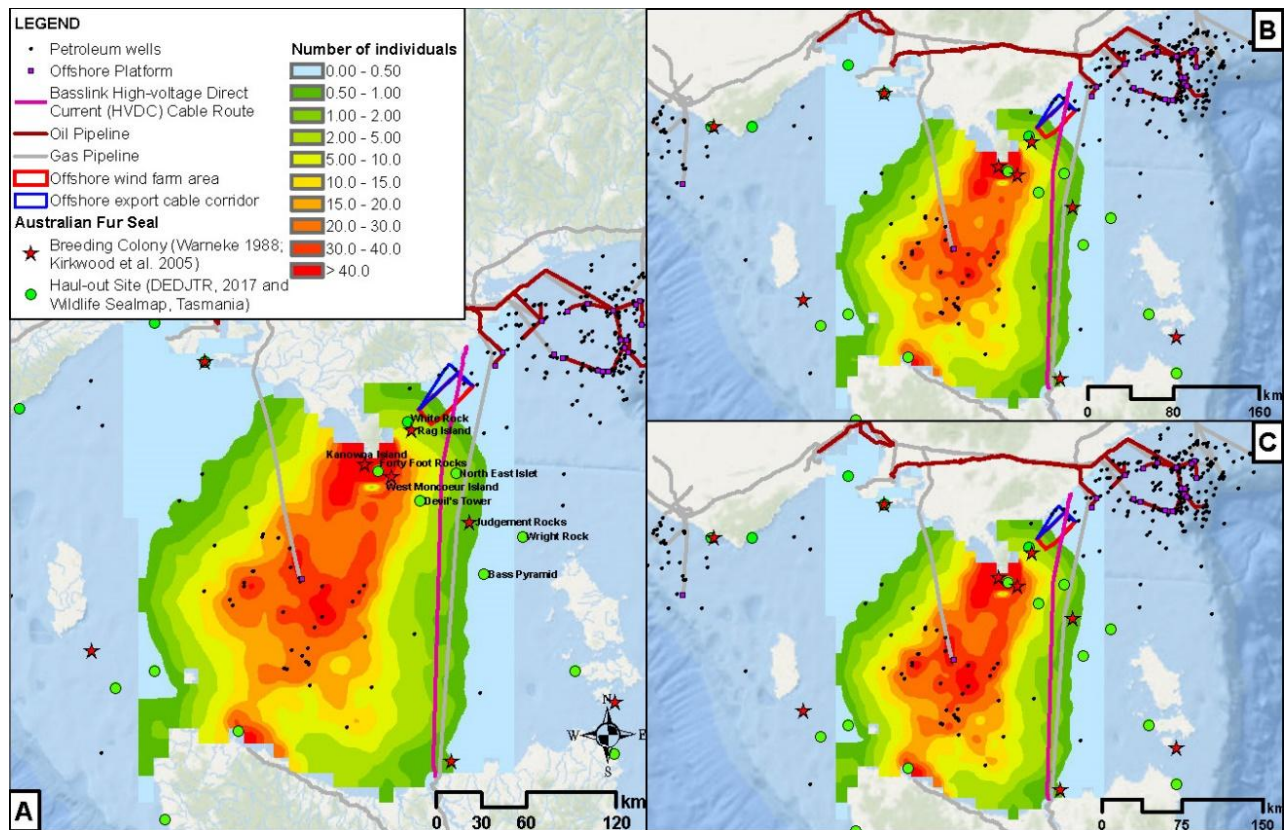


Figure 6-15: Estimated at-sea spatial distribution of AUFS population from Kanowna Island, based on a 10 km × 10 km grid cell size, for three population ranges (corresponding to ranges of pup-count correction factors): a) Mid population estimate; b) Lower population estimate; c) Upper population estimate. Pre-feasibility license area shown was used during the MESP survey

6.2.7.1.2 Rag Island colony

The tracking data from adult female AUFS at Rag Island obtained during the MESP are the first for the species at this location and provide information for one of the most recently re-established AUFS colonies (Kirkwood et al., 2005). The trip duration, total distance covered, and maximum distance from the colony observed in female AUFS from Rag Island are like those recorded at Kanowna Island and previously at other colonies (Kirkwood and Arnould, 2011). However, there was an unexpected amount of repeated travel parallel and close to the coastline by a large proportion of tracked individuals (Arnould et al., 2021a). All fur seals tagged in 2020 travelled through the OWFA at least once, with five doing so regularly (Figure 6-16), and in 2021, six out of ten tagged individuals travelled regularly through the OWFA (Figure 6-17) (Appendix A). Habitat use reflected these movements with high intensity areas to the northeast of Rag Island being associated with sea floor infrastructure.

The Bass Strait and the Gippsland Basin have a variety of existing sea floor infrastructure (shipwrecks, pipelines, cable routes, oil / gas wells), and seals are frequently seen resting and foraging on the Bass Strait oil and gas platform structures (Esso, 2002). A 2015 study looking to assess the effects of sea floor infrastructure on the foraging patterns of 36 female AUFS from Kanowna Island found that 72 percent of individuals spent time foraging in the vicinity of anthropogenic sea floor structures, with pipelines and cable routes being the most frequented (Arnould et al., 2015). Similar use of sea floor infrastructure has been observed in phocid seals around the UK, with individuals using the sea floor cable routes of offshore wind farms as foraging habitats (Russell et al., 2014).

Tagged AUFS also hauled out at The Skerries, another 150 kilometres to the east, potentially attracted to the nearby productive region of the New Zealand Star Bank (a rocky bank with diverse habitat) in eastern Bass Strait for foraging (Arnould and Kirkwood, 2008; Arnould et al., 2021a). This is consistent with artificial haul-outs such as oil platforms and buoys providing resting locations to seals that extend their foraging range.

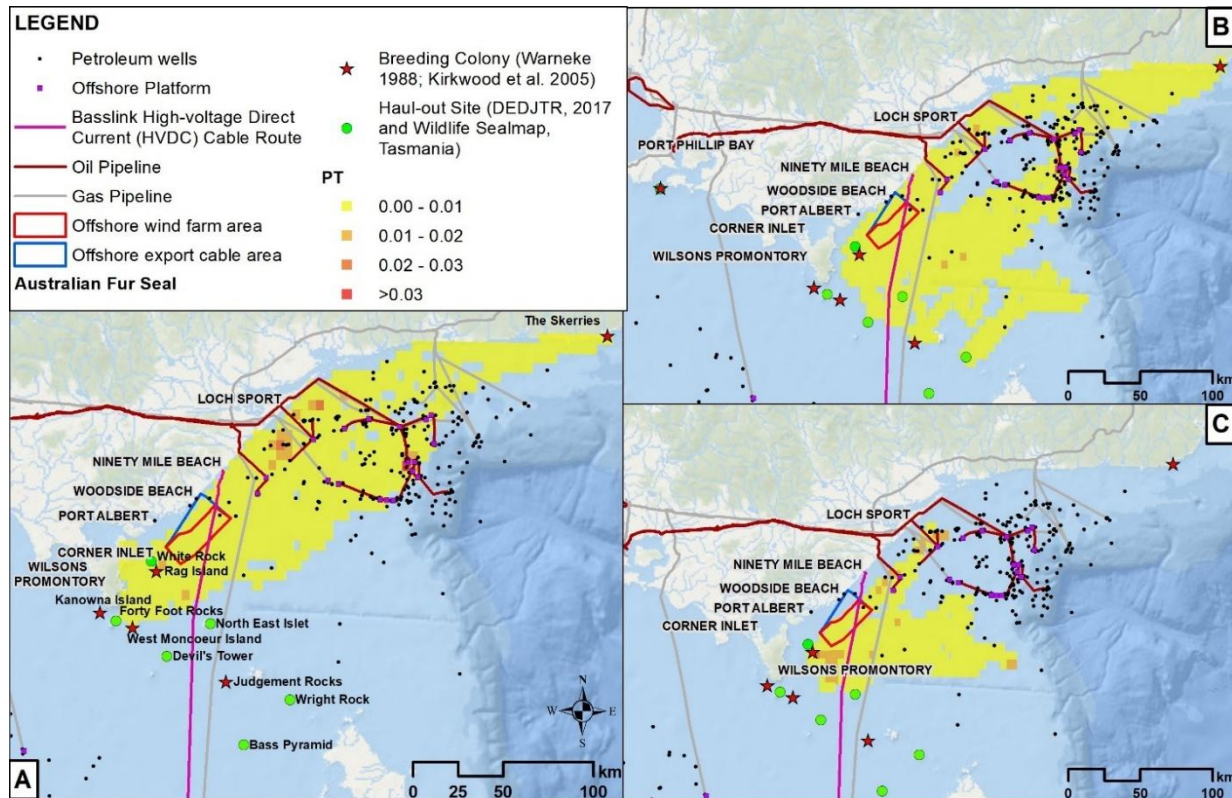


Figure 6-16: Proportional time-spent-in-area (5 km × 5 km grid cells) habitat use by adult female Australian fur seals from Rag Island during winter (mid to late lactation) 2020 to 2021 (A) ($n=10$), spring (post-weaning) 2020 to 2021 (B) ($n=10$) and summer (early lactation) 2020 to 2021 (C) ($n=4$). Pre-feasibility license area shown which was used during the MESP survey

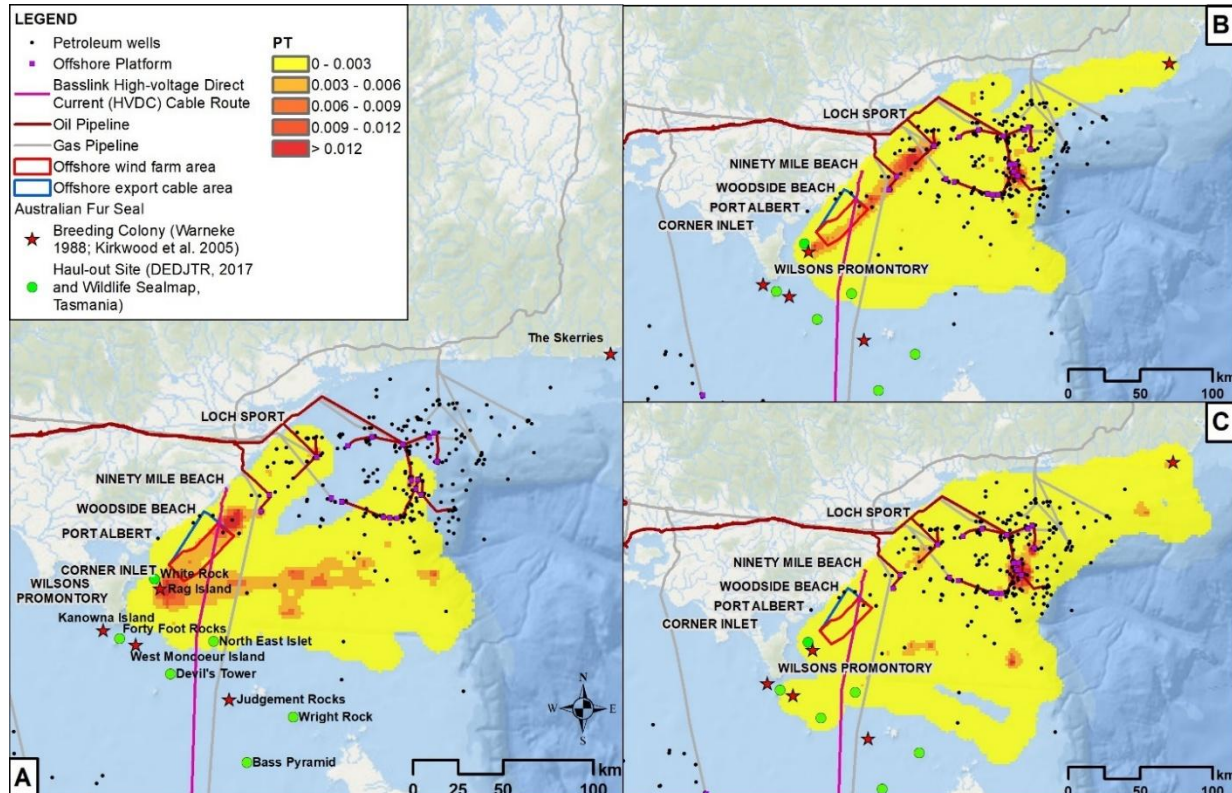


Figure 6-17: Proportional time-spent-in-area (5 km × 5 km grid cells) habitat use by tagged adult female Australian fur seals from Rag Island during winter (mid to late lactation) 2021 to 2022 (A) ($n=10$), spring (post-weaning) 2021 to 2022 (B) ($n=9$) and summer (early lactation) 2021 to 2022 (C) ($n=5$). Pre-feasibility license area shown which was used during the MESP survey.

The Rag Island AUFS colony has experienced rapid growth since it was first recorded in March 2003 with 30 pups (direct count from boat) (Kirkwood et al., 2005) and subsequent direct counts of 277 (February 2007) and 295 pups (January 2013) (McIntosh et al., 2018). Direct counts are likely to be underestimates, as are estimates from remote piloted aircraft (RPA) surveys, in comparison to capture-mark-recapture (CMR) methods (Kirkwood et al., 2010; Sorrell et al., 2019). Nonetheless, the 2020 and 2022 RPA survey counts of AUFS pups is consistent with the rapid population size increases observed in other fur seal species recolonising their former range following local extirpation (Hes et al., 1971; Wickens et al., 1992; Boyd, 1993; Bester, 2019) (Table 6-2). Population increase is likely to be attributed to recovery from exploitation; however, it may also be due to an improved foraging environment or increasing protection measures regarding interactions with commercial fishing operations (Kirkwood et al., 2005).

Table 6-2: Population counts of Australian fur seals at Rag Island

Colony	Year	Number of pups	Estimated colony size
Rag Island (MESP)	2022	637 ± 4	3,497 ± 23
Rag Island (MESP)	2020	586 ± 5	3,217 ± 27
Rag Island	2017	350	-
Rag Island	2013	295	-
Rag Island	2007	277	1,500
Rag Island	2003	30	-

For AUFS females from Rag Island, the highest probabilities of at-sea usage were predicted in areas surrounding Rag Island, within the OWFA, and for coastal areas to the north-east (Figure 6-18). There were also predictions of diffuse usage near the Skerries colony, a secondary haul-out. Estimated usage of the OWFA was greatest during mid to late lactation, in June to late September (Figure 6-18).

The estimated number of AUFS from Rag Island in the OWFA differed depending on the lactation stage. In early lactation, estimated numbers were lowest with 62 to 73 individuals in the OWFA. The highest number of individuals in the OWFA was during mid-lactation (145 to 173 individuals), while during post-weaning the estimated number was reduced to 88 to 105 individuals (Appendix A). These estimates represent 1.8 to 2.1 percent, 4.1 to 4.9 percent, and 2.5 to 3.0 percent, respectively, of the total AUFS population at Rag Island (Arnould et al., 2022).

While previous studies of adult males and juvenile AUFS within Bass Strait have suggested substantial overlap in their foraging areas with adult females (Knox et al., 2017; Salton et al., 2019), it is known that adult males extend their foraging range temporarily to southern Tasmania before and after the breeding season. In the absence of contemporary site-specific data on the at-sea movements of adult males and juveniles, the analyses in the present study implicitly assumed these age/sex categories had the same habitat-use patterns as adult females and that their predicted at-sea densities were derived from the tracking data of adult females only. Consequently, at sea-density estimates within the OWFA may be conservatively high (i.e., a greater number of individuals than may be present) for each colony as adult males have much wider ranges before and after the breeding season.

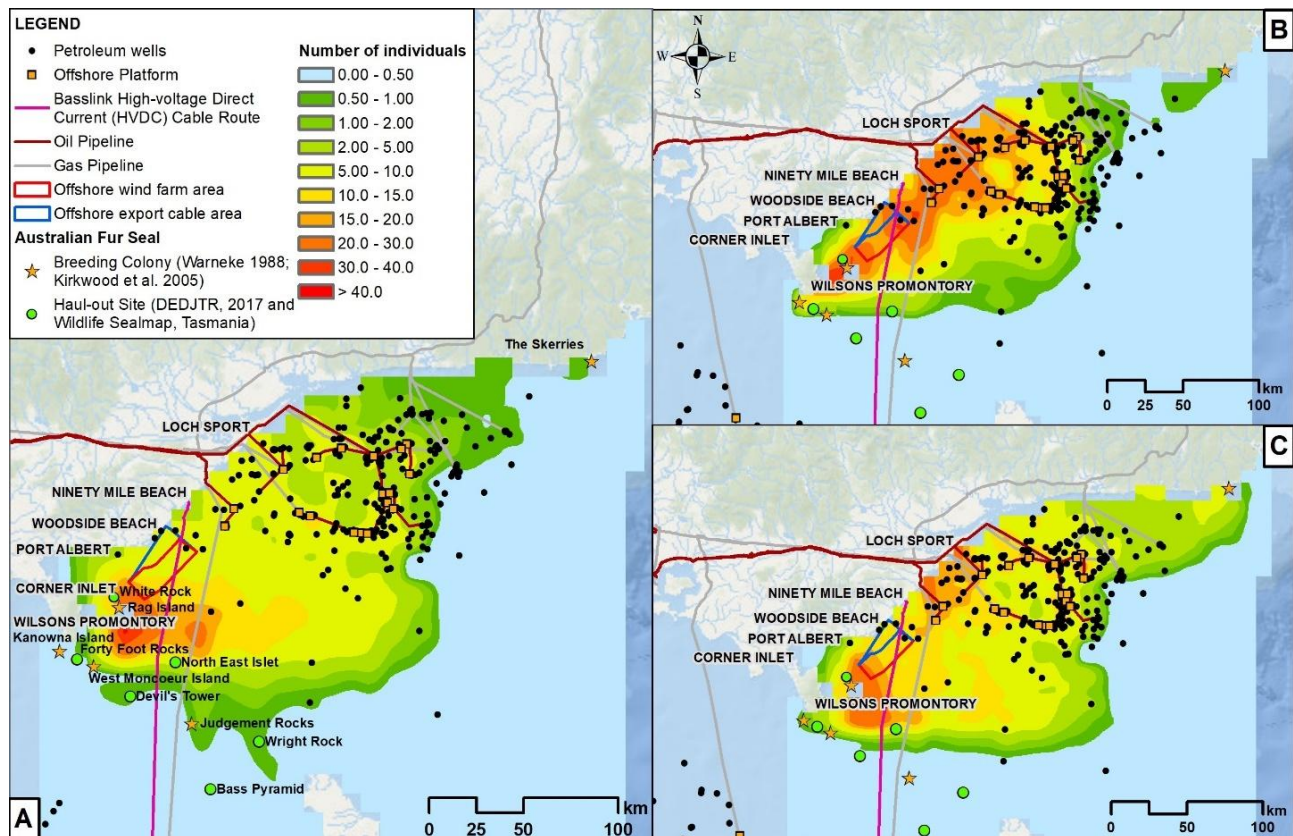


Figure 6-18: Estimated at-sea spatial distribution of the Australia fur seal population from the Rag Island colony, based on a 10 × 10 metre grid cell size for different lactation stages: A) early lactation, B) mid to late lactation and C) after weaning. The population estimate used in this figure is based on the mid-population estimate (corresponding to ranges of pup-count correction factors). Pre-feasibility license area shown which was used during the MESP survey

6.2.7.2 New Zealand fur seal

New Zealand fur seals (NZFS), also known as the long-nosed fur seal, have a widespread distribution from the New Zealand and Australian subantarctic islands through to temperate northern New Zealand and southern Australia. Most breeding sites for the NZFS in Australian waters are outside Victoria, with lower density breeding areas in the vicinity of the OWFA at Kanowna Island (Kirkwood et al., 2009) and Anser Island (Arnould, unpubl. data).

The Kanowna Island colony was discovered in the late 1990s (Arnould et al., 2000) as the first site of recolonisation of Bass Strait by the species following extirpation from the region during the commercial sealing era. The colony increased slowly in size until the mid-2010s when numbers started to decrease, which can be accounted for by the discovery in 2019 (Arnould unpubl. data) of a new colony for the species on nearby Anser Island (39°08'16"S, 146°19'12"E; 76.9 ha in area), 1.5 kilometres north-east of Kanowna Island.

While there have been very few studies on the foraging habits of NZFS, it seems that they have different foraging distributions to the AUFS despite sharing haul-out sites. At the Kanowna Island colony, NZFS foraging ranges over a much greater area than the AUFS from Kanowna Island, predominantly exploiting waters to the east and southeast of the colony (Hoskins et al., 2017). During a foraging trip, NZFS individuals appear to adopt one of two strategies: either foraging in areas near the colony or foraging much farther afield in areas east of Kanowna Island, including deep waters beyond the continental shelf. This differs from the AUFS, which forages exclusively over the continental shelf.

The NZFS breeding season is the same as the AUFS. Pups begin to forage in June to July and are generally weaned by September to October (Shaughnessy, 1999). During the non-breeding season (November to January), breeding sites are occupied by pups / young juveniles, while adult females alternate between breeding sites and foraging at sea (Shaughnessy, 1999).

NZFS predominantly dive to shallow depths of around 17 metres, indicating that they are epipelagic foragers (Arnould and Hindell, 2001; Hoskins et al., 2017). The NZFS at Kanowna Island venture far beyond the continental shelf-edge of both eastern and western Bass Strait (Arnould et al., 2021a), confirming that they have a largely pelagic foraging mode. This is consistent with previous studies of female NZFS elsewhere displaying wide-ranging habitat use (Harcourt et al., 1997; Baylis et al., 2008). This foraging strategy was also confirmed by an analysis of dietary composition, which found that NZFS predominantly consumed pelagic species (Hoskins et al., 2017).

Previous studies of NZFS have revealed age and sexual segregation in foraging areas. Studies of NZFS in South Australia revealed adult males and juveniles disperse further beyond the continental shelf-edge than adult females (Baylis et al., 2005; Page et al., 2006). Therefore, assessment of the potential impact of Star of the South on NZFS breeding at Kanowna Island and Anser Island should consider the difference in foraging areas between the population as a whole and not just females.

During the MESP the foraging trip durations, maximum distances from the colony and total distance covered by female NZFS during mid-late lactation are like those previously reported for the species at Kanowna Island (Hoskins et al., 2017) but are substantially greater than data recorded for NZFS breeding in South Australia (Page et al., 2006). This is likely to reflect local differences in food availability. While Bass Strait is considered an area of low primary productivity (Evans et al., 1998; Middleton et al., 2007), the adjacent continental shelf-edge regions and beyond support a considerable biomass of pelagic fish resources (Prince, 2001). Correspondingly, access to these resources necessitates female NZFS at Kanowna Island to undertake longer foraging trips.

Individual NZFS tagged at Kanowna Island during the MESP visited numerous haul-outs and other NZFS colonies throughout Bass Strait and southern Tasmania (Figure 6-19). While a previous study of female NZFS at Kanowna Island (Hoskins et al., 2017) revealed some individuals travelled through the OWFA, only a single individual in this study did so (Arnould et al., 2021a). This may reflect inter-annual variation in prey distribution (Foo et al., 2019; 2020).

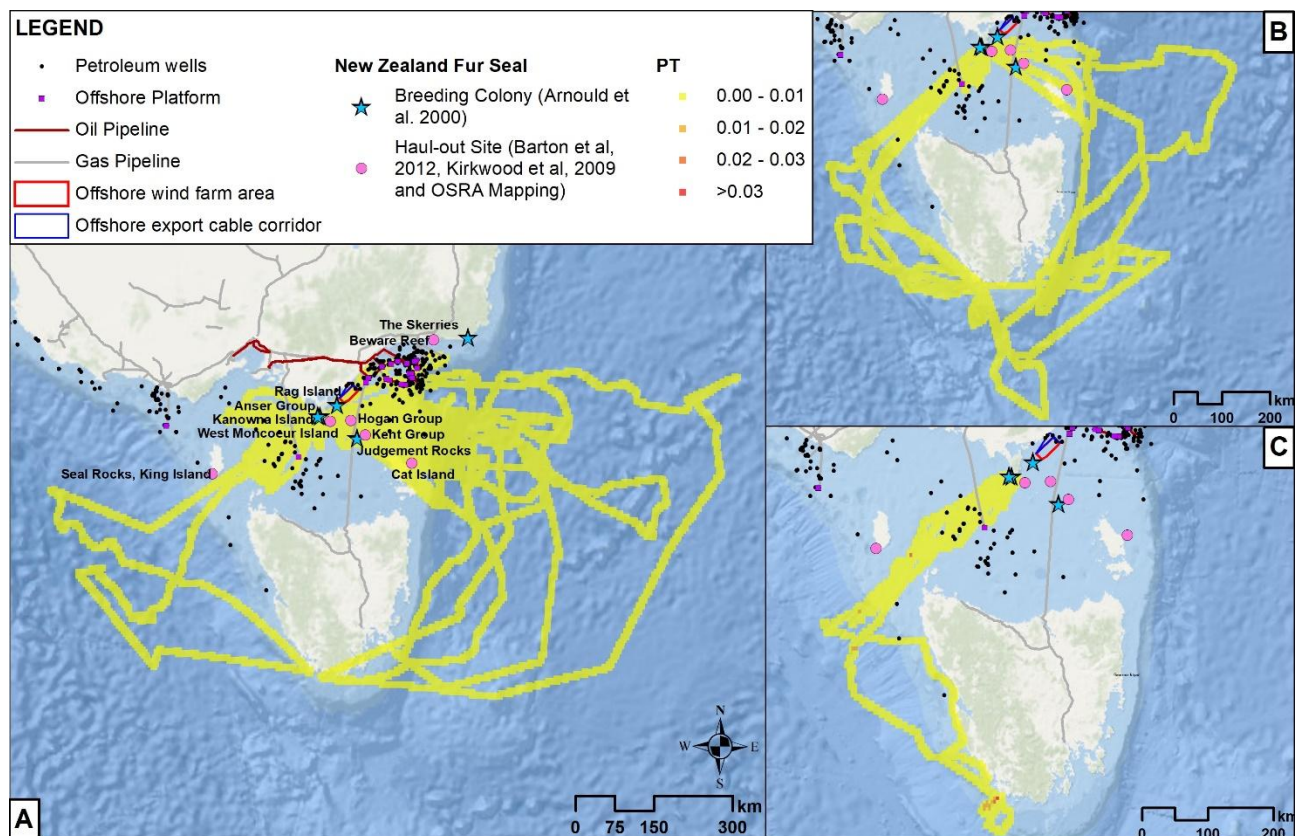


Figure 6-19: Proportional time-spent-in-area (5 km × 5 km grid cells) habitat use by adult female New Zealand fur seals from Kanowna Island during winter (mid to late lactation) 2020 to 2021 (A) (n=10), spring (after weaning) 2020 to 2021 (B) (n=5) and summer (early lactation) 2020 to 2021 (C) (n=4). Pre-feasibility license area shown which was used during the MESP survey

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The observed NZFS pup production at Kanowna Island and Anser Island (Table 6-3) is likely to be an underestimate as the RPA survey for Anser Island was conducted in late lactation (Arnould et al., 2021a). Nonetheless, the results indicate a continued slow increase in numbers in the region since NZFS were first observed in the late 1990s. As the current Bass Strait NZFS population size is still substantially less than the estimated pre-sealing levels (Kirkwood et al., 2009), colony sizes and the establishment of new (recolonised) areas are likely to experience continued increase.

Table 6-3: Population counts for New Zealand fur seals at Kanowna / Anser Island

Colony	Year	Number of pups	Estimated colony size
Kanowna Island (MESP Study)	2021	16 ± 0	56
Anser Island	2019	31 ± 1	132 ± 4
Kanowna Island	2008	55	-

The spatial distribution of NZFS was determined using at-sea density models developed using the satellite tracking data obtained from adult females. The highest probabilities of at sea usage for NZFS females from Kanowna Island were found near Kanowna Island and Bull Rock, with relatively dense hot spots of activity northeast of the OWFA off the shelf edge (Figure 6-20). The low population size and widely dispersed foraging range of NZFS from Kanowna Island contributed to their substantially lower predicted density distribution, both in general and within the OWFA. The predicted less than 0.45 total individuals within the OWFA at any given time suggests any potential impacts would affect a negligible proportion of the population (0.2 per cent).

NZFS could occur in the OWFA, however, the OWFA and surrounding region do not represent important foraging habitats for NZFS from Kanowna Island, and therefore, they are expected in smaller numbers than AUFS.

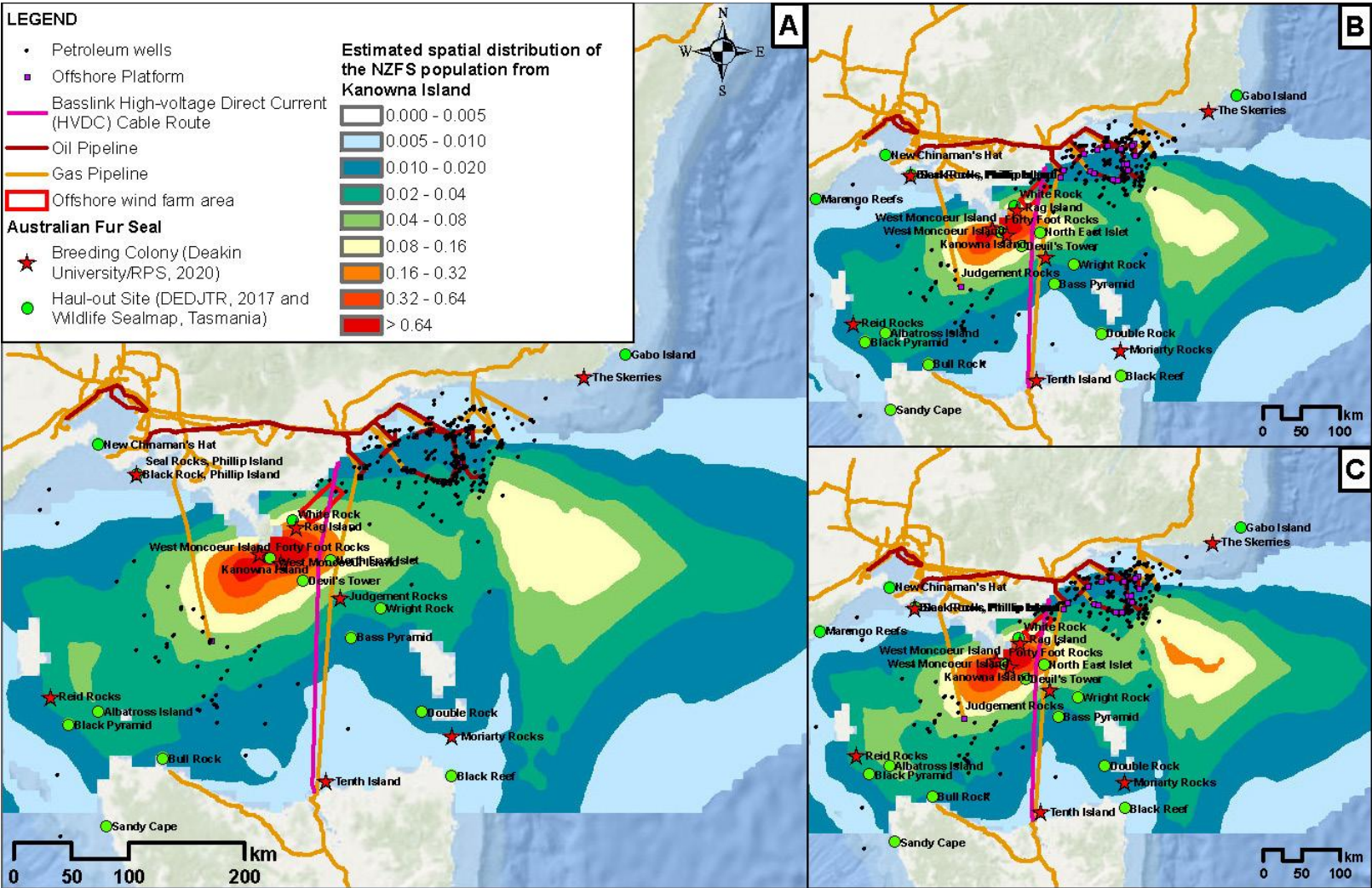


Figure 6-20: Estimated spatial distribution of the New Zealand fur seal population from the Kanowna Island colony, given the upper population estimate (corresponding to ranges of pup-count correction factors). Pre-feasibility license area shown which was used during the MESP survey

6.2.8 Marine turtles

Of the seven species of marine turtles that can be found globally, six are found in Australian waters. These include the leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*), green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), flatback (*Natator depressus*), and olive ridley turtle (*Lepidochelys olivacea*). Coastal and offshore Gippsland is outside of the geographical range for breeding and nesting for all species, and there are no known areas / habitats of importance for foraging and/or migration near the OWF area. There have been very few marine turtle sightings recorded in the VBA and ALA databases within the east Gippsland area between 1961 to 2024, all of which are of leatherback turtles (**Figure 6-21**). The South Australian Sea Turtle (SAST) project, an initiative of the Centre for Integrative Ecology at Deakin University, began in April 2014 to bring together publicly and privately held information on marine turtles for southern Australia from as early as 1889 and has since been completed. The SAST project gathered over 209 sightings of marine turtle species off South Australia, Victoria, and Tasmania (Figure 6-22).

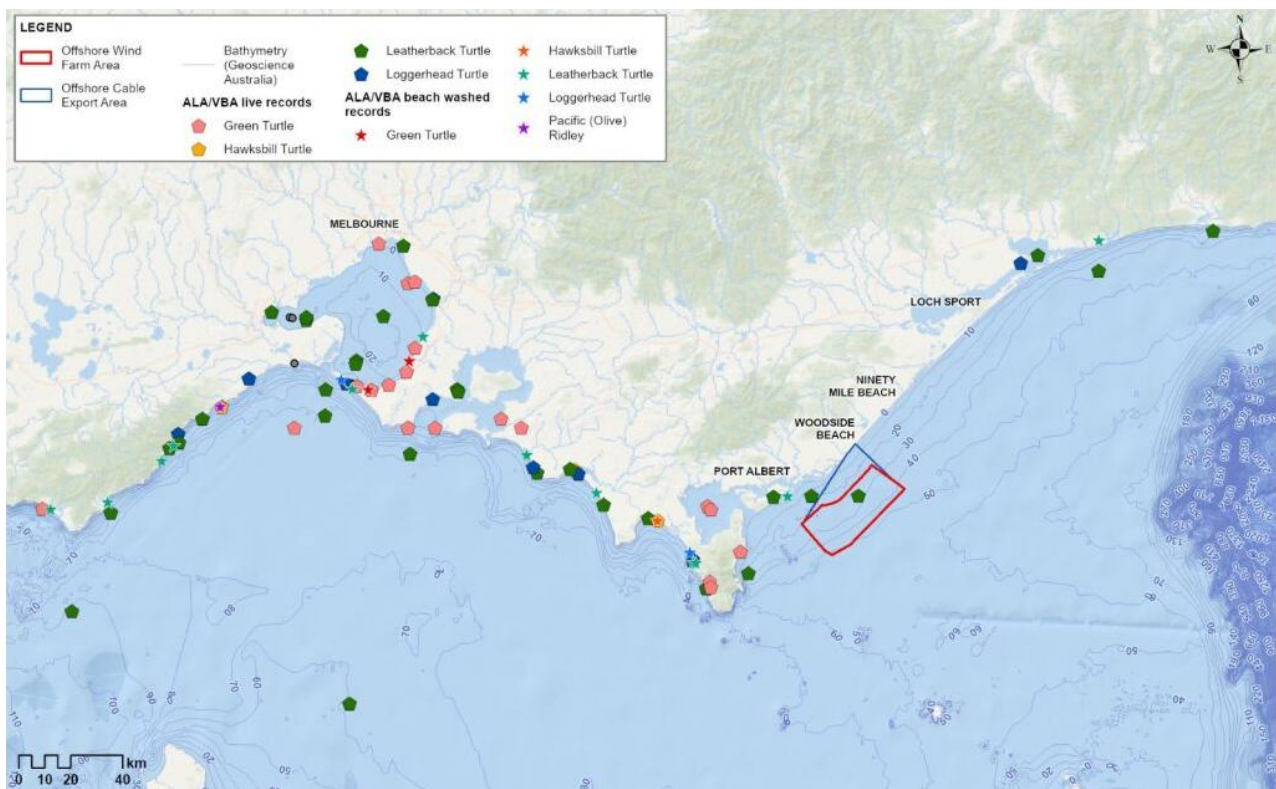


Figure 6-21: Historical marine turtle sightings in Bass Strait and in proximity to the offshore wind farm area and offshore export cable area (historic sightings range from 1760 – 2021)

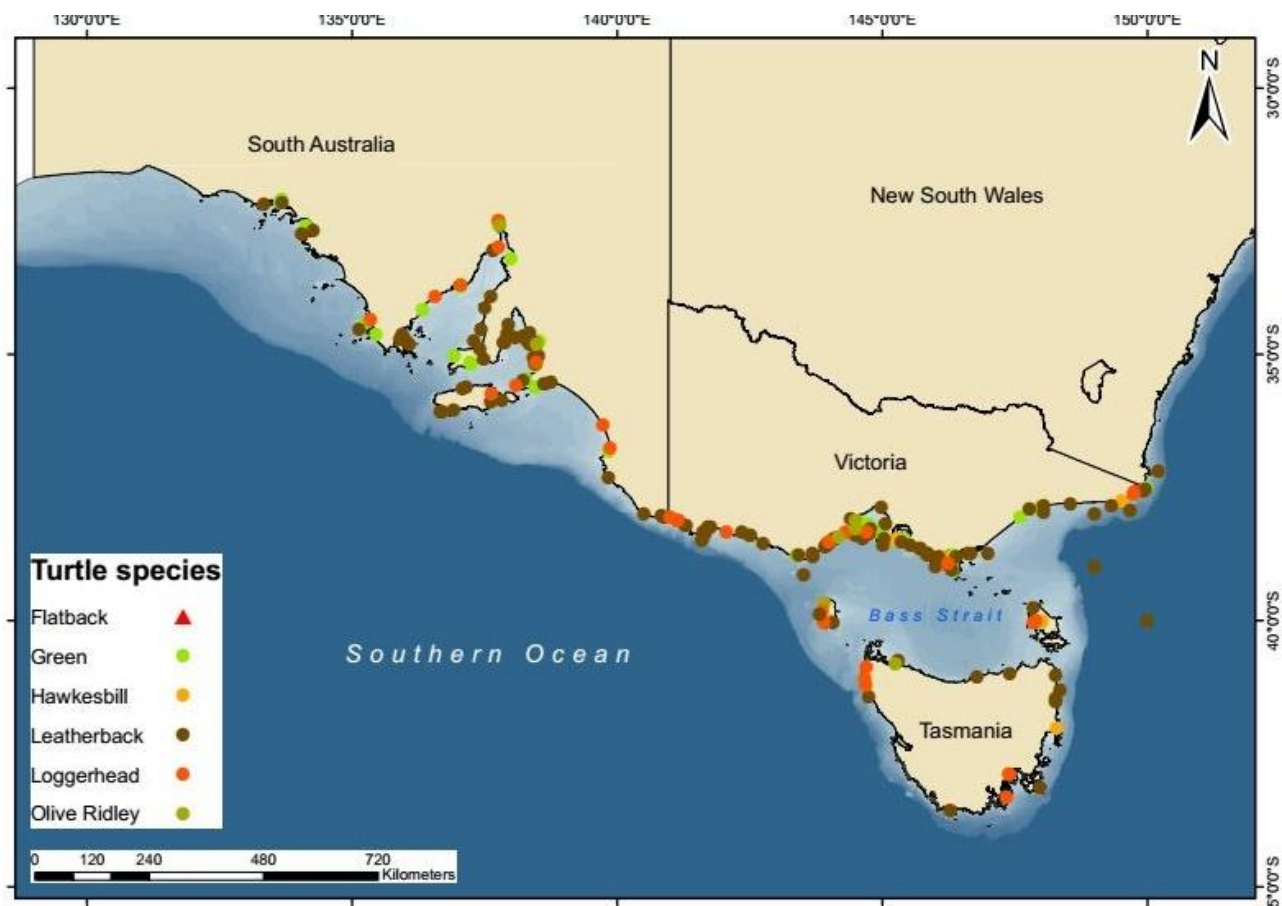


Figure 6-22: Marine turtle sightings reported by the South Australian Sea Turtle project since 1889

Flatback turtles have no recorded sightings in Victorian waters, are not identified as having the potential to be present in the OWFA from the PMST search and are not predicted to occur in the Gippsland region according to the distribution ranges identified in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017a) and therefore they were excluded at the first step of the scoping process.

Hawksbill turtles, listed as vulnerable under the EPBC Act, are distributed in subtropical, tropical, and temperate waters in all the oceans of the world. In Australia, major nesting areas are in north-west Western Australia and the northern Great Barrier Reef (DoE, 2020). Hawksbill turtle distribution extends down the east coast to the Bass Strait but does not extend into the Gippsland region (DoE, 2020). There were just five historical sightings of hawksbill turtles in Victoria between 1961 to 2024 documented in the ALA and VBA databases, indicating a very limited presence of the species. Of the five sightings of the hawksbill turtle in the VBA / ALA database, only two were in Gippsland, with one of those being a deceased turtle washed up on the beach. Hawksbill turtles were not predicted to occur in the OWFA from the PMST search or according to the distribution ranges identified in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017a). Due to the unlikely occurrence of hawksbill turtles in the OWFA and surroundings, they were not considered in the EIA.

Olive ridley turtles are distributed almost exclusively in tropical and subtropical waters. No concentrated nesting for olive ridley turtles has been found in Australia, although low-density nesting occurs along the Northern Territory coast (Chatto and Baker, 2008) and in north-western Cape York Peninsula, Queensland (Limpus, 2008). It is thought that the Australian population may represent an isolated breeding population (DoE 2022). Olive ridley turtles typically forage over shallow water habitats from northern Western Australia to south-east Queensland (Limpus 2008), though they have also been recorded foraging in pelagic habitats (Musick and Limpus, 1997). There were just two records of deceased olive ridley turtles in Victoria in the ALA and VBA databases between 1961 to 2024, with the most recent sighting over 20 years ago. Of the two observations of olive ridley turtles found in records for Victoria, one was washed up on a beach, and none were within the Gippsland region. Olive ridley turtles were not predicted to occur in the OWFA from the PMST search or according to the distribution ranges identified in the Recovery Plan for Marine Turtles in

Australia (Commonwealth of Australia, 2017a). Due to the unlikely occurrence of olive ridley turtles in the OWF and surrounds, they were not considered in the EIA.

6.2.8.1 Leatherback turtle

Leatherback turtles are distributed throughout tropical, sub-tropical and temperate waters around the world (Limpus, 2009). In Australia, leatherbacks feed in coastal waters around central eastern Australia (Sunshine Coast in Queensland to central NSW), south-east Australia (Tasmania, Victoria, and eastern South Australia) and south-western Australia (DCCEEW, 2021b). Leatherbacks have a distinct carapace with five ridges; it's black with light spotting and an adult can reach lengths of 1.6 metres (DCCEEW, 2021b). Unlike other marine turtles, leatherback turtles do not take up residency in continental shelf waters but instead spend most of their life travelling vast distances and foraging in temperate coastal and open ocean areas. Leatherback turtles are solitary and rarely interact with other individuals.

No major leatherback turtle rookeries have been recorded in Australia, although nesting is known to occur in the Northern Territory during December and January, as well as occasionally along parts of southern Queensland and northern New South Wales (last reported in 1996) (Commonwealth of Australia, 2017a). It is thought that leatherback turtles inhabit and breed in warmer waters in Indonesia, Papua New Guinea and the Solomon Islands between spring and autumn before travelling to forage in the southerly latitudes of south-east Australian waters during summer (November to February) (Bailey et al., 2012). The Bass Strait is reportedly a foraging hot spot for leatherback turtles, with individuals concentrating in areas where productivity is higher (Bone, 1998; Eckert et al., 1989; Houghton et al., 2006; Benson et al., 2011).

Between 1961 and 2024, there are 49 leatherback turtle sightings in Victoria documented in the ALA and VBA databases, 18 of which are situated within the Gippsland Area, including six in East Gippsland, four off Corner Inlet (one within the OWFA), three around Wilsons Promontory and the remaining west of Wilsons Promontory. Sightings in Victorian waters were reported in most months of the year, except for August and November. During the MESP baseline surveys, there was one observation of a 'likely' leatherback turtle off the western side of Wilsons Promontory in April 2023. Leatherbacks are listed as an Endangered species under the EPBC Act. According to the PMST search, their predicted range in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017a), the potential for Bass Strait to be an important foraging location and sightings recorded from VBA / ALA the leatherback turtle will be considered as having the potential to be present in the OWFA and surrounds and will be included in the EIA in a 'marine turtle' category.

6.2.8.2 Loggerhead turtle

Loggerhead turtles are globally distributed in tropical, subtropical waters and temperate waters (Limpus, 2008a). In Australia, breeding areas are generally confined to coastlines of southern Queensland and north-west Western Australia (Limpus, 2008a). Loggerhead turtles forage in the waters of all coastal states and territories but are uncommon in South Australia, Tasmania, and Victoria (Commonwealth of Australia, 2017a). The loggerhead carapace is made of five pairs of large scales on each side; it is red/brown and can reach a length of approximately one metre (DCCEEW, 2021a). Loggerhead turtles have a minimum temperature threshold of 18 °C, below which the turtle's mobility and foraging behaviour decreases (Lutz et al., 1989; Polovina et al., 2004). The species shows strong fidelity to their breeding and feeding areas, and most turtles migrate less than 1,000 kilometres between these areas (Limpus, 2008a; Limpus et al., 1992). There are 13 records of loggerhead turtles in Victoria between 1961 and 2024 documented in the ALA and VBA databases, though none near the OWFA. These sightings were reported in March, April, July, October, November, and December. It is unknown whether recordings of loggerhead turtles in Victoria are isolated outliers from known foraging areas or if the area comprises part of the broader post-hatchling dispersal area (Limpus, 2009a). A single loggerhead turtle (probable species identification) was recorded in January 2021 during seabird DAS as part of the MESP baseline surveys.

Loggerheads are listed as an Endangered species under the EPBC Act. According to the PMST search, their predicted range in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017a) and sightings recorded from VBA / ALA and MESP, the loggerhead turtle will be considered as having the potential to be present in the OWFA and surrounds and will be included in the EIA in a 'marine turtle' category.

6.2.8.3 Green turtle

Green turtles are distributed in subtropical and tropical waters around the world (Limpus, 2008b). In Australia, green turtles are predominantly found off the Northern Territory, Queensland, and Western Australian coastlines, with limited numbers in Victoria, New South Wales, and South Australia (Commonwealth of Australia, 2017a). Breeding areas of green turtles in Australia are separated into regional populations, these areas include the southern Great Barrier Reef, the northern Great Barrier Reef, the Coral Sea, the Gulf of Carpentaria, Western Australia's north-west shelf, the Ashmore and Cartier Reefs and Scott Reef (DCCEEW, 2021b). Most green turtles migrate less than 1,000 kilometres between feeding and breeding areas (Limpus, 2008b). The carapace on the green turtle comprises of a large high dome with four pairs of large scales on either side. It is light to dark green with dark mottling and can reach approximately one metre (DCCEEW, 2021a).

There are nineteen sightings of green turtles reported in Victoria between 1961 and 2024 documented in the ALA and VBA databases. Three of these were sighted east of Wilsons Promontory. Green turtles are listed as a Vulnerable species under the EPBC Act. According to the PMST search, their predicted range in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017a) and sightings recorded from VBA / ALA the green turtle will be considered as having the potential to be present in the OWFA and surrounds and will be included in the EIA in a 'marine turtle' category.

6.3 Justification for inclusion in EIA

A summary of all marine mammal and turtle species considered and those that have been scoped into and out of this assessment based on their likelihood of occurrence is provided in Table 2-2 of Appendix A (Literature Review) of Appendix A (MESP Baseline Survey) to this report.

The final list of species / groups included in the EIA are identified in Table 6-4 below and can be described as follows:

- Blue whales (both EIO and NZ populations for pygmy blue whales and Antarctic blue whales)
- Southern right whales
- Humpback whales
- Other mysticetes
- Odontocete - dolphins
- Pinnipeds
- Marine turtles.

Mysticetes (baleen whales) that are listed as threatened under the EPBC Act, have BIAs near or within the OWFA and have active recovery plans in place will be considered on an individual basis for the EIA. These include the blue whale and the southern right whale. The only other mysticete species that will be considered separately for the EIA is the humpback whale due to their high abundance near the OWFA recorded in both historical and MESP baseline study sightings. All other mysticetes in Australian waters are considered as possibly occurring in the OWFA and considered in the EIA as 'other mysticetes'. These species include the sei whale and fin whale (due to conservation advice applying to these species and identification in PMST and VBA / ALA), Bryde's whales and minke whale (dwarf minke and Antarctic minke whale) (all seen during baseline surveys) and pygmy right whales (only other mysticete species from Australian waters and identified in PMST and VBA / ALA). This group of species fall within the very low frequency and low frequency hearing range and subsequently will respond similarly to the impacts and risks outlined in the EIA. The mitigation measures used for the impacts and risks identified will be the same for all species recognised in this group. For the impact assessment, no known models exist yet for population consequence of disturbance, unlike for offshore wind farm assessments in the UK; therefore, these assessments were undertaken in a qualitative rather than quantitative way. However, there is a NESF-funded project looking at the efficacy of developing an interim PCoD framework, and although at present it is data deficient, it may become available in the future.

Odontocetes (toothed whales) are categorised into two groups: 'odontocete – dolphins' and 'odontocete – whales'. No odontocete whales were considered likely to occur in the OWFA and surrounds as none of these species were identified in the PMST search and according to the description of their habitat use in the DCCEEW database, despite occasional sightings of mostly stranded individuals in the area. Species

including sperm whales, pygmy sperm whales, long and short-finned pilot whales, Cuvier's beaked whale, and the strap-toothed beaked whale have been ruled out for inclusion in the EIA due to their unlikely presence in the OWFA. Therefore, they are not specifically assessed within the EIA, however mitigation measures proposed for baleen whales (mysticetes) would provide sufficient protection for any odontocete species given the much lower sensitivity of the latter to potential impacts from project activities, e.g. underwater noise emissions. Odontocete dolphins are of the Delphinidae family, and all have high-frequency hearing. The following species have the potential to occur in the OWFA and surrounds and will be included as a category in the EIA: the common dolphin, Indo-Pacific bottlenose dolphin, common bottlenose dolphin, striped dolphin, Risso's dolphin, killer whale, and false killer whale. Although dusky dolphins will not be specifically considered in the EIA any impact or risk mitigation measures proposed would be applied to all dolphin species.

The main pinniped species that are likely to occur within the OWFA and its surrounds are the Australian and New Zealand fur seals. These are the most abundant pinniped species near the OWFA and are the focus of the EIA under a category of pinnipeds.

Three marine turtle species will be considered in a marine turtle category for the EIA: the leatherback turtle, loggerhead turtle, and green turtle, although the likelihood of any of these species being present in the OWFA and surrounds is low.

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Table 6-4: Justification for inclusion in the project impact and risk assessments (refer Table 2-2 in Appendix A (Literature Review) of Appendix A (MESP) to this report for summary of all marine mammal and turtle species considered and those that have been scoped into and scoped out based on their likelihood of occurrence).

Species	EPBC Act listed ²	FFG listed ³	BIA ⁴	Recovery plan / Conservation advice	Presence PMST ⁵	Records in Victoria (VBA or ALA)	Presence detected during MESP	Assessment level
Mysticetes								
Blue whale (<i>Balaenoptera musculus</i> including <i>B. m. intermedia</i> – Antarctic and <i>B. m. brevicauda</i> - EIO and NZ populations)	EN, Mi, ce	EN	Foraging	Yes	Yes	Yes	Yes	Assessed at species level 'blue whale'
Southern right whale (<i>Eubalaena australis</i>)	EN, Mi, ce	EN	Migration/ Reproduction	Yes	Yes	Yes	Yes	Assessed at a species level 'southern right whale'
Sei whale (<i>Balaenoptera borealis</i>)	V, Mi, ce			Yes ⁶	Yes	Yes	No	Assessed under 'other mysticetes'
Fin whale (<i>Balaenoptera physalus</i>)	V, Mi, ce			Yes ⁶	Yes	Yes	No	Assessed under 'other mysticetes'
Humpback whale ⁷ (<i>Megaptera novaeangliae</i>)	Mi, ce				Yes	Yes	Yes	Assessed at a species level 'humpback whale'
Dwarf minke whale (<i>Balaenoptera acutorostrata</i> ; unnamed subspecies)	ce				No	Yes	Yes	Assessed under 'other mysticetes'
Antarctic minke whale (<i>Balaenoptera bonaerensis</i>)	Mi, ce				No	No	Yes	Assessed under 'other mysticetes'
Bryde's whale (<i>Balaenoptera edeni</i>)	Mi, ce				Yes	Yes	Yes	Assessed under 'other mysticetes'
Pygmy right whale (<i>Caperea marginata</i>)	Mi, ce				Yes	Yes	No	Assessed under 'other mysticetes'
Odontocetes								
Common dolphin (<i>Delphinus delphis</i>)	ce				Yes	Yes	Yes	Assessed under 'odontocete dolphins'

² Threatened, migratory, marine and/or cetacean under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

³ Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act)

⁴ Australian Marine Spatial Information System (AMSIS)

⁵ [EPBC Act Protected Matters Search Tool](#) (PMST)

⁶ Conservation Advice

⁷ Humpback whales were recently removed from the EPBC Act threatened species list in February 2022.

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Species	EPBC Act listed ²	FFG listed ³	BIA ⁴	Recovery plan / Conservation advice	Presence PMST ⁵	Records in Victoria (VBA or ALA)	Presence detected during MESP	Assessment level
Indo-Pacific bottlenose dolphin (<i>Tursiops aduncus</i>)	ce				Yes	Yes	No	Assessed under 'odontocete dolphins'
Bottlenose dolphin (<i>Tursiops truncatus</i>) including Burrunan dolphin (<i>Tursiops australis</i>)	ce				Yes	Yes	Yes	Assessed under 'odontocete dolphins'
Striped dolphin (<i>Stenella coeruleoalba</i>)	ce				No	Yes	Yes (ID not confirmed)	Assessed under 'odontocete dolphins'
Risso's dolphin (<i>Grampus griseus</i>)	ce				Yes	Yes	No	Assessed under 'odontocete dolphins'
Killer whale (<i>Orcinus orca</i>)	Mi, ce				Yes	Yes	Yes	Assessed under 'odontocete dolphins'
False killer whale (<i>Pseudorca crassidens</i>)	ce				Yes	Yes	No	Assessed under 'odontocete dolphins'
Pinnipeds								
Australian fur seal (<i>Arctocephalus pusillus</i>)	Ma				Yes	Yes	Yes	Assessed under 'pinnipeds'
New Zealand fur seal/ long-nosed fur seal (<i>Arctocephalus forsteri</i>)	Ma	V			Yes	Yes	Yes	Assessed under 'pinnipeds'
Marine Turtles								
Leatherback turtle (<i>Dermochelys coriacea</i>)	EN, Mi, Ma	CE		Yes	Yes	Yes	Yes (ID not confirmed)	Assessed under 'marine turtles'
Loggerhead turtles (<i>Caretta caretta</i>)	EN, Mi, Ma			Yes	Yes	Yes	Yes	Assessed under 'marine turtles'
Green turtle (<i>Chelonia mydas</i>)	V, Mi, Ma			Yes	Yes	Yes	No	Assessed under 'marine turtles'

7 PROJECT PARAMETERS THAT DEFINE THE BASIS OF IMPACT AND RISK ASSESSMENTS

7.1 Construction project parameters

The indicative windfarm layout used for the MDS is shown in Figure 7-1. Effects of greater adverse significance to those assessed here are not predicted should any other development scenario be taken forward in the final design. Star of the South will ensure that activity and equipment parameters do not exceed those described in the MDS.

Table 7-1 specifies the parameters that have been assessed for construction. These represent the project parameters from the project envelope that would have the greatest potential impact to an identified sensitive receptor or receptor group. See Sections 8 and 9 for more information on how maximum design scenarios are applied in the impact assessments.

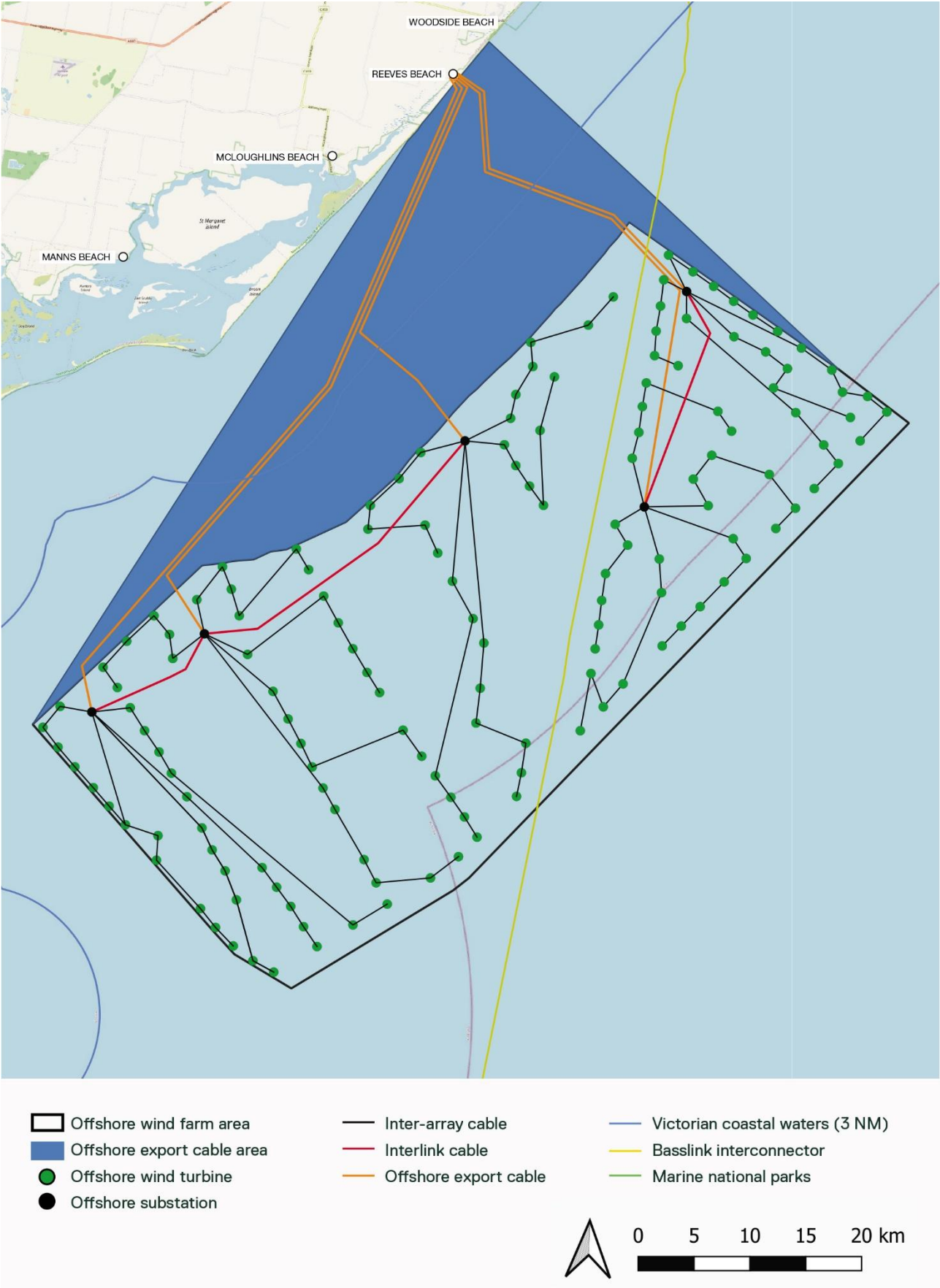


Figure 7-1: Indicative wind farm layout of 147 small turbines

Table 7-1: Maximum design scenario–construction

Impact/ risk ID	Potential Impact/ Risk pathway	Maximum design scenario	Justification
MMT-I002 MMT-I004 MMT-I007 MMT-R001 MMT-R003	Construction activities including artificial lighting, risk of vessel strike, routine discharges, and debris escape that may cause direct injury, health impacts, disturbance or displacement, or indirect impacts through potential changes in prey distribution	•Maximum area of the OWFA and OECA are 586 km² and 232 km², respectively Duration of works •Offshore construction period of four years and eleven months •If the project is constructed in two stages, minimum time lag of 12 months between stages •Installation activities underway 24 hours per day and seven days per week, weather permitting •Simultaneous construction of infrastructure (for example, wind turbines being installed on foundations while foundation installation is underway elsewhere within the OWFA) Infrastructure •Installation of up to 147 fixed bottom WTGs (Figure 7-1) with a minimum spacing of 1062 m between turbines •Up to five fixed bottom offshore substations (OSS), with monopile or jacket foundations. •Installation of total length of subsea cable: 286 km of export cable route 418 km of array cable route 40 km of interlink cables Vessels •Up to 8,320 vessel movements during the construction period, comprising: ◦7,820 trips from port by construction management vessels during the construction period in total transiting from Corner Inlet ◦500 large vessel trips, e.g. FOU and WTG installation vessels, from construction feeder ports •Vessels operating over a construction period of four years eleven months, 24 hours per day and seven days per week (weather permitting)	The MDS provides for the greatest disturbance/ displacement effects to marine mammal and turtle species due to construction activities (magnitude and duration). The two-stage construction scenario is not expected to change the risk profile compared to a single continuous construction phase. Infrastructure quantities are the maximum scenarios, thereby presenting the greatest potential project footprint and representing the greatest magnitude and duration of impacts. The maximum number of turbines and associated infrastructure would lead to the highest level of construction activities and, therefore the highest level of construction vessel round trips. Vessels operating concurrently would cause the greatest disturbance to marine mammals and turtles.
MMT-I001	Underwater noise from piling, vessels and other construction activities (rock dumping, drilling) may cause direct auditory impairment, disturbance or displacement, or indirect impacts through potential changes in prey distribution	Monopiles – WTG foundations •Installation of up to 152 monopile foundations (147 WTG and 5 OSS) •Monopile foundation diameter up to 11.8 m •Foundation installation could occur for a period of up to 24 months •Predicted piling duration of less than four hours impact piling per foundation (including 30-minute soft start) (likely to be approximately 2-2.5 hours, however this will be confirmed with pre-construction modelling and verification testing). •Monopiles installed sequentially •Monopiles driven into the seabed using an impact or vibratory hammer •Maximum hammer energy of 4,000 kJ •No concurrent installation of WTG and OSS foundations Jacket piling – OSS foundations only •Installation of up to five jackets, each with up to six legs and 12 steel pin piles •Installation of up to four pin piles per day (each pin pile up to 3.25 m diameter) •Installation of pin piles would be sequential, i.e. not concurrent. •Pin pile foundations driven into the seabed using an impact or vibro hammer. •Maximum hammer energy of 3,500 kJ Vessel noise (all project construction vessels) •Up to 8,320 vessel movements (a port call) during the construction period, comprising: ◦7,820 trips from port by construction management vessels during the construction period in total transiting from Corner Inlet ◦Up to 500 large vessels trips e.g. FOU and WTG installation vessels from construction feeder ports •Vessels holding position using Dynamic Positioning (DP) via thrusters •Vessels operating over a construction period of four years eleven months, 24 hours per day and seven days per week (weather permitting) •Concurrent vessel operations (for example installation vessel may install wind turbines on foundations while the foundation installation vessel is underway elsewhere within the OWFA, vessels during cable installation) Scour protection •Five OSS jackets) •Maximum scour protection footprint (per jacket): 15,425 m² •Maximum total scour protection footprint (total): 47,945 m² •Maximum total scour protection volume : 95,897 m³ •147 WTG monopiles with a predicted maximum scour protection volume of 292,236 m³ (2,341 m³ per monopile) •Greatest source of noise from vessels holding station whilst on DP (refer to vessel noise above) Drilling of monopiles •Up to 5% (8) of the monopile foundations may need to be drilled if refusal occurs (jetting can also be explored as an emerging option, however, may not be feasible at this stage). •The greatest source of noise from vessels holding station whilst on DP (refer to vessel noise above) .	The Foundation Options Assessment Report and the Underwater Noise Report include the justification for the maximum design scenarios for underwater noise relating to foundation type and installation method. The key controllable parameters that contribute to the underwater noise profile for pile driving activities include the piling method (e.g. impulsive or non-impulsive), pile diameter, hammer energy used, blow count combinations, duration and timing of piling and noise mitigation systems used. The geotechnical properties of the seabed also influence the noise ranges generated at the WTG foundation sites and how the sound propagates, and the modelling is based on the geotechnical data. Besides pile driving, vessels using dynamic positioning create non-impulsive noise. A key controllable parameter is thruster power; however, while power can be minimised, on some occasions, power will be dictated by safety and technical reasons. Modelling has considered noise profiles for 50% thruster power. However, this is still likely to represent a worst-case operating scenario during marginal weather conditions, with measured data suggesting thruster power did not exceed 10% of installed power during offshore operations in the Gippsland..

Impact/ risk ID	Potential Impact/ Risk pathway	Maximum design scenario	Justification
MMT-I003	Seabed disturbance and sediment plumes from cable installation activities (including HDD at the shore crossing) and possible drilling of monopiles causing reduced water quality disrupting foraging, and potentially displacement	Duration and installation • Export cable and inter-array/interlink cable installation is expected to take up to 19 and 11 months respectively • Installation method: ploughing, jetting or trenching • Cable route and seabed clearance of the entire length • Cables buried below the seabed wherever possible. If this is not possible, up to 5% of the cables would be protected with rock or concrete mattresses depending on ground conditions Inter-array cables • 418 km of array cable route • Maximum trenching width and depth of 5 and 2 m, respectively. • Maximum temporary seabed disturbance area 6.52 km² Interlink cables • Up to three HVAC interlink cables would be installed, totalling 40 km • Maximum trenching width and depth of 5 and 2 m, respectively. • Maximum seabed temporary disturbance area 0.62 km² Export cables • 286 km of export cable route • Up to eight export cables would be installed • Maximum trenching width and depth of 5 and 2 m, respectively. • Maximum seabed temporary disturbance area 4.46 km² • HDD at shore crossing: • Up to ten bore holes (two contingency), for eight export cables • Offshore exit pits minimum five metre water depth at exit • Water based drilling fluids. Maximum fluid loss to marine environment 5,684 m³ Drilling of monopiles • Up to 5% (8of the monopile foundations may need to be drilled if refusal occurs • Drilling rate approximately 20 m³/hr • Up to 2,513 m³ of sediment and cuttings generated per monopile • Worst case cuttings discharged at the sea surface	The maximum seabed disturbance area is determined by the width and length of cable clearance. Within this area trenching would occur to a depth of up to 2 m. The greatest extent of seabed disturbance and excavation would result in the greatest potential for turbidity causing decreased water quality. Ploughing is considered the maximum impact method as it creates the larges zone of influence. Sediment volumes assume 100 per cent of cables could be trenched to maximum 2 m depth, as well as drilling of pile refusal of 95% of the pile depth. At the shore crossing, the greatest number of bore holes (exit points) and the longest HDD length would result in the largest volume of drilling fluid and cuttings lost to the marine environment Further information on turbidity is found in Technical Report B – Benthic Ecology).
MMT-R002 MMT-R004	Accidental hydrocarbon release and/or accidental discharges which may cause toxicity, displacement and/or disrupt foraging	Synthetic compound and hydrocarbon contamination resulting from offshore infrastructure installation and vessels, comprising: • Water based drilling muds associated with drilling to install foundations, should this be required (i.e. refusal occurs) • Vessel spill scenario is modelled on 300 m³ of marine gas oil (MGO) and transformer spill of 40 m³ of naphthenic transformer oil. • Up to 8,320 vessel movements (a port call) during the construction period.	Parameters that create the greatest use of fuel, chemicals and hazardous waste offshore in the project area at any one time, that have the potential to spill into the marine environment. The accidental release of contaminants may directly affect marine mammals and turtles or indirectly via their prey. Maximum vessel traffic movements will be associated with greatest turbine numbers (and associated infrastructure) and will cause highest risk of a pollution incident.

7.2 Operations project parameters

Table 7-2 specifies the parameters of the maximum design scenarios that have been assessed for operations. These represent the project parameters from the project envelope that would have the greatest potential impact to an identified sensitive receptor or receptor group. See Sections 10 and 11 for more information on how maximum design scenarios are applied in the impact / risk assessment.

The indicative windfarm layout used for the MDS is shown in Figure 7-1.

Table 7-2: Maximum design scenario—operations

Impact / risk ID	Impact / Risk	Maximum design scenario	Justification
MMT-I002 MMT-I005 MMT-I007 MMT-R001 MMT-R003	Operations and maintenance activities including risk of vessel strike, routine discharges, and debris escape that may cause direct injury, health impacts, disturbance or displacement, or indirect impacts through potential changes in prey distribution	Duration of operation •Design life of the project is 30+ years. •Maximum operations time is 100% •Annual minimum downtime for turbines is 1%. Turbines •Build out of the entire OWFA (586 km²), with a minimum spacing of 1062 m between turbines •147 WTGs, with a rotor diameter of up to 236 m (total swept area 43,744 m³) and maximum tip height of 271 m •Minimum air gap of 35 m above LAT •Monthly mean rotor speeds of up to 6.4 rpm. OSS •Up to five OSS, with jacket foundations. •Indicative maximum topside dimensions 70 m L × 50 m W × 63 m H (including 33 m clearance height above LAT). Vessels •Up to 1,202 CTV return trips per year •Up to 52 SOV return trips per year •Occasional large, specialised vessels for maintenance activities	The longest operational period with the greatest amount of failures requiring more vessel activity would present the greatest potential displacement impact for marine mammals and turtles The greater number of smaller turbines built out within the entire OWFA would also present the greatest displacement potential.
MMT-I005	Physical presence of project infrastructure potentially leading to the attraction of marine mammals and turtles for foraging opportunities and/or refuge (e.g. haul-outs)	Turbines •Build out of the entire OWFA (586 km²) of up to 147 WTGs, with a minimum spacing of 1062 m between WTGs •Scour protection: - Maximum footprint (per monopile): 2,341 m² - Maximum footprint (total): 344,127 m² - Maximum volume: 292,236 m³ Offshore substations •Up to five OSS, with jacket foundations. •Indicative maximum subsea dimensions 60 m L × 80 m W •Scour protection - Maximum footprint (per jacket): 15,425 m² - Maximum footprint (total): 47,945 m² - Maximum volume: 95,897 m³ Subsea cables •Up to 279,000 m³ of rock to be used for cable remedial protection •Up to 3,600 m³ of rock to be used for cable crossings •Up to ten navigational aids and ancillary structures (e.g. LiDAR buoys)	The largest extent of operational infrastructure presents the greatest potential for attraction of benthic foraging marine mammal species (i.e. Australian fur seals). The greatest amount of new hard substrate (e.g. scour protection and monopiles) within the water column represents the greatest potential for artificial reef.
MMT-R002 MMT-R004	Accidental hydrocarbon release from a vessel collision during operations and/or accidental spill from transformers, causing behavioural/physical impacts to marine mammals and turtles	•Up to 1,202 CTV return trips per year •Up to 52 SOV return trips per year •Some large-scale maintenance operations such as replacement of WTG main components may be required, which would involve larger specialised vessels such as jack-up vessels (JUV) up to 180 metres in length. •The maximum release scenario from a single vessel tank was identified to be 300 m³ of marine gas oil to the sea surface over a 6-hour period. •The maximum release scenario from a substation transformer was identified to be 40 m³ of marine gas oil, the maximum quantity that a typical substation transformer is likely to contain. •A typical wind turbine is likely to contain up to 25 m³ of lubricants.	The greatest number of vessels over the longest operations period would result in the greatest number of discharge events – both routine and accidental. The largest number of vessel movements would also result in the greatest risk of propeller injury to marine fauna, such as penguins. Maximum vessel traffic movements will be associated with greatest turbine numbers (and associated infrastructure) and would cause highest risk of a pollution incident. The maximum estimated spill volumes from vessels (300 m ³) and infrastructure (40 m ³ from substation transformers) were selected for the accidental hydrocarbon release modelling and risk assessment (see Sections 9.2 and 11.2)
MMT-I001	Underwater noise from operational wind turbines and project vessels leading to behavioural disturbance and/or masking impacts to marine mammals and turtles	•Up to 1,202 CTV return trips per year •Up to 52 SOV return trips per year •Occasional large, specialised vessels for maintenance activities •Operation of up to 147 × large turbines (rotor diameter 285 m) for 30+ years	The greatest number of vessels results in the greatest exposure to underwater noise from vessels. Larger vessels, especially those on DP will result in larger noise. The largest size turbines with the largest rotor diameter have the greatest operational noise output.
MMT-I006	Electromagnetic interference (EMI) from electrical equipment causing a change in fauna behaviour and/or a decline in prey species	Operation of: •Up to 418 km of 66 kV inter-array cables •Up to 286 km of high voltage 275 kV export cables •Up to 40 km of high voltage 66 to 275 kV interlink cables •All cables will be alternating current (AC). •Up to 5% of cables will be remedial protected. •Minimum depth of lowering for inter-array and interlink cables: 0.6 m •Minimum depth of lowering for export cables: 1 m •Operational period of 30+ years.	Cable installation parameters are dependent on seabed conditions and will be refined following detailed site investigations. The depth at which the cables are buried and the amount of rock laying used for protection of cable that cannot be buried will influence the strength of the generated electric fields and their impact on fauna behaviour and prey availability. The greatest extent of cables would result in the greatest potential exposure.

*Minimum spacing 820 m. Because of the irregular spacing the distance between turbines may be considerably more than this

7.3 Decommissioning

While details of these activities will not be resolved for a number of years, the MDS for the decommissioning phase assumes activities include:

- Removal of OSS topsides and foundations to just below the seabed
- Removal of WTG, transition pieces and monopiles to just below seabed
- Removal of scour protection where possible and appropriate to do so
- Retention of subsea cables *in situ*
- Seabed will be returned to baseline conditions as far as reasonably practicable.

Decommissioning is expected to involve similar types and numbers of vessels and equipment. As for construction, assumptions are based on maximum build-out over the greatest area and use of temporary safety zones and buoyed decommissioning area.

7.4 Initial mitigation measures adopted as part of the project

As part of the project design process, several initial mitigations (designed-in measures) have been proposed to reduce the potential for impacts of the project. As there is a commitment to implementing these measures as standard best practice, they are considered inherently part of the design of the project and have therefore been considered within the impact / risk assessment presented in Sections 8 to 11. Many of these measures are considered standard industry practice for offshore wind globally and/or offshore industries in Australia.

Routine maritime or project-specific management plans provide initial sources of mitigation that are applied prior to the assessment of initial impacts. Initial mitigation measures for all phases are summarised in Table 7-3.

Table 7-3: Initial mitigation measure – construction, operations and decommissioning

ID	Mitigation measure	Mitigation description	Impact / risk pathway ID	Effect	Phase
EMI-M01	Depth of cable burial	Subsea cables will have a minimum depth of lowering (MDoL) of 1.0 metres for offshore export cable and 0.6 metres for inter-array cables	MMT-I006	Burial and protection of cables will minimise expose to electromagnetic interference (EMI) for sensitive receptors such as fish and invertebrates which are prey for marine mammals and turtles and for direct impacts to marine mammals and turtles.	Construction
LIT-M01	Infrastructure light management	Wind farm and vessel lighting during all phases of the project will comply with National Light Pollution Guidelines for Wildlife (DCCEEW, 2023), to limit the effects of artificial lighting on wildlife, where these do not conflict with safety (i.e. needed for safe work, navigation and aviation). This includes: • the minimisation of light spill; • avoidance of long wavelength light sources; • avoidance of blue, violet or ultra-violet wavelengths; and • lighting in each maintenance area will be kept to the minimum requirement for safe passage when personnel are not required to be working in the area. Construction lighting and marking requirements will be included in the Marine Operations Framework, including vessel lighting and temporary lighting and marking on structures within the Offshore Wind Farm Area (OWFA). For the operation phase, an operational lighting and marking plan will be developed in consultation with relevant regulators, such as the Civil Aviation Authority and the Australian Maritime Safety Authority. The plan sets out the design and operation of lighting within the Offshore Wind Farm Area, including on turbines and substations for both aviation and navigational safety requirements. During good weather while in operations, lighting on turbines and substations will be reduced where practicable as agreed with relevant regulators, including the Civil Aviation Safety Authority (CASA) and the Australian Maritime Safety Authority (AMSA). The specific requirements for lighting will be set out in the Operations Lighting and Marking Plan, in agreement with relevant authorities.	MMT-I004	Reduction in light intensity and minimise light spill where safe to do so to reduce impacts to sensitive receptors.	Construction Operations Decommissioning
OFF-M02	Marine debris minimisation	During all phases of the project, all activities will be undertaken in accordance with the management actions provided in the Commonwealth “Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia’s coasts and ocean (2018)” to limit impacts of marine debris on sensitive marine receptors. The project will take practicable actions to avoid and minimise the loss of marine debris from offshore installations and project vessels. Appropriate training will be communicated during crew induction. In the event of debris lost, if practicable, Star of the South will retrieve the debris. Reporting and monitoring will be undertaken according to the Environmental Management Framework.	MMT-R003	Compliance will ensure that impacts of marine debris on marine fauna does not occur	Construction Operations Decommissioning
OFF-M04	Low toxicity marine drilling fluids	During the construction period, only water-based drilling fluids (such as those containing xanthan gum and bentonite, or low toxicity alternatives) will be used for marine drilling activities, including trenchless installation of the shore crossing (at Reeves Beach) and drilling monopiles in the Offshore Windfarm Area (OWA) in the event of pile refusal. Low toxicity fluids will limit potential environmental harm, including impacts to sensitive marine receptors associated with decreased water quality.	MMT-I002	Reduces the potential impacts associated with reduced water quality	Construction
SNV-M04	Cable burial risk assessment	A cable burial risk assessment will be undertaken as part of detailed design to ensure that cables will be buried to adequate depth, for the safety of other marine users. Factors considered include shipping activity, use of anchors, fishing activity, substrate type and metocean conditions. Where possible cable burial will be the preferred option for cable protection. Where sufficient depth of cover cannot be achieved during installation, remedial protection will be used.	MMT-I006	Burial and protection of cables will minimise expose to electromagnetic interference (EMI) for sensitive receptors such as fish and invertebrates which are prey for marine mammals and turtles and for direct impacts to marine mammals and turtles.	Construction
SNV-M07	Vessel Passage Plan	During all phases of the project, a Vessel Passage Plan (VPP) will be produced by the vessel 'master for navigation' for relevant vessels entering Corner Inlet, in consultation with the Gippsland Ports Harbour Master as per requirements set out in the <i>Port Information Handbook for the Port of Corner Inlet and Port Albert</i>. The VPP is required on the first entry to the Port of Corner Inlet for relevant vessel classes, or if the vessel has not entered for a period exceeding six months. The vessel master must submit to the Harbour Master (or their delegate) a formal passage plan, to be lodged with the Notification of Arrival/Departure and Application for Berth form. The VPP, provides active management of vessels to reduce the choke points and provision of safe separation distances limiting impacts to third-party vessels and port congestion. The VPP, will include requirements as set out in the <i>Port Information Handbook for the Port of Corner Inlet and Port Albert</i>.	MMT-R001 MMT-R002	Minimise disturbance to marine fauna, avoid vessel strike	Construction Operations Decommissioning
SPL-M01	Refuelling and resupply limitations	To minimise the likelihood of vessel collision and hydrocarbon release, project vessels (during all phases of the project) will comply with all statutory requirements, including MARPOL (Marine Order 97). This includes the following refuelling measures: • Wherever possible, routine refuelling of project vessels will occur in port. • Should refuelling be required at sea, refuelling will not occur within shipping lanes or areas of high traffic to minimise the likelihood of vessel collision and fuel spill. • Vessel fuel must only contain a maximum sulfur content of 0.50 per cent m/m in compliance with MARPOL and Marine Order 97. • Materials and equipment that have the potential to spill onto the deck or into the marine environment will be stored within a contained area.	MMT-R002	Reduces the likelihood of an MGO spill during refuelling / resupply	Construction Operations Decommissioning

ID	Mitigation measure	Mitigation description	Impact / risk pathway ID	Effect	Phase
		- Spill response kits will be available and routinely checked to ensure adequate stock is maintained. Bunkering and bulk liquids will be transferred in accordance with bulk transfer procedures to reduce the risk of an unintentional release to sea during transfer. The procedures include standards for: - Certified equipment with confirmed integrity (e.g. hose and valves). - Transfer process (e.g. safety, communication, monitoring, inventory, emergency shut down procedures, procedural documents, and spill incident details).			
SPL-M02	Spill Response Plan	Develop, implement and maintain a Spill Response Plan (SRP) for accidental spill release from project activities within the marine environment, including prevention, response and management during all project phases to minimise risk to sensitive marine receptors. The SRP describes first strike management measures (initial response measures) for vessel spills until the Australian Maritime Safety Authority (AMSA) takes over the response as the designated Control Agency for vessel spills. If a spill was to occur the SRP would be activated and will include the following: - Initial response measures - Notification and reporting requirements - Determine if oil spill modelling and/or tracking buoys are required - Monitoring of the spill such as water quality monitoring - Response tactics to be implemented, such as subsea or surface dispersants, mechanical dispersion, containment and recovery and in-situ burning, depending on the nature and scale of the spill - Determine if shoreline protection and deflection and shoreline clean up are needed. - Monitoring and assessment of ecological impacts	MMT-R002	Reduces the impact of a spill on wildlife	Construction Operations Decommissioning
SPL-M03	Maintenance of offshore substation transformers	To reduce the risk of potential hydrocarbon spill in the marine environment, the following measures will be undertaken during the operations phase: - Offshore substation transformers will be maintained in accordance with manufacturer's requirements. - All transformers will be banded appropriate to the oil capacity to reduce the risk of hydrocarbon release to the environment. - Regular inspection of items that have a potential hydrocarbon spill risk.	MMT-R002	Reduces the potential risk of a spill associated with substation transformers	Operations
UWN-M01	Piling soft start procedure	The project will implement soft start and ramp-up of hammer energy measures at the commencement of each impact pile driving activity for both monopile and jacket pile foundations during the construction phase. The soft start will involve the implementation of lower hammer energies at the beginning of the piling sequence before the energy input applied by the hammer is 'ramped up' (increased) over time to the required higher levels. Soft start and ramping up of energy during piling is aimed at discouraging wildlife (e.g. fish, diving seabirds and marine mammals) from remaining in close proximity to the noise source, and reduce the number of individuals potentially occurring within hearing impairment ranges. It is proposed that each piling event would commence with a minimum of 10 minutes at 10% of the maximum hammer energy, followed by a gradual ramp-up for at least 20 minutes up to 80% of the maximum hammer energy for all pile driving activities.	MMT-I001	Reduced the noise generated during pile driving that could disturb marine fauna	Construction
UWN-M02	Maintenance of turbines	Maintain turbines to reduce problems arising (e.g., vibration) that could contribute to unnecessary underwater noise	MMT-I001	Reduces the noise generated by the OWF that could disturb marine fauna	Operations
VES-M01	Vessel operations framework	To ensure vessel safety and to reduce the risk of accidents (such as vessel collision and fuel spills) the project will develop, implement and maintain a vessel operations framework to be approved by the regulator, in accordance with International and Australian maritime legislation, including: - the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS) (implemented in Australia by Marine Order 30 (Prevention of collisions) 2016), - the International Convention for the Safety of Life at Sea (SOLAS) as part of the Navigation Act 2012 (lights and signals to be used by a vessel and to reduce potential vessel collisions), - the International Convention for the Prevention of Pollution from Ships (MARPOL) (regulations aimed at preventing both accidental pollution and pollution from routine vessel operations) implemented through the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Commonwealth), the Navigation Act 2012 (Commonwealth) and the Pollution of Waters by Oil and Noxious Substances Act 1986 (Victoria). All project vessels will ensure that they are operated in accordance with this framework (as required by vessel size and class) during every project stage (construction, operation and decommissioning) within both Commonwealth and State waters (including at Port, transiting to and from the OPA, as well as within the OPA). Star of the South will ensure that prior to procuring project vessels, all vessels have a record of inspections and compliance.	MMT-I002 MMT-I004 MMT-R001 MMT-R002 MMT-R003 MMT-R004	Prevent pollution of the marine environment including pollution from light emissions, vessel discharges and accidental hydrocarbon releases. Minimise the risk of a collision that may result in an accidental hydrocarbon release by governing lighting and signals required for navigational and work safety. Reducing and mitigating risk of accidents at sea will decrease any risk to fauna within the operational area from a hydrocarbon spill.	Construction Operations Decommissioning
VES-M03	Marine coordination centre	To minimise risk of third-party vessel interactions, a Marine Coordination Centre (MCC) will manage movements of project vessels to and within the Offshore Project Area (OPA). The marine coordination centre will also monitor third party vessels and aircraft around the project area. The marine coordination centre will operate 24/7 in the construction phase and in the operations phase it will be staffed during working hours and operate 24/7 during large scale maintenance campaigns such as blade replacement.	MMT-R001 MMT-R002	Reduce the likelihood of a vessel collision and spill	Construction Operations Decommissioning

ID	Mitigation measure	Mitigation description	Impact / risk pathway ID	Effect	Phase
VES-M04	Vessel movement controls	To reduce the likelihood of an accidental hydrocarbon release from a vessel collision occurring within the marine environment the following measures will be applied: • All construction, operations and decommissioning activities will occur within the designated Offshore Project Area (OPA) • Project vessels will use defined shipping routes between construction feeder ports and the OPA, as well as within Corner Inlet. Vessel routes will be further defined in consultation with relevant stakeholders. Deviation from recommended routes can occur for safety or environmental reasons. • All project vessels that require dynamic positioning (DP) will comply with the DP Certification scheme.	MMT-R001 MMT-R002	Reduce risk of an accidental hydrocarbon release Minimise disturbance to marine fauna, avoid vessel strike	Construction Operations Decommissioning
VES-M05	Vessel biosecurity controls	Project vessels and subsea equipment will be compliant with relevant biosecurity legislation and guidelines, including: • Prior to commencing project activities, all installation and support vessels will have a project-approved Ballast Water Management Plan and a Ballast Water Management Certificate. • Reporting and management of ballast water will be in accordance with The Biosecurity Act 2015 and the Ballast Water Management Convention's Guidelines for Ballast Water Management and Development of Ballast Water Management Plans. • An Invasive Marine Species (IMS) risk Assessment Procedure (IMS-RAP) will be undertaken in accordance with the International Maritime Organisation Guidelines for the Management of Ships Biofouling for all vessels undertaking project activities, and the vessel will be confirmed to be a low biosecurity risk before approval to enter the Offshore Project Area (OPA) and Corner Inlet. • Biosecurity clearance prior to entering Australian Waters for foreign vessels: ◦ Vessels that are intending to discharge internationally sourced ballast water within Australian waters must submit a Ballast Water Report through Maritime Arrivals Reporting System (MARS) at least 12 hours prior to arrival to gain biosecurity clearance. • Ballast tank sediment must be disposed of in an area outside 200 nautical miles from the nearest land, and in at least a depth of 200 metres, or at an approved land-based reception facility. • Management of anti-fouling and in-water cleaning in accordance with the Australian anti-fouling and in-water cleaning guidelines	MMT-I002 MMT-R004	Reduce the impact of routine discharges and the likelihood of accidental discharges, including a decline in water quality, increase in turbidity and temporary toxicity to fauna from bilge water discharge.	Construction Operations Decommissioning
VES-M06	Vessel strike - marine mammals	All project vessels will implement the following requirements during all project phases (construction, operation and decommissioning) as prescribed by the EPBC Regulations 2000 Part 8 and Victorian State Wildlife (Marine Mammal) Regulations 2019 to minimise the risk of collision with a whale or dolphin: • Implementation of 'no approach' and 'caution' zones for whales, dolphins and seals: – No approach zone (whales): within 100 metres of a whale, and within 300 metres to the front and rear of a whale – No approach zone (dolphins): within 50 metres of a dolphin, and 150 metres in front and to the rear of a dolphin – No approach zone (seals): within 30 metres of a seal, if the seal is on land or a haul out; or within 5 metres if the seal is on infrastructure within state waters – Caution zone (whales): within 300 metres of a whale – Caution zone (dolphins): within 150 metres of a dolphin. • Vessels must not enter the 'no approach zone' and must not wait in front of the direction of travel when a calf is present	MMT-R001	Minimise disturbance to marine fauna, avoid vessel strike	Construction Operations Decommissioning

7.5 Impact and risk pathways of offshore wind farm development for marine mammals and turtles

Large offshore developments, including offshore wind farms, pose the risk of negatively impacting the surrounding environment, including changes to ocean ecosystems and habitats, alteration of food webs, disturbing important behaviours of resident and migratory species (i.e. through increased noise or artificial light), displacement or attraction of species, and risks associated with increased anthropogenic uses including vessel strike and accidental hydrocarbon releases (Gill, 2005; Bailey et al., 2014).

Marine mammal and turtle species are fast becoming flagship species to assess the ecological impact of offshore wind farms (Bergström et al., 2014; Kraus et al., 2019). The high use of coastal and near-shore waters for key life history stages, including breeding, migrating and foraging by marine mammals and turtles, make them particularly susceptible to potential negative impacts of offshore wind construction, operation and decommissioning. In addition, the dependency of hearing systems for communication, navigation and prey location is key to the success of these life history stages, which can be altered due to adverse behavioural responses, displacement, and the masking of other noises leading to the inability to acoustically interpret the environment (Thomsen et al., 2006; Kraus et al., 2019).

The sensitivity of each species to stages and activities associated with offshore wind development depends on a range of factors, including life-history traits, behaviour, abundance and distribution, underwater communication and hearing, wind farm siting and design, and local environmental geological conditions (Gill 2005; Bailey et al., 2014; SEER, 2022). Cumulative impacts of marine mammal and turtles can also occur, this is when the effects of multiple wind farms and / or stressors in their environment combine incrementally to affect many individuals over space and time (Brignon et al., 2022), which have the potential to drive population-level effects (Masden, 2010; Platteeuw et al., 2017). It is, therefore, imperative that the implications of offshore developments are appropriately assessed with careful consideration of local ecology conditions, resident and migratory marine species, and the protection status of these.

Understanding the differences in sensitivity of each marine species and the potential exposure pathways is critical for informing wind farm siting and, subsequently, biologically meaningful environmental impact assessment. The main impact pathways are grouped depending on offshore wind farm phase, including construction, operation and decommissioning. The main risk and impacts are explained for each phase regarding marine mammal and turtle species. The main impacts and risks are summarised below:

- Habitat modification (through routine discharges, light emissions, and seabed disturbance)
- Prey modification (indirect effects on marine mammals and turtles due to changes in distribution of prey species)
- Physical disturbances / risks (mortality, auditory impairment, behavioural disturbance, stress or acoustic masking due to underwater noise, vessel strike, accidental hydrocarbon release, and debris / entanglement)
- Displacement (from key habitats due to electromagnetic fields and increased underwater noise).

The potential assessed impact and risk pathways as they relate to marine mammals and turtles that are carried through to the impact assessment are summarised in Table 7-4.

Assessments focus on those species identified by subject matter experts, with evidence from published literature, where the initial consequence level (i.e. before additional mitigation) to the population is Moderate (C), Major (B) or Severe (A) (Table 6-4). Where an initial consequence of Negligible (E) or Minor (D) was ascribed, species were not carried through for further assessment for specific impact pathways.

This approach ensures that the focus of the EIA is on those species and impact pathways, which have the potential for outcomes that are beyond applicable standards / guidelines or where there may be substantial and permanent change to the receptor affecting population viability. Thus, not all species that have the potential to interact with or be impacted by the project are considered in detail, beyond the impact and risk assessment screening process (see Appendix A for full detail relating to each species).

REPORT

Table 7-4: Summarises the key species discussed in the existing environment and the assessed potential impact and risk pathways for marine mammals and turtles carried through to the impact assessment.

Common name	Impact / Risk assessment group	MESP – recording during survey program	Primary habitats			Direct Impact							Risks			Indirect impacts
			Coastal	Inshore	Offshore	Underwater noise	Routine discharges	Seabed disturbance	Artificial light	Displacement, barrier, attraction	EMI	Vessel strike	Accidental hydrocarbon release	Debris escape	Accidental discharges	Changes to prey distribution
Blue whale	Blue whales	Y				X	X			X		X	X	X	X	X
Southern right whale	Southern right whales	Y				X	X			X		X	X	X		
Sei whale	Mysticetes					X	X			X		X	X	X		
Fin whale	Mysticetes					X	X			X		X	X	X		
Humpback whale	Mysticetes	Y				X	X			X		X	X	X		X
Dwarf minke whale	Mysticetes	Y				X	X			X		X	X	X		X
Antarctic minke whale	Mysticetes	Y				X	X			X		X	X	X		
Bryde’s whale	Mysticetes	Y				X	X			X		X	X	X		X
Pygmy right whale	Mysticetes					X	X			X		X	X	X		
Common dolphin	Odontocetes - dolphins	Y				X	X	X		X		X	X	X	X	X
Indo-Pacific bottlenose dolphin	Odontocetes - dolphins					X	X	X		X		X	X	X	X	X
Common bottlenose dolphin	Odontocetes - dolphins	Y				X	X	X		X		X	X	X	X	X
Striped dolphin	Odontocetes - dolphins	Y				X	X	X		X		X	X	X	X	X
Risso’s dolphin	Odontocetes - dolphins					X	X	X		X		X	X	X	X	X
Killer whale	Odontocetes - dolphins	Y				X	X	X		X		X	X	X	X	X
False killer whale	Odontocetes - dolphins					X	X	X		X		X	X	X	X	X
Australian fur seal	Pinnipeds	Y				X	X	X		X	X	X	X	X	X	X
New Zealand fur seal	Pinnipeds	Y				X	X			X		X	X	X	X	X
Leatherback turtle	Marine turtles					X	X	X	X	X		X	X	X	X	X
Loggerhead turtle	Marine turtles	Y				X	X	X	X	X	X	X	X	X	X	
Green turtle	Marine turtles					X	X	X	X	X	X	X	X	X		

8 CONSTRUCTION IMPACT ASSESSMENT

This section discusses the potential impacts of the project as a result of construction and commissioning activities and the associated mitigation measures that aim to reduce impacts to as low a level as reasonably practicable.

The following discussion refers to impacts associated with construction activities for the project. The assessment presented below describes the impacts with all the mitigation measures implemented i.e. with both initial and final mitigations implemented. Appendix B presents the detailed impact registers that assess the level of impact with application of initial and final mitigations measures.

8.1 Underwater noise emissions (MMT-I001)

8.1.1 Existing sources of underwater noise

There are a variety of existing marine noise sources in the offshore Gippsland area including shipping activity originating from nearby Port Albert and Port Welshpool, noise associated with the Gippsland petroleum facilities and vessel operations, seismic survey signals, wind noise, various biological noise sources and flow noise due to the high seabed currents (refer to Section 6.1.2). Underwater noise studies were conducted as part of the MESP program and recorded a range of natural, physical and anthropogenic noise across the proposed Star of the South project site, with wind speed the primary driver of baseline low-level ambient noise.

An example ambient noise spectra from all sampled sites during a quiet period with low wind (~ seven knots) and minimal biological activity from snapping shrimp and vessel traffic, and noisier period with higher wind (~22 knots) and no vessel traffic is shown in Figure 8-1. Ambient noise in the frequency range from 8 Hz to 32 kHz varies between ~40 - 85 dB re 1 μPa^2 in low wind conditions, increasing to over 90 dB re 1 μPa^2 in higher wind conditions. There is an almost 25 dB increase in ambient noise level at 1000 Hz due to wind alone (Figure 8-1).

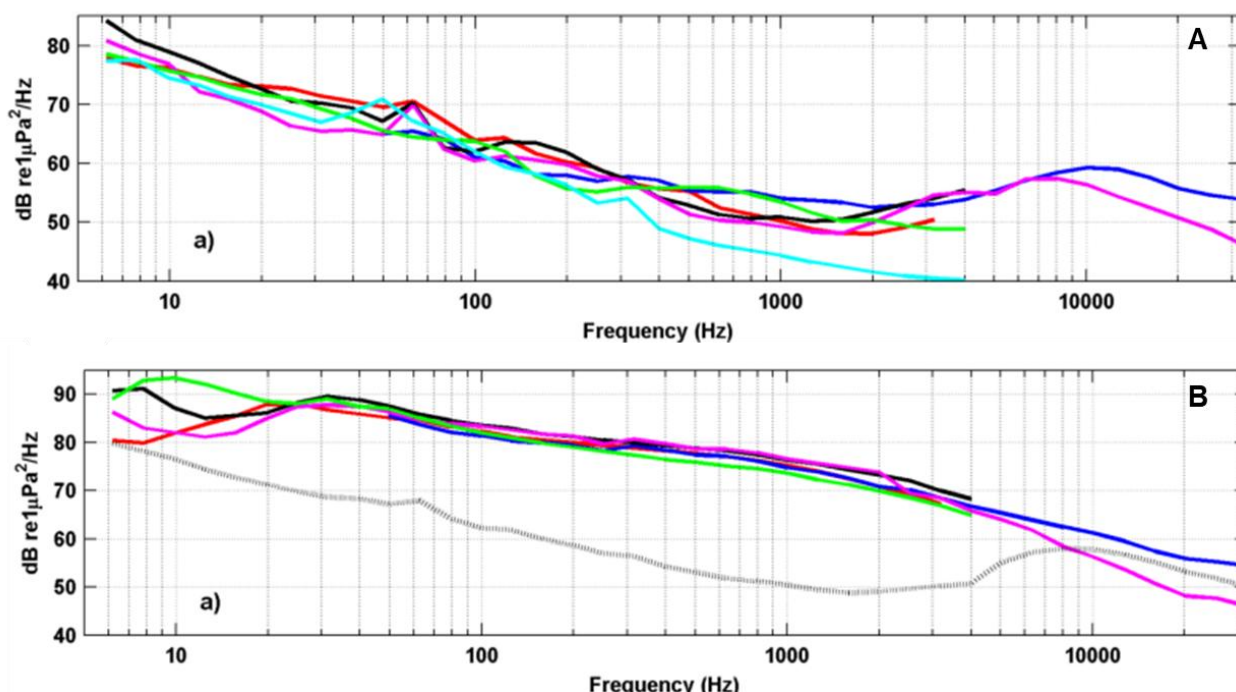


Figure 8-1: Average spectral level curves under (A) low wind conditions and (B) higher wind conditions at: southeast region of the OWFA in 40 metres water depth (red and blue curves); southwest corner of the OWFA in 25 metres water depth (black and magenta); and offshore of the OWFA in 60 metres water depth (cyan)

The 50 percentile (median) ambient noise across the entire recording period, including biological noise sources, wind noise, vessel traffic and petroleum facility related noise, but excluding noise artefacts and

periods of seismic activity, are shown in Figure 8-2. Vessel traffic and possibly petroleum facility related noise appeared mostly at 5 to 100 hertz, with wind generated noise mostly at frequencies above ten hertz, and biological noise from 15 hertz and up. The median ambient noise across the entire recording period in the frequency range from 5 Hz to 32 kHz varies between ~65 - 85 dB re 1 $\mu\text{Pa}^2/\text{Hz}$.

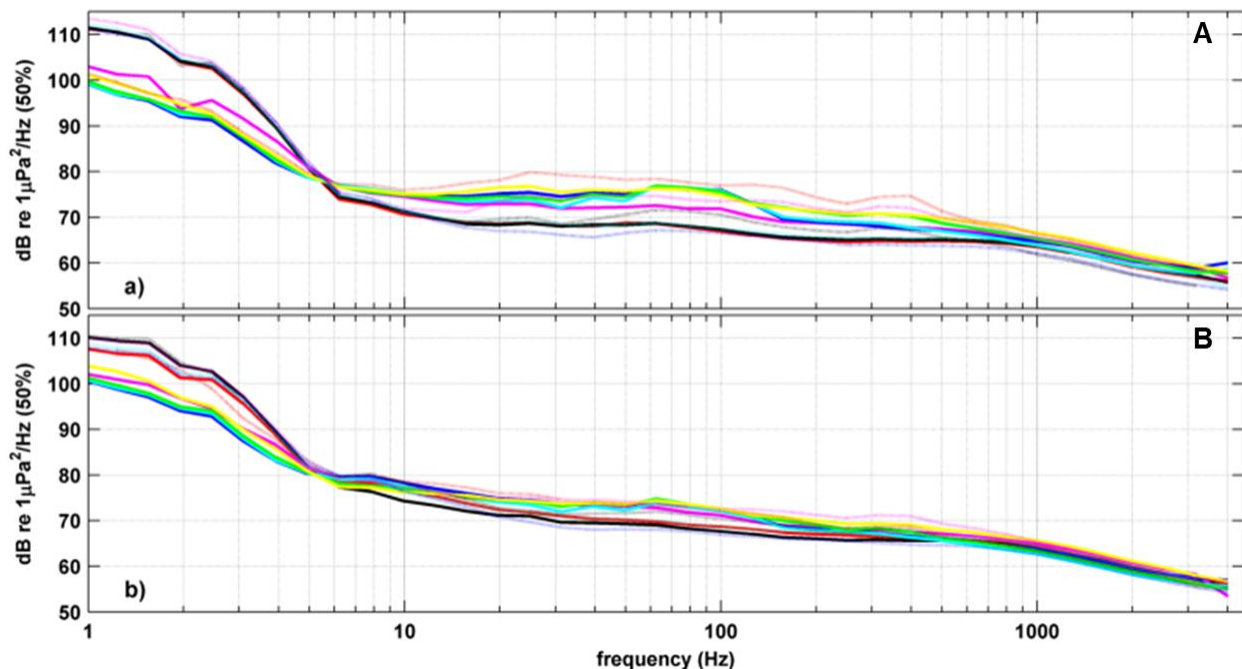


Figure 8-2: 50 percentile ambient noise curves for A) southeast region of the OWFA in 40 metres water depth and B) offshore of the OWFA in 60 metres water depth, for: January (solid red), February (solid black), March (solid magenta), April (solid blue), June (solid green), July (solid yellow), August (dotted red), September (dotted black), October (dotted magenta), November (dotted blue) and December (dotted cyan)

Noise monitoring showed that multiple large vessels (e.g. median 2.7 per day) transit through the area each day affecting baseline noise levels for about two to three hours per ship equating to six to nine hours of ship noise per day. Seismic survey signals were also detected in the area during the survey period with potential for this source to continue intermittently in the future for oil and gas and / or carbon capture and storage projects. For a full review of existing baseline noise levels, including the contribution from whales please refer to Marine Mammal Study Report, Star of the South MESP (RPS, 2023).

8.1.2 Auditory effects

Marine mammals, and particularly cetaceans, use sound for a range of important behaviours and activities such as communicating with conspecifics, foraging, navigation, and predator avoidance.

Elevated underwater noise levels can affect marine fauna in three main ways (Richardson et al., 1995; Simmonds et al., 2004):

- By causing direct physical effects, including hearing or auditory impairment. Auditory impairment may be temporary (temporary threshold shift — TTS), or permanent (permanent threshold shift — PTS), with PTS generally considered to represent a form of injury. However, recent guidance on the Blue Whale Conservation Management Plan considers TTS to be a form of injury (DAWE, 2021).
- Through disturbance, leading to behavioural changes or displacement from important areas. The occurrence and intensity of disturbance is highly variable and depends on a range of factors relating to the animal and situation.
- By masking or interfering with other biologically important sounds used by marine mammals and turtles (including vocal communication, signals, and sounds produced by predators or prey).

Permanent Threshold Shift (PTS)

PTS refers to a hearing threshold shift that does not return to the pre-exposure level. PTS is considered injury as a result of noise exposure; however, there are no published data on the exposure durations and sound pressure levels that cause PTS in marine mammals. Instead, PTS is extrapolated as it is considered unethical to conduct experiments measuring PTS in animals. The onset of PTS was extrapolated from early experiments on TTS growth rates in chinchillas (Henderson and Hamernick, 1986) and is conservatively considered to occur where there is a 40 dB shift in the hearing threshold above the temporary threshold shift (TTS) onset threshold (Southall et al., 2007). This extrapolation is considered conservative because available data has shown that noise induced threshold shifts of up to 50 dB have not resulted in PTS (NMFS, 2024).

Temporary Threshold Shift (TTS)

The National Marine Fisheries Service (NMFS) defines TTS as a temporary, reversible increase in the threshold at a specified frequency or portion of an individual's hearing range above a previously established reference level (NMFS, 2024). Though TTS is recoverable, a large shift in hearing threshold near to values that could cause PTS may require multiple days to recover (Finneran, 2015). In marine mammals, the onset level and growth of TTS is frequency specific and depends on the temporal pattern, duty cycle and the hearing test frequency of the fatiguing stimuli. For example, if a shift occurs within a frequency band that lays outside of the main hearing sensitivity of the receiving animal there may be a 'notch' in this band, but potentially no effect on the animal's ability to survive. Moreover, this variation in onset level and growth of TTS can result in differences in the susceptibility of marine mammal species to TTS, with odontocetes identified to be more susceptible to TTS than pinnipeds from the same sound due to species hearing sensitivities (Kastelein et al., 2019). No changes in animal susceptibility to TTS were observed in harbour seals exposed to impulsive noise (Kastelein et al., 2019), however, studies on terrestrial mammal species have evidenced changes in animal susceptibility due to conditioning (Kujawa and Liberman, 1997; Mannstrom et al., 2015).

Noise-induced TTS was studied in harbour porpoises exposed to pile driving, identifying that the animals hearing recovered from TTS within 48 minutes post-exposure (Kastelein et al., 2015). After multiple independent exposures to a sound source, the rate of recovery from TTS or response from the animal can vary. Kastelein et al (2020) reports that after multiple impulsive sound exposure studies on harbour porpoises, TTS onset could not be reproduced on the same animal, with the researchers suggesting that the animal may have learned over time to self-mitigate against the repeated impulsive exposures, thus reducing its hearing sensitivity (von Benda-Beckmann et al., 2020).

While the NMFS does not consider TTS as injury, in Australia recent guidance under the Blue Whale Conservation Management Plan (CMP) (DAWE, 2021) defines injury to blue whales as "both permanent and temporary hearing impairment (PTS and TTS)". Given the southern right whale also has a recovery plan, with action areas the same as those in the blue whale CMP, TTS is conservatively considered injury for southern right whales in this impact assessment as well. For this assessment, TTS is referred to as hearing impairment, however, there remains uncertainty about the definition of TTS and its application in Australia. Updates to EPBC Policy Statement 2.1 and the creation of Underwater Noise Guidelines may result in changes to the definitions applied in this document.

Behaviour

Behavioural responses to underwater sound are difficult to determine because animals vary widely in their response type and strength, and individuals from the same species exposed to the same sound may react differently (Nowacek et al., 2004; Gomez et al., 2016; Southall et al., 2016). For example, the response of an animal with prior experience to the noise could be lesser or greater than might normally occur depending on prior habituation or sensitivity to the source. The behavioural state, life stage and biological adaptations of an animal is also important. Foraging animals may not stop foraging if their need to feed is greater than their motivation to respond, while animals with dependant calves may be less inclined to move if they are at their energetic limits (Marley et al., 2017). Southall et al. (2021) suggest separating responses into three categories which may differentially affect vital rates: foraging, survival and reproduction. See Section 8.1.4.5 (Sound Exposure Thresholds) for more information.

In response to sound, marine mammals have been observed to alter respiration rate and swim speed, change diving and foraging behaviour, exhibit habitat displacement and avoidance, and alter migration paths

(Nowacek et al., 2007; Weilgart, 2007; Erbe, 2013). Behavioural responses could also be a secondary response to a primary effect e.g. PTS/TTS, or masking.

Masking

Masking is described as a reduction in the ability of an animal to detect relevant sounds in the presence of other sounds (Erbe et al., 2016). Relevant sounds include those used for individual survival and population dynamics, including finding food and communication with conspecifics. To increase the detectability of their calls, marine mammals have been found to alter the intensity of calls, call rates, duration, and frequency, or cease calling until the noise source has decreased its intensity (Buckstaff, 2004; Parks et al., 2007; Di Iorio and Clark, 2010; Marley et al., 2017; Fouda et al., 2018).

As peak underwater SPL measured for pile driving are ~200 dB re 1 µPa @1 m, and the sound ranges in frequency between 80 Hz and 2,000 Hz, this noise may have a direct impact of masking on those marine mammal species which vocalise in this frequency range or are hearing sensitive in this range (Southall et al., 2007; Dahl et al., 2015).

8.1.3 Hearing sensitivity

Marine mammal species differ in their hearing capabilities and their frequency band of hearing (Richardson et al., 1995; Wartzok and Ketten 1999; Southall et al., 2007). To reflect these differences Southall et al. (2007; 2019) proposed relatively broad marine mammal hearing groups based on their known hearing sensitivity and sound production parameters, as well as common auditory anatomical features. These groups reflect the auditory similarities between groups of marine mammal species which are related phylogenetically. For this assessment, the relevant groups are low-frequency (LF) cetaceans, high-frequency (HF) cetaceans and otariid pinnipeds (in water) (Table 8-1). Very high frequency (VHF) cetaceans are also included for demonstrative purposes, though we don't expect any VHF species to occur in the OWFA and surrounds.

Within the LF cetacean group, there is evidence to suggest that some whales (e.g. blue whale, fin whale, southern right whale) may be more sensitive to very low frequencies, including the relatively larger size of these whales compared to other mysticetes, and very low frequency components of most of their vocalisations, and should form a separate group for very low-frequency (VLF) cetaceans (Southall et al., 2019). However, at present there is insufficient direct information and no direct measurements of hearing sensitivity or TTS for any species to make a distinction between LF and VLF cetaceans, and given the logistical challenges of working with these species it is unlikely this information will be obtained in the near future (Southall et al., 2019). Additionally, there was no revision in the recent update to the National Marine Fisheries Service (NMFS) technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing (NMFS, 2024). Therefore, all baleen whales are grouped as LF cetaceans.

Table 8-1: Marine mammal and turtle functional hearing groups (Southall et al., 2007; 2019; Finneran et al. 2017, NMFS, 2024).

Functional hearing group	Generalised hearing range
LF cetacean	The LF cetacean group includes all mysticete (baleen) whales. There have been no direct measurements in hearing sensitivity for any of these species. The estimated audible frequency hearing range of LF cetaceans is 7 hertz (Hz) to 36 kilohertz (kHz). It is noted that blue whales and southern right whales are included in the LF cetacean group, however there is evidence to suggest these species should be treated separately as very low-frequency cetaceans.
HF cetacean	The HF cetacean group includes most delphinid species (e.g. bottlenose dolphin, common dolphin and killer whales), beaked whales and sperm whales. The estimated audible frequency hearing range of HF cetaceans is 150 Hz to 160 kHz.
VHF cetacean	The VHF group includes true porpoises, <i>Kogia</i> (dwarf / pygmy sperm whale), river dolphins, and some oceanic dolphin species. The estimated auditory frequency hearing range of VHF cetaceans is 200 Hz to 165 kHz. There are no VHF cetacean species expected to occur in the OWFA and surrounds.
Otariid pinnipeds (in water)	The Otariid pinnipeds refers to sea lions and fur seals.

Functional hearing group	Generalised hearing range
	The estimated audible frequency hearing range of otariid pinnipeds (in water) is 60 Hz to 68 kHz.
Marine turtles	The estimated audible hearing range of marine turtles is 50 Hz to 1,600 Hz.

Marine turtles are most sensitive to sound at low frequencies in the range of 100 to 700 Hz (Bartol et al., 1999; Finneran et al., 2017), although have poor auditory sensitivity overall (Bartol and Ketten, 2006; Dow Piniak et al., 2012). Accordingly, PTS and TTS thresholds for turtles are likely more similar to fish than to marine mammals (Table 8-7, Table 8-8) (Popper et al., 2014).

8.1.4 Construction activities

8.1.4.1 Project activities

Construction of the offshore project will produce underwater noise emitted during various activities above background levels (i.e. installation of WTG foundations via impact piling or vibro-piling, installation of offshore sub-station structures as either monopile or jacket foundations via impact or vibro-piling, rock dumping), as well as from vessels engaged in these activities, including DP. There are two main classes of anthropogenic noise; impulsive and continuous (Popper et al., 2019). Impulsive sounds are typically short duration, single or repetitive, and may show large change in amplitude over their time course such as piling for the installation of monopile foundations. Continuous noise during construction is produced by vessels, including vessels on DP during installation of WTG foundations and securing of transition pieces, and vibro-piling, if used as an installation method for WTG monopile foundations. However, it should be noted that even vessel noise and vibro-piling noise will not be continuous, with variation in vessel thruster activity and intervals between vibro-piling set up, installation and pack down resulting in breaks in noise emissions.

It is anticipated that pile driving of monopile foundations and vessel noise whilst under DP (i.e. use of thrusters to maintain vessel position while undertaking an activity) would be the dominant sources of underwater noise during the construction phase (see Attachment I – ‘Underwater noise modelling’ for a full review of underwater noise sources and levels).

The other noise generating activity during the construction phase is the installation of subsea cables via a cable lay vessel and rock dumping for scour protection. The primary noise source associated with these activities is the positioning of the vessel using DP thrusters.

The decibel (dB) scale is used to measure the amplitude, or loudness of a sound wave and is strongly influenced by the density of the medium the sound is travelling through. For underwater sounds, the decibel scale is denoted relative to the reference pressure of one micro-Pascal (μPa) e.g., dB re 1 μPa .

Pile driving

Impact piling is recognised as a source of intense and impulsive underwater noise. This technique involves a large weight being dropped or driven (hammered) on top of a pile, forcing it into the seabed by a series of blows. The pile is repeatedly driven until it reaches the required depth and the number of blows required to achieve the target depth is influenced by seabed type, pile size and pile driving methods (Matuschek & Betke, 2009). A description of the pile driving properties used in this noise modelling study is provided in Attachment I – Underwater noise modelling.

At a maximum, piling for installation of foundations for turbines and substations will occur at a single location at any one time across the entire project. It is estimated that the installation of each monopile by impact hammer will take approximately four hours to reach full depth and by vibro hammer the installation time is reduced to approximately 30 minutes. The installation of each monopile will be supported by an Offshore Installation Vessel (OIV) that will hold station by either DP or jack-up legs that sit on the seafloor and lift the vessel above sea level. Jack-up vessels do not require the use of thrusters during monopile installation and therefore do not contribute to the underwater noise field. In contrast, DP installation vessels will require continuous thruster use to maintain position against prevailing weather/currents and will generate non-impulsive noise emissions. It is estimated that the DP thrusters will be in operation for a period of approximately 17 hours per monopile for the impact piling method and 13.5 hours for the vibro-piling method.

Piling of foundations over the entire OWFA will occur for a period of up to 24 months, however active piling (hammering) will only occur for up to four hours per monopile (Table 7-2). Active piling for jacket foundations will be up to six hours per day, taking three days to install each jacket due to the need to install multiple (up to 12) pin piles. This means that the period during which marine mammals and turtles could potentially be impacted by piling noise within the underwater noise effect zones around the activity, amounts to a total of 608 hours over 24 months. Vibro-piling installation is likely to be much quicker, with one monopile potentially taking as little as half an hour to install.

Drilling

In the event of pile refusal, drilling or jetting may be required as an intervention before pile driving can continue with selected installation method. Based on wind farm developments overseas and geotechnical survey data it is conservatively estimated that seabed conditions may prohibit pile-driving in up to five percent of monopile foundations to their target depth, with the MDS equating to eight monopiles. If pile 'refusal' occurs it is likely to be at the final target depth range, meaning that up to 95 per cent of the depth may be drilled. If drilling is required during monopile installation, it is expected that both piling and drilling would be undertaken by the same vessel with each drilling operation lasting up to 24 hours and seawater used as drilling fluid.

Noise emissions from drilling operations (non-impulsive sound) are less than for impact piling activities (impulsive sound) (Huang et al., 2023) and less than for vessels operating on DP, and therefore impact piling and DP are the MDSs. For example, underwater noise modelling for ESSO's drilling activities in the Gippsland in 60 metres water depth predicted TTS ranges for low frequency cetaceans out to a maximum of 190 m (for an eight-hour drilling scenario and with a support vessel holding position using DP alongside the jack-up drilling vessel), (Matthews et al., 2023). Marine mammal behavioural disturbance ranges for the same drilling activity were predicted to be within 2.9 km and 3.7 km, depending on the proximity of the support vessel on DP, i.e. the largest range was when the support vessel was furthest from the drilling vessel (Matthews et al., 2023). Underwater noise modelling for drilling activities during Beach's drilling and plug and abandonment (P&A) activities in the Otway in 80 metres water depth predicated TTS onset could occur within 820 metres (for an eight-hour drilling scenario with a support vessel holding position on DP alongside an anchored mobile offshore drilling unit), with behavioural response disturbance ranges out to 6.23 kilometres (Stroot et al., 2022).

Installation of subsea cables and scour protection

The installation of subsea cables (array, interlink and export) and scour protection will require the use of vessels on DP. This activity could occur at any time within the four year and 11-month construction timeframe and vessels are likely to undertake 24-hour operations.

Rock cutting during cable lay

It is possible that rock cutting may be required during cable lay activities in the event that hard rock sediments are encountered along the cable route.

8.1.4.2 Underwater noise modelling approach

A series of underwater noise modelling was carried out in order to develop the final scenarios to be inputted into the model and used in this assessment (Section 8.1.4.3). Detailed information on modelling considerations and results is provided in the Underwater noise modelling (Attachment I) (RPS, 2025a), with information summarised below.

The first round of underwater noise modelling (2020-2022) informed project design decisions, such as the use of NAS and removal of concurrent pile driving operations, which was further refined during the second round of modelling (2023-2024). Key differences between the first and second rounds of modelling included the use of site-specific geotechnical data for each modelling location in the second round, as opposed to noise propagation measurements and assumed geological layers from the literature used in early modelling. Additionally, the hammer size and energy for installation of jacket foundation pin piles was increased from a 2,300-kilojoule hammer in early modelling to a 3,500-kilojoule hammer in the second-round modelling, which reduced the installation time by around 1.5 hours. The monopile diameter was also refined, from a maximum of 13.5 metres diameter used in the early modelling to a maximum of 11.8 metres used in the second-round modelling, with monopile diameter consistent irrespective of site location and water depth.

A third round of modelling (2024-2025) was undertaken to determine the noise effect ranges from vibro-piling rather than impact piling, which had been modelled during the previous two rounds. This involved the modelling of a continuous noise source rather than an impulsive noise source, and consequently, different noise thresholds were applied. In addition, the NMFS Updated Technical Guidance was released in October 2024 with the new thresholds used in the modelling. For the first time, site-specific geotechnical data was used for each modelling location and to build the ground model. This enabled variation in the maximum monopile diameter to be used at each location, respective of water depth, with a maximum pile diameter of 11.8 metres in deep water, 11 metres in intermediate water depths and 9.2 metres in shallow water.

A fourth round of impact pile driving noise modelling was undertaken in 2025 which included several new advancements that had not been included in the first and second round modelling, also for impact piling. Firstly, the number of WTG monopile locations was increased from two to four, including a new location with relatively harder driving according to geotechnical data. As with the round three vibro piling modelling, pile diameter size varied with depth, with the largest pile size used for deeper water. During this fourth round of modelling 4,000-kilojoule hammer was used for the monopiles and “a more refined drivability profile was used for this round that utilised the upper 90th percentile of applied energy at each depth interval. The new NMFS (2024) thresholds and associated frequency weightings for marine mammals were applied, along with the new PTS and TTS onset thresholds for marine turtles to impulsive noise sources in Accomando et al. (2025). Additionally, a further NAS, the modified hammer system (MHS), was included in conjunction with a double big bubble curtain (DBBC) and hydro sound damper (HSD).

8.1.4.3 Conservatism in the underwater noise model

Contemporary input data, as it has become available, have been used over four rounds of underwater acoustic modelling from 2020 to 2025 to predict the underwater noise emissions for the SOTS project from impact pile driving of monopile and jacket pin pile foundations, vibro-piling of monopile and jacket pin pile foundations and vessel operations associated with construction of the project. However, despite the inclusion of the best available input data, the modelling still includes a large degree of conservatism.

Some of this conservatism is associated with the pile driving input parameters themselves, for example largest pile diameter modelled at both deep and shallow water sites for impact pile driving, 95% percentile energy in each layer, maximum hammer energy, total pile duration and strike rate modelled, as well as geotechnical information included in the model. Other conservatism in the model comes from the use of the winter seasonal parameters, which provide a worst-case scenario and therefore larger ranges to sound exposure thresholds, and the use of lower effect onset level thresholds for PTS and TTS in marine mammals, initially proposed by Southall et al. (2007) and updated in Southall et al. (2019) and NMFS (2024) (Section 8.1.4.5).

In this impact assessment, results of the animat modelling (see Underwater noise modelling (Attachment I, RPS 2025a)) are used as a more realistic profile of animal movement through the ensonified area, and because during the baseline surveys blue whales were not found to persist and forage in the project area. The project area overlaps a migratory BIA for southern right whales. The modelled sound fields suggest that the distance to behavioural disturbance thresholds was less towards the coastal southern right whale reproductive BIA corridor compared to the distance to thresholds offshore. However, the results of the static acoustic model, which assumes whales are stationary, i.e. there is no consideration of normal animal movement and resulting reduction in noise exposure over time, are also considered in the event that there is a need to revert to these for adaptive management purposes. In this case, distances to sound exposure thresholds and consequently mitigation distances would be a conservative estimate.

The purpose of including this level of conservatism is to ensure that validated noise emissions during construction are equal to or less than the predicted noise impact ranges from the modelling study, and to ensure no impacts to marine fauna. However, it is possible that modelled predicted ranges may be overly cautious and in practice ranges may be much smaller, such as in shallow waters with a smaller pile diameter in the summer months.

8.1.4.4 Underwater noise modelling scenarios

Underwater noise modelling scenarios were developed using parameters relevant to construction activities. These scenarios were used to infer the sound propagation at locations across the OWFA. Justification for the underwater noise scenarios is included in the Underwater Noise Modelling Report. As indicated above the scenarios focussed on piling and vessel activities.

8.1.4.4.1 Piling

- Installation of monopile WTG foundations using impact piling. Installation of a single monopile with a DBBC, HSD and MHS applied around the pile was modelled at four sites within the project area; shallow NW corner (21 metre water depth), central intermediate (34.7 m water depth), deepest SW corner (51.3 m water depth) and deep SW corner (47 metre water depth). Monopile diameters increased in size with increasing water depth. At the shallow site, the modelled pile diameter was 9.2 m, 11 m at the intermediate site and 11.8 m at the two deep water sites.
- Installation of OSS jacket structures (four pin-piles in total) for OSS foundations using impact piling with a DBBC and MHS at a single site at the midpoint of the OWFA (30 metres water depth).
- Installation of monopile WTG foundations using vibro-piling. Installation of a single monopile was modelled at three sites within the project area; the shallow NW corner (21 metre water depth), the centre of the project area in intermediate water (34.7 metre water depth) and the deep SW corner (51.3 metre water depth). Monopile diameters increased in size with increasing water depth. At the shallow site, the modelled pile diameter was 9.2 m, 11 m at the intermediate site and 11.8 m at the deep water site.

8.1.4.4.2 Noise attenuation systems

Underwater noise was initially modelled without the use of any initial mitigations to reduce noise propagation. The outputs of the modelling demonstrated that unmitigated piling (i.e. without NAS) would result in unacceptable levels of impact on sensitive receptors (see Section 8.1.4.5.1). As a result, a commitment was made to use a DBBC during all impact piling and this initial mitigation was subsequently incorporated into the modelling assumptions. Further modelling included the use of multiple NAS in combination. The modelling outputs for impact piling with a DBBC, HSD and MHS in place are used in the following sections to assess the impacts on marine mammals and turtles from underwater noise emissions.

Noise attenuation systems such as DBBC can be used during impact piling to decrease the propagation of sound energy away from the pile. Star of the South has committed to the use of a DBBC around each pile during installation as an initial mitigation (Section 7.4). Bubble curtains have been measured to reduce sound levels by approximately 10 decibels to more than 20 decibels outside of the curtain, dependent on the depth of water and current, and configuration and operation of the curtain (Bellmann, 2014; Koschinski & Lüdemann, 2013; 2020; Nehls et al., 2016).

It has been reported that the functionality of the BBC or DBBC is influenced by the technical design of the DBBC (nozzle and riser hoses number, length, configuration), air flow, deployment design and distance to the piling site, as well as the influence of physical environmental parameters (e.g. currents, etc.) (Bellman et al., 2019). Star of the South has investigated the practical experiences and effectiveness of the DBBC in other offshore wind projects where there are similar sensitive baleen whale species, such as the northern right whale in the case of offshore wind projects in the US. The following provides a summary of challenges facing DBBC effectiveness and the practical performance improvement measures implemented by the Vineyard Wind 1 project following in-field underwater noise measurement program ('Big Bubble Curtain Performance Memo' accessed via [Incidental Take Authorization: Vineyard Wind 1 LLC Construction of the Vineyard Wind Offshore Wind Project off of Massachusetts | NOAA Fisheries](#)). Vineyard Wind 1 project employed a single BBC for initially for the installation of monopile foundations and observed exceedances of distances to predicted marine mammal thresholds. A second BBC was added which was shown to be effective in reducing sound energy, however it was determined that a maintenance schedule and improvement procedure was required to address technical functionality of the DBBC and the continued exceedances. The enhanced procedure required the re-drilling of the holes in the hoses on the seabed due to sedimentation problems, so that the bubbles could emanate without impedance. This was a more conservative approach than taken in the North Sea, where the holes are re-drilled after every third deployment. Given the challenges of the much siltier environment in the Vineyard Wind 1 project area, adaptive management was required to ensure the effectiveness of the DBBC. Following the application of the enhanced maintenance procedure, there were no further exceedances for marine mammals (Küsel et al., 2024).

The above adaptive management demonstrates the measures that can be implemented to address performance challenges for DBBCs and improve the effectiveness to meet noise reduction criteria, and that SOTS has access to personnel experienced in using these technologies and who know how to maintain them throughout construction, to ensure continued effectiveness of the measure. The DBBC system

modelled in this study assumed a configuration of two big bubble curtains located 90 and 130 metres from the pile.

The HSD is a cylindrical net containing foam elements held in position by a frame (ballast box) surrounding the pile and deployed on the seafloor from the installation vessel using a lifting device. The size of the HSD is fitted to the dimensions of the pile. The size and number of foam elements can be adjusted according to project requirements. At water depths of up to 40 metres, HSD systems have showed a reduction in per-strike broadband SEL of 10–12 dB when used on their own (Bellman et al., 2020). HSDs are particularly effective at frequencies below 200 Hz and are often used in combination with other mitigation tools.

There are several emerging primary noise reduction methods at various stages of development that are focused on reducing noise emissions at the source by modifying the way that hammers interact with the pile, for example, including the PULSE developed by IQIP. The PULSE is a primary noise reduction technology, designed as an add-on feature to a standard hammer. The PULSE system is placed between the hammer and the sleeve and acts as a fluid cushioning, thus elongating the impact of the hammer and lowering the peak force. The amount of fluid between the plungers can be adjusted when the hammer is on the pile to optimise noise reduction without delaying installation. As a relatively new noise abatement technology, limited published literature is available identifying the noise level reduction of PULSE in the field, however, this technology has now been used to install over 200 monopiles and 100 pin piles globally. IQIP report a 6–10 dB reduction in noise level (SEL) in their testing when using a conventional hammer (IQIP, 2025), and early reports from installation of 9.2 metre diameter monopiles for an OWF in Germany demonstrate a noise reduction of 24 dB by PULSE when used in combination with a noise mitigation screen and DBBC (Buljan, 2024).

8.1.4.4.3 Vessels

Installation of project infrastructure would require a range of vessels including self-elevating ‘jack-up’ vessels or heavy lift dynamically positioned vessels used to install the wind turbines and substations, cable laying vessels used to install subsea cable, and installation support vessels such as transportation freighters and barges, trenching vessels, dive and remote operated vehicle (ROV) support vessels, special operation vessels, crew transfer vessels (CTVs) and tugboats.

Underwater noise emitted from vessels is produced mainly by propeller and thruster cavitation, with a smaller fraction of noise produced by sound transmitted through the hull, such as by engines, gearing, and other mechanical systems. Sound levels tend to be the highest when thrusters are used to position the vessel and when the vessel is transiting at high speeds. A vessel's sound signature depends on the vessel's size, power output, propulsion system and the design characteristics of the vessels drive system (e.g., blade shape and size). Vessels typically produce broadband acoustic energy with most of the energy emitted below a few kilohertz.

At this stage, vessels have not been selected, and vessel operators have not been contracted, thus exact vessel specifications are unknown. Although it is possible to use jack-up vessels to reduce noise emissions from construction vessels, this will depend on vessel availability, supply chain constraints, port access and technical capabilities. Consequently, the impact assessment has used vessels on DP as part of the realistic approval envelope approach. A worst-case scenario has been adopted for the analysis within the Project Design Envelope (PDE). The modelling assumes a configuration involving a large WTG heavy-lift installation vessel operating on dynamic positioning, supported by a platform support vessel and a cable lay vessel. For the WTG installation vessel, thruster power limits of 50% have been adopted, representing the maximum safe operational limits for this vessel type. Operations were modelled in both deep and shallow water environments under worst-case metocean conditions.

Due to the absence of available source data—since WTG installation vessels are not typically required to monitor underwater noise—no known direct measurements exist for this vessel type globally. As the project-specific vessel has not yet been selected, a surrogate vessel operating in the same region under similar conditions was used to represent the target vessel. Scaling adjustments were applied to account for potential differences in source levels between the surrogate and installation vessels. Vessel noise modelling was conducted using peer-reviewed literature and JASCO's extensive experience in modelling and measuring underwater noise from offshore development activities. The Attachment I - Underwater noise modelling and JASCO SOTS Noise Modelling Report provide further information on the approach and parameters selected for vessel underwater noise modelling.

The estimated source levels of the vessels used in this modelling study ranged from 179 to 186 dB re 1 μPa^2 m^2 . Note that reference value for source level is cited as 1 μPa^2 m^2 in this assessment, however, it may also

be cited as 1 μPa @ 1 m. This source level range was derived from a measurement program for a support vessel in the Gippsland region and the total thruster power was scaled up to match that of the nominal vessels selected as representative of the vessels that will be utilised for the construction program. The mechanical thruster power for the support vessel during the measurement period was limited to a maximum of 10 per cent and this has been scaled up for the purposes of the modelling to be a maximum of 50 per cent to reflect a realistic worst-case, i.e. marginal weather conditions, during the construction campaign. In normal operating conditions vessels never operate at more than 50 per cent of thruster power due to safety reasons and usually operate less than this.

Noise modelling for vessels considered a deep and a shallow water scenario that included a combination of:

- OIV on DP during installation of foundations
- Platform support vessel
- Cable lay vessel.

8.1.4.5 Sound exposure thresholds

8.1.4.5.1 Cetaceans (whales and dolphins)

The sound exposure thresholds applied to cetaceans for impulsive noise sources are shown in Table 8-2. Dual metric thresholds have been defined for the peak pressure of the sound wave per pulse (PK), and the total sound energy (accumulated) (SEL) that an individual is subjected to over 24 hours. The PK and frequency-weighted accumulated SEL thresholds are consistent with NMFS (2024). The onset of PTS or TTS is considered to occur when either one of the two metrics is exceeded.

The marine mammal unweighted behavioural threshold for impulsive noise sources is based on the current (NOAA, 2019) root mean square (rms) sound pressure level (SPL) criterion for marine mammals. Whilst the more recently published Southall et al. (2021) provides recommendations and discusses the nuances of assessing behavioural response, the authors do not recommend new numerical thresholds for the onset of behavioural response for marine mammals.

Table 8-2: Sound exposure thresholds for cetaceans to impulsive noise sources (impact piling) (NOAA, 2019; NMFS 2024)

Hearing group	Behavioural SPL (dB re 1 μPa)	PTS onset PK (dB re 1 μPa)	Weighted SEL _{24h} (dB re 1 $\mu\text{Pa}^2\cdot\text{s}$)	TTS onset PK (dB re 1 μPa)	Weighted SEL _{24h} (dB re 1 $\mu\text{Pa}^2\cdot\text{s}$)
LF cetaceans	160 (unweighted)	222	183	216	168
southern right whale female and calf pairs	140 (weighted – refer to Table 8-3)				
HF cetaceans	160 (unweighted)	230	193	224	178

Wood et al. (2012) defined behavioural response categories for sensitive species (including harbor porpoise and beaked whales), for migrating mysticetes, and for all other species (Table 8-3). The migrating mysticete category has been used for all species with a behavioural response / disturbance threshold of 160 dB SPL given the highest response (90% response rate). Southern right whales are susceptible to elevated underwater noise (National Recovery Plan for the Southern Right Whale (DCCEEW 2024)), and therefore precaution has been added. In this assessment a more conservative behavioural response threshold of 140 dB re 1 μPa (SPL), based on the Wood et al. (2012) 50 per cent probability of response is applied instead of the usual 160 dB re 1 μPa (SPL) for impulsive noise. This is an extremely conservative threshold to apply, because even if 50% of individuals have a response, the severity of a response at this level is likely to be at a level of a minor or brief response (see Southall et al. 2021 below) and not expected to affect foraging, reproduction or survival. This is because Gippsland has had industrial activity and shipping occurring for decades (see also below), and because this threshold will trigger active mitigation measures to thereafter reduce noise (see Construction Underwater Noise Management Framework).

Table 8-3: Sound pressure levels (SPL) thresholds to evaluate potential behavioural impacts to migrating mysticetes from impulsive sounds (from Wood et al., 2012)

Marine mammal group	Frequency weighted probabilistic response (SPL, dB re 1 μ Pa)			
	120	140	160	180
Migrating mysticetes	10%	50%	90%	100%

The sound exposure thresholds applied to cetaceans for continuous noise sources are shown in Table 8-4. The PK and frequency-weighted accumulated SEL thresholds are consistent with NMFS (2024).

The marine mammal unweighted behavioural threshold is based on the current (NOAA, 2019) root mean square (rms) sound pressure level (SPL) criterion for marine mammals of 120 dB re 1 μ Pa. This is considered to be conservative threshold as previous studies have identified varying responses for marine mammals to noise between 140 to 180 dB re 1 μ Pa (SPL), and for LF cetaceans the data indicated no or very limited response at a received level of 90 to 120 dB with an increasing probability of avoidance of behavioural response from 120 to 160 dB (Southall et al., 2007). Dr Brandon Southall provided advice to Beach Energy with regard to an exploration drilling program (continuous noise) as to his opinion of what sound level would be required to disturb/displace blue whales from foraging. Brandon's response was that based on studies on feeding blue whales off California whales were found to respond to sound in the 130 to 140 dB range (Beach Energy, 2020).

Table 8-4: Sound exposure thresholds for cetaceans to continuous noise sources (vibro-piling and vessels) (NOAA, 2019; NMFS 2024)

Hearing group	Behavioural Unweighted SPL (dB re 1 μ Pa)	PTS onset Weighted SEL _{24h} (dB re 1 μ Pa ² .s)	TTS onset Weighted SEL _{24h} (dB re 1 μ Pa ² .s)
LF cetaceans	120	197	177
HF cetaceans	120	201	181

Sound effect thresholds (PK and SEL_{24h}) allow the spatial extent of impacts to be predicted and subsequently estimate the number of animals that may be impacted. However, this approach can lead to increased conservatism, and caution should be applied. The all-or-nothing thresholds for behavioural response across broad sound categories (i.e. continuous and impulsive) and taxonomic groups can lead to significant errors in predicting the effects (Southall et al., 2021). Firstly, extensive data gaps have been identified, for example measurements of the effects of elevated noise on baleen whales (Southall, 2021), and therefore extrapolation from other species was required. Secondly, differences between species, among individuals, across situational context, the temporal and spatial scales over which they occur and the potential interacting effects of multiple stressors (e.g. reduction in prey, noise and disturbance, contamination) can lead to variability in the probability and severity of behavioural responses. There are broad differences in the hearing range for different marine mammal hearing groups and sounds that disturb one species may be irrelevant or inaudible to another species.

Southall et al. (2021) propose a new framework for developing the probabilistic response functions of behavioural impacts to marine mammals. The authors suggest separating responses into three categories which may differentially affect vital rates (Southall et al., 2021):

- foraging (encompassing search, pursuit, capture and consumption),
- survival (including effects on defence, resting, social interactions and navigation) and
- reproduction (including mating and parenting behaviours).

Distinctions are made by sound source i.e. vessels, pile driving, seismic surveys. The severity of responses in free-ranging marine mammals ranged from minor/brief responses (0-3), higher potential to affect foraging, reproduction, or survival (4-6) and likely to affect foraging, reproduction, or survival (7-9) (Southall et al., 2021). Increasing severity response is presumed a consequence of noise exposure (Southall, 2021). A recent study by Darias-O'Hara et al. (2025) determined behavioural response thresholds for Antarctic marine mammal species to vessel noise, with cetaceans eliciting a response at 137 dB re 1 μ Pa (SPL). A response was considered to be of the severity scale of five or above according to Southall et al. (2021). Animals in the Antarctic are considered to be less exposed to anthropogenic noise, and consequently it can be assumed they would display a greater response in comparison to other whales that are more frequently exposed to

vessel noise, including in the Gippsland. Subsequently the thresholds used here for behavioural disturbances are extremely conservative.

For impulsive sounds, Southall et al. (2007) proposed 'protective' (lower effect onset levels) thresholds for hearing impairment (PTS and TTS onset) in marine mammals. However, this increased precaution has led to practical challenges for those seeking to enforce regulations, and those seeking to comply with them (Southall, 2021). It is highly unlikely that predicted ranges to PTS and TTS onset in the tens of kilometres from the source are realistic (Southall, 2021). In reality, acoustic signals begin to lose impulsive characteristics at ranges of several kilometres, and especially beyond ten kilometres, however the precise range at which the transition from impulsive to non-impulsive sound occurs is difficult to define (Hastie et al., 2019). While research into this is still ongoing, Southall (2021) emphasise that predicted ranges to PTS and TTS in the range of tens of kilometres is almost certainly an overly precautionary interpretation of the existing threshold.

8.1.4.5.2 Pinnipeds

The sound exposure thresholds applied to otariid pinnipeds in water for impulsive noise sources are shown in Table 8-5 and Table 8-6 for continuous noise sources. The PK and frequency-weighted accumulated SEL thresholds are consistent with NMFS (2024). The marine mammal unweighted behavioural threshold is based on the current NOAA (2019) sound pressure level (SPL) criterion for marine mammals.

Table 8-5: Sound exposure thresholds for otariid pinnipeds (in water) to impulsive noise sources (impact piling) (NOAA, 2019; NMFS, 2024)

Hearing group	Behavioural Unweighted SPL (dB re 1 µPa)	PTS onset PK (dB re 1 µPa)	Weighted SEL _{24h} (dB re 1 µPa ² .s)	TTS onset PK (dB re 1 µPa)	Weighted SEL _{24h} (dB re 1 µPa ² .s)
Otariid pinnipeds	160	230	185	224	170

Table 8-6: Sound exposure thresholds for otariid pinnipeds (in water) to continuous noise sources (vibro-piling and vessels) (NOAA, 2019; NMFS, 2024)

Hearing group	Behavioural Unweighted SPL (dB re 1 µPa)	PTS onset Weighted SEL _{24h} (dB re 1 µPa ² .s)	TTS onset Weighted SEL _{24h} (dB re 1 µPa ² .s)
Otariid pinnipeds	120	199	179

8.1.4.5.3 Marine turtles

The sound exposure thresholds applied to marine turtles are shown in Table 8-7 for impulsive noise sources and Table 8-8 for continuous noise sources. The peak pressure levels (PK) and frequency-weighted accumulated sound exposure levels (SEL) are consistent with Accomando et al. (2025) for PTS and TTS onset. The behavioural response threshold is based on the NMFS and applied in the Arctic Programmatic Environmental Impact Statement (NSF, 2011), and the behavioural disturbance threshold is based on the level reported in McCauley et al. (2000).

Table 8-7: Sound exposure thresholds for marine turtles to impulsive noise sources (impact piling) (McCauley et al., 2000; NSF, 2011; Accomando et al., 2025)

Hearing group	Behavioural Response Unweighted SPL (dB re 1 µPa)	Disturbance	PTS onset PK (dB re 1 µPa)	Weighted SEL _{24h} (dB re 1 µPa ² .s)	TTS onset PK (dB re 1 µPa)	Weighted SEL _{24h} (dB re 1 µPa ² .s)
Marine turtles	166	175	230	184	224	169

Table 8-8: Sound exposure thresholds for marine turtles to continuous noise sources (vibro-piling and vessels) (Accomando et al., 2025)

PTS onset	TTS onset
Weighted SEL _{24h} (dB re 1 $\mu\text{Pa}^2\cdot\text{s}$)	Weighted SEL _{24h} (dB re 1 $\mu\text{Pa}^2\cdot\text{s}$)
198	178

8.1.4.6 Impact assessment for baleen whales

As presented in Section 6.2, low frequency cetacean species (baleen whale species) that may be present in the OPA and surrounding waters include the blue whale, southern right whale, humpback whale, Antarctic blue whale, fin whale, sei whale, minke whale (Antarctic and dwarf), Bryde's whale and pygmy right whale. Due to the presence of important habitats (BIAs) for southern right whales and blue whales, and the high numbers of humpback whales that use the OWFA and surrounding waters, a detailed assessment of underwater noise impacts to these species is provided below. All other baleen whale species are grouped as 'other mysticetes'.

8.1.4.6.1 Noise effect ranges for baleen whales

The results of the underwater noise modelling for impact piling of monopiles and OSS jacket pin piles vibro-piling of monopiles and vessels on DP are set out below for low frequency cetaceans in Table 8-9Table 8-9, Table 8-11Table 8-10, Table 8-11, Table 8-13, Table 8-14, and Table 8-15. These results provide maximum predicted effect ranges for PTS, TTS and behavioural response. The results for impact piling (monopile and jacket pin pile) represent the effect ranges predicted when a DBBC, HSD and MHS (monopiles) and DBBC and MHS (jacket pin piles) is utilised. Results with no mitigation applied from the early modelling (second round) are provided in Section 6.2 of Attachment I - Underwater noise modelling (RPS, 2025a). For the SEL 24-hour cumulative thresholds the modelling assumes that whales are stationary, i.e. there is no consideration of normal animal movement and resulting reduction in noise exposure over time.

Animat modelling was also undertaken to explore the influence of whale movement on cumulative noise exposure and the TTS and PTS effect ranges. This modelling was completed for the blue whale, southern right whale, humpback whale, and minke whale and other mysticetes, and is based on the best available behavioural data (e.g. diving and foraging depth, swim speed and surface times) for these species. The results of the animat modelling are shown in Table 8-11 and Table 8-15 and referenced throughout the impact assessment for the relevant species below to provide an indication of how natural behaviours of these species will reduce cumulative noise exposure and potential effects.

The results from the animat model provide a way to estimate the radial distances to noise effect thresholds. The distance to the closest point of approach (CPA) for each of the animats was recorded. The ER95% (95% Exposure Range) is the horizontal distance that includes 95% of the animat CPAs that exceeded a given effect threshold (Figure 6 4 in Attachment I - Underwater noise modelling). Within the ER95%, there is generally some proportion of animats that do not exceed threshold criteria. This occurs for several reasons, including the spatial and temporal characteristics of the sound field and the way in which animats sample the sound field over time, both vertically and horizontally. The sound field varies as a function of range, depth, and azimuth based on a variety of factors such as bathymetry, sound speed profile, and geoacoustic parameters. The way the animats sample the sound field depends upon species-typical swimming and diving characteristics (e.g., swim speed, dive depth, surface intervals, and reversals). Furthermore, even within a particular species definition, these characteristics vary with behavioural state (e.g., feeding, migrating). Therefore, the probability that an animat within that distance was exposed above threshold within the ER95% was also computed (P_{exp}).

Animat ranges can be used for determining the range for potential TTS for humpback whales and other whale species. However, these ranges may not be appropriate for southern right whales and blue whales due to the overlap of the project area and sound fields with foraging and reproductive BIAs where behaviour may vary compared with the movement input parameters included in the animal modelling and animals may remain in an area for a prolonged period of time, and for which there are specific actions associated with recovery plan requirements. For these species the static (no account for animal movement) modelling results with a DBBC, HSD and MHS (monopiles) or DBBC and MHS (jacket pin piles) in place will also be considered in the impact assessment as they provide a highly conservative basis with which to evaluate

impacts and design control measures in the event adaptive management is required. This is a highly conservative approach because the majority of the overlap of the sound field from the project is for the migratory corridor for southern right whales, and since the baseline PAM monitoring determined that while blue whales were detected moving through the area they did not persist. Adaptive management triggers have also been included whereby static ranges can be reverted to for other species if it is identified during the course of monitoring that numbers or behaviours are different to predictions.

Impact piling

Table 8-9: Maximum predicted horizontal distances ($R_{\max}$) to PTS, TTS and behavioural response thresholds for low frequency cetaceans to cumulative (multiple strike) noise exposure from pile driving of a single monopile with a DBBC, HSD and MHS in winter

Sound exposure threshold	$R_{\max}$ distance (km)			
	Shallow (MP1)	Intermediate (MP2)	Deepest (MP3)	Deep (MP4)
PTS onset				
183 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	0.77	0.41	0.18	0.36
TTS onset				
168 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	8.61	5.48	3.30	3.56
Behavioural response				
160 dB re 1 μPa (unweighted SPL)	5.64	5.18	2.37	2.72
140 dB re 1 μPa (weighted SPL)	7.17	6.37	3.21	3.17

Table 8-10: Maximum predicted horizontal distances ($R_{\max}$) to PTS, TTS and behavioural response thresholds for low frequency cetaceans to cumulative (multiple strike) noise exposure from pile driving of jacket pin piles with a DBBC and MHS in winter

Sound exposure threshold	$R_{\max}$ distance (km)	
	Single jacket pile	Four pin piles
PTS onset		
183 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	1.93	4.30
TTS onset		
168 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	11.40	22.40
Behavioural response		
160 dB re 1 μPa (unweighted SPL)	2.60	N/A
140 dB re 1 μPa (weighted SPL)	9.67	N/A

Animat modelling (monopiles)

Table 8-11: Exposure ranges (ER_{95%}) in kilometres and the probability of exposure within ER_{95%} ranges (P_{exp}) to PTS, TTS and behavioural response thresholds for blue whales, southern right whales and humpback whales to cumulative (multiple strike) noise exposure from pile driving of a single monopile with a DBBC, HSD and MHS in winter

Species	Sound exposure threshold	Shallow (MP1)		Intermediate (MP2)		Deepest (MP3)		Deep (MP4)	
		ER _{95%}	P _{exp}	ER _{95%}	P _{exp}	ER _{95%}	P _{exp}	ER _{95%}	P _{exp}
Blue whale	PTS onset	-	-	0.03	14	0.04	25	0.06	15
	TTS onset	4.60	53	2.28	82	1.34	74	0.86	61
	Behavioural response	5.20	74	4.65	84	2.38	91	2.08	74
Southern right whale	PTS onset	-	-	-	-	0.05	17	-	-
	TTS onset	1.49	58	0.84	40	0.44	24	0.37	30
	Behavioural response (160 dB unweighted)	4.49	73	3.56	91	1.86	83	1.48	65
	Behavioural response (140 dB weighted)	5.68	82	4.55	91	2.35	85	2.41	70

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Humpback whale	PTS onset	0.20	5	-	-	0.02	>99	-	-
	TTS onset	4.27	25	2.45	20	1.48	14	1.43	11
	Behavioural response	4.79	71	4.33	82	2.24	77	1.84	73
Minke whale	PTS onset	-	-	-	-	-	-	-	-
	TTS onset	1.42	58	0.57	61	0.27	22	0.08	74
	Behavioural response	4.68	73	4.40	89	2.29	87	1.83	74

A dash denotes that the threshold was not reached within the minimum limit of the modelling resolution (20 m), indicating predicted horizontal distances of <20 m

Animat modelling (jacket pin piles)

Table 8-12: Exposure ranges (ER_{95%}) in kilometres and the probability of exposure within ER_{95%} ranges (P_{exp}) to PTS, TTS and behavioural response thresholds for blue whales, southern right whales and humpback whales to cumulative (multiple strike) noise exposure from impact pile driving of jacket pin piles with a DBBC and MHS in winter

Species	Sound exposure threshold	Single jacket pile		Four pin piles	
		ER _{95%}	P _{exp}	ER _{95%}	P _{exp}
Blue whale	PTS onset	0.62	46	1.08	65
	TTS onset	6.61	88	10.50	91
	Behavioural response	2.27	83	2.15	92
Southern right whale	PTS onset	0.51	23	1.46	22
	TTS onset	4.73	75	7.65	70
	Behavioural response – 160 dB (unweighted)	2.14	79	2.13	88
	Behavioural response cow/calf pairs – 140 dB (weighted)	8.21	85	8.23	94
Humpback whale	PTS onset	0.78	21	1.54	19
	TTS onset	6.26	59	8.97	65
	Behavioural response	2.27	81	2.28	86
Minke whale	PTS onset	-	-	0.02	23
	TTS onset	3.40	75	4.66	85
	Behavioural response	2.24	85	2.16	92

A dash denotes that the threshold was not reached within the minimum limit of the modelling resolution (20 m), indicating predicted horizontal distances of <20 m).

Vibro-piling

Vibro-piling results may be updated once modelling is run with a more realistic piling profile that will include how refusal will be mitigated e.g. impact piling through refusal layers. Vibro-piling is a continuous noise source, so thresholds are lower than for impact piling and at present it has not been possible to model vibro-piling noise outputs with mitigations in place. Therefore, results should be compared to unmitigated impact piling results (Section 6.2 of Attachment I - Underwater noise modelling (RPS, 2025a)). It is also notable that vibro-piling installation times are much shorter (~ 30 mins) than impact piling time frames (~2 – 3 hours). Vibro-piling may be used if threshold ranges were equal to or better than impact piling ranges and/or the potentially short duration resulted in a better environmental outcome.

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Table 8-13: Maximum predicted horizontal distances ($R_{\max}$) to PTS, TTS and behavioural response thresholds for low frequency cetaceans to vibro-piling of a single monopile in winter

Sound exposure threshold	$R_{\max}$ distance (km)		
	Shallow (MP1)	Intermediate (MP2)	Deep (MP3)
PTS onset			
197 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	11.10	5.82	21.10
TTS onset			
177 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	83.50	37.00	68.70
Behavioural response			
120 dB re 1 μPa (SPL)	>90	>90	>90

Vessels

Table 8-14: Maximum predicted horizontal distances ($R_{\max}$) in kilometres to PTS, TTS and behavioural response thresholds for low frequency cetaceans to vessel noise in winter

Sound exposure thresholds	$R_{\max}$ distance (km)	
	Scenario 1 WTG MP Inshore	Scenario 2 WTG MP Offshore
PTS onset		
197 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	0.08	0.07
TTS onset		
177 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	9.16	6.35
Behavioural response		
120 dB re 1 μPa (SPL)	15.60	12.00

Animat modelling (vessels)

Table 8-15: Exposure ranges ($ER_{95\%}$) in kilometres and the probability of exposure within $ER_{95\%}$ ranges (P_{exp}) to PTS, TTS and behavioural response thresholds for blue whales, southern right whales and humpback whales to vessel noise in winter

Species	Sound exposure threshold	Scenario 1 WTG MP Intermediate		Scenario 2 WTG MP Deep	
		$ER_{95\%}$	P_{exp}	$ER_{95\%}$	P_{exp}
Blue whale	PTS onset	-	-	-	-
	TTS onset	0.21	35	0.15	10
	Behavioural response	11.6	99	7.79	86
Southern right whale	PTS onset	-	-	-	-
	TTS onset	1.09	13	1.00	13
	Behavioural response	10.8	89	7.87	86
Humpback whale	PTS onset	-	-	-	-
	TTS onset	0.77	16	0.83	11
	Behavioural response	10.8	90	7.82	87
Minke whale	PTS onset	-	-	-	-
	TTS onset	0.02	98	0.02	85
	Behavioural response	10.8	97	7.20	94

A dash denotes that the threshold was not reached within the minimum limit of the modelling resolution (20 m), indicating predicted horizontal distances of <20 m

8.1.4.6.2 Southern right whale

Southern right whales occupy southern Australian waters during May to November to rest, breed (mate) and calve. The OWFA is within the known core range for southern right whales and overlaps with a southern right whale BIA for 'Migration' with the National Recovery Plan (NRP) for the Southern Right Whale (DCCEEW,

2024b) identifying a temporal window for migration of approximately April to October. In addition, the OECA overlaps the 'Reproduction' BIA for southern right whales with a period of occupancy of approximately May to September (DCCEEW, 2024b).

The NRP for the southern right whale lists anthropogenic underwater noise, including noise from pile driving and vessels as a threat to the species, although it is relevant that climate change is also a threat for this species. The NRP defines auditory impairment to southern right whales as any noise induced hearing loss, including temporary or permanent reduction in hearing sensitivity (DCCEEW, 2024b). Southern right whales, and particularly pregnant females and mother and calf pairs, may be at increased susceptibility to elevated underwater noise due to the sensitivity and higher energy demands of this life stage. As a result, additional conservatism has been applied to the assessment of behavioural disturbance from impact pile driving by using a more conservative behaviour response threshold of 140 dB re 1 μ Pa SPL, frequency weighted (Table 8-3).

Southern right whales in Victoria are considered to be part of the eastern subpopulation, recently estimated to be approximately 268 individuals (Stamation et al., 2020). Three southern right whale female and calf pairs and a single unaccompanied adult (seven individuals) were sighted during the MESP aerial surveys; one in June, two in July and one in September (Appendix A). Of these whales, photo ID images of two adult females (one female and calf pair in September 2020 and one unaccompanied adult in June 2021) were collected and successfully 'matched' to the national right whale photo ID catalogue ARWPIC. One individual was matched to a known reproductive female in the eastern subpopulation, while the other was matched to a known reproductive female in the western subpopulation. This indicates that southern right whales from both subpopulations may occur in the OWFA and surrounding waters.

The OWFA and surrounding waters do not represent a historic high use area for southern right whales, and the presence of whales is expected to be limited to occasional whales transiting en-route to calving and aggregation sites in western Victorian waters and / or to and from calving grounds on the New South Wales south coast (e.g. Eden, Jervis Bay). Of the southern right whales sighted during the MESP, one female and calf pair was sighted in NSW in July and August of the same year, indicating the animal had calved in NSW waters and was on its southbound migration when sighted in September offshore of the OWFA. Another single adult, sighted in coastal waters in June was later resighted in South Australia in July with a calf, suggesting the whale had calved west of the OWFA (Appendix A). Moreover, an absence of resights of southern right whales in subsequent aerial surveys suggests that whales were not persisting in the area, and therefore the 'Reproduction' BIA inshore of the OWFA is unlikely to represent an important calving site. However, the NRP for southern right whales identifies that there have been increasing numbers of sightings along the Gippsland coast, east of Wilsons Promontory. Wintering southern right whales generally occupy sheltered, shallow waters (less than 20 metres depth) within two kilometres of the coast, particularly evident for female and calf pairs (Pirzl, 2008; Charlton et al., 2019a). The greatest reported within season movement of a southern right whale was approximately 3,800 kilometres from Sydney, NSW to Israelite Bay in WA (Watson et al., 2021), demonstrating a strong capacity for coast-wide movement and behavioural flexibility. However, the migratory movements and locations where southern right whales enter coastal Australian waters from offshore feeding grounds are largely unknown.

Southern right whales are susceptible to anthropogenic threats due to their high site fidelity, slow reproductive rates and high age at sexual maturity. Charlton et al. (2022) report 70% site fidelity for reproductive females at the HOB. However, shifting of selected calving habitat (Watson et al., 2021) and re-establishment of former calving grounds (Charlton et al., 2019b) have been reported far west of the OWFA. While two historical shore-based whaling stations were located at Wilsons Promontory, these areas were classified as possible, not probable calving areas, and reestablishment of these areas for aggregation is unlikely due to a restricted memory of calving habitat and lack of conspecifics (Pirzl, 2008). A lack of southern right whale social sounds recorded during the MESP and reported behaviour of animals visually sighted (Appendix A) suggests that it is likely that animals use coastal waters for resting and slow travel.

At Logans Beach, the only recognised calving area for southern right whales in the eastern subpopulation, located far west of the OWFA, Stamation et al. (2020) report a population increase rate of 4.7 per cent per year. A recent assessment of southern right whales across the entire Australian population documented an apparent decline in the rate of increase between 2011 and 2018 (6.69 per cent increase per annum from 1992 to 2010, 4.91 per cent increase per annum from 1992 to 2018), suggesting the rate of recovery may have slowed in recent years (Evans et al., 2021). Recent studies of long-term trends report the same slowing in the rate of recovery and propose further recovery to pre-whaling population levels is seeming less likely (Grundlehner et al. 2025, O'Shannessy et al. 2025).

Potential effects on southern right whales

Piling activities

Pile driving for construction of the SOTS Project could occur over a period of up to four years and 11 months, of which the sum duration of installation periods is 608 hours of pile driving over a 24 month period. While the OWFA and surrounding waters do not represent historic high use areas, it is possible that some reproductive females could be exposed to pile driving noise while resting and slowly travelling during two separate calving events (based on a three- to four-year calving cycle).

The response of southern right whales to pile driving noise is poorly understood; however, Richardson et al. (1999) reported an avoidance response of bowhead whales, a species closely related to right whales, to seismic surveys. In response to an alert signal (intermittent signals), North Atlantic right whales (NARWs) were shown to abandon foraging dives and increase their time spent at the surface / subsurface (1 to 10 metres) (Nowacek et al., 2004). Although, Nowacek et al. (2004) suggest NARWs may become habituated to alert signals.

The southern right whale reproduction BIA is located over seven kilometres from the OWFA and consequently the nearest piling location. The behavioural response range for southern right whales is predicted to extend up to 5.6 kilometres from an impact pile driving location during construction activities with a DBBC, HSD and MHS in place using the static model. With the addition of the animal movement model, behavioural response ranges for southern right whales are reduced to around 4.5 kilometres or less using the 160 dB unweighted threshold (NOAA 2019). With the application of the 140 dB (SPL) weighted threshold (Wood et al., 2012) in the animat model, results suggests that southern right whales could elicit a behavioural response within around 5.6 kilometres of the impact piling location. As a result, there is not expected to be any behavioural disturbance within this Habitat Critical to Survival because of impact pile driving noise.

The behavioural response range for vibro-piling is predicted to be more than 90 kilometres, however this estimate is overly conservative as set out in Section 8.1.4.5.1. If the vibro-piling method is utilised the large effect ranges will be reduced by applying effective noise abatement (there is currently insufficient data available to model this) and the drive time to full penetration depth is substantially shorter than for impact piling. The maximum pile drive time for impact piling is 4 hours, compared to approximately 30 minutes for vibro-piling. However, it should be noted that vibro-piling is still likely to require hammering for refusal and/or for the final depths and that since it is a continuous noise source, there could be cumulative noise generated associated with overlapping continuous noise fields from DP vessels. A specific mitigation measure has been developed to limit disturbance to SRWs within their reproduction BIA (Table 8-28).

There is also potential for disturbance to southern right whales as they migrate into and out of the coastal reproduction BIA. There is no defined migration route for southern right whales into and out of the Gippsland coast, however the OWFA overlaps a migration BIA for this species. The MESP only detected a total of seven southern right whales over a 2.5-year period and only one female and calf pair was located outside of the coastal reproduction BIA and this pair was outside of the OWFA. As a result, there is potential for low numbers of southern right whales to migrate through the OWFA and the 5.6 km behavioural disturbance radius around a single impact piling location (on any given day) is small relative to the broad area of potential migratory habitat. This localised avoidance is not expected to have a significant energetic cost and will be reduced through a suite of mitigation and monitoring measures. As stated above, the behavioural response range from vibro-piling is extensive and will be reduced through effective noise abatement and compliance with a noise level limit if utilised. As technology develops, more information is expected to become available to understand and mitigation of impacts from this type of pile driving.

Southern right whales could experience hearing impairment within five kilometres if they persist within the area over the duration of piling (up to four hours per pile). However, the five kilometres range for temporary hearing impairment assumes that a southern right whale remains within this exposure range for a 24-hour period, an event that is unlikely based on sightings during the MESP suggesting that southern right whales were not persisting in the area and would not occur during the activity considering that there would be mitigations in place to prevent exposure. Additionally, the OWFA does not represent suitable calving habitat for southern right whales, which typically aggregate in shallow, north-east trending bays over sandy bottoms (Bannister et al., 1996), usually in waters less than 10 metres deep (DSEWPAC, 2012). While Wilsons Promontory may have historically been a location where southern right whales aggregated prior to whaling, persistent use of these areas is not likely to occur without aggregative (i.e. animals will only persist in an area if a significant number of others are present) and philopatric tendencies, which are now thought to be lost (Pirzl, 2008). Further to this, modelling of animal movement using representative data for southern right whales predicted a maximum auditory impairment (TTS) range of 1.5 kilometres in shallow water and around 400 metres in deep water (Table 8-11), which would eliminate the potential for TTS in the reproduction BIA.

Mitigation measures are required to prevent auditory impairment and disturbance to southern right whales within their migration and reproduction BIAs to align with performance outcomes (Table 8-28).

Vessel operations

There is limited information on the response of southern right whales to vessel noise; however, several studies have documented the response of NARW, who have critical habitat overlapping with several major shipping lanes. Nowacek et al. (2004) found NARWs showed no response to vessel noise at received levels between 132 to 142 dB SPL (rms), suggesting that they may have become habituated to it. However, Rolland et al. (2012) found evidence that ship noise increases stress in NARWs.

In response to increasing noise levels, right whales have been found to alter their call parameters. For example, Parks et al. (2011) found NARW increased the amplitude of their calls linearly with increasing background noise levels (i.e. Lombard response), indicating that whales were able to maintain the signal-to-noise ratio of their calls to compensate for moderate noise levels. However, there is a physical limit to this, and at a point where background noise levels exceed the compensation abilities of right whales, either the whales' communication space will be reduced, or they will have to wait until noise levels are lower to call. Hatch et al. (2012) estimated that calling NARW may have lost 63 to 67 per cent of their communication space, when considering upcalls, due to shipping noise, though this is reduced to only 5 per cent when considering gunshots.

A comparison of call parameters of southern right whale calls and NARW calls found that NARWs call at a higher frequency and have a larger frequency bandwidth than southern right whales, likely due to the higher ambient noise levels (Parks et al., 2007), and in response to increasing background noise, southern right whales were found to shift the minimum frequency of their calls and increase duration (Parks et al., 2015). Parks et al. (2011) suggest that a change in call frequency may be more gradual (i.e. over a longer timeframe) than a short-term change in call amplitude.

Southern right whale mother and calf pairs are reliant on noise to maintain contact and facilitate reunion in the event of separation. However, this species is also known to exhibit acoustic crypsis (Nielsen et al., 2019; Dombroski et al., 2020) and may preferentially occupy noisier, shallow waters near the surf zone to avoid detection by predators. No southern right whale upcalls were detected in underwater noise recordings in shallow water collected during the two-year MESP (Appendix A). Possible gunshot calls were detected, however differences in identified seasonal presence of southern right whales indicate it is probable these signals were produced by another species. It is possible that southern right whales in waters inshore of the OWFA are resting, and therefore did not produce calls, or that there were too few southern right whales and therefore individuals were silent (Clark, 1982). Though it is also possible that calls were not picked up in underwater noise recordings if the whales were within the 10-metre depth contour given the low amplitude of social calls (Nielsen et al., 2019; Dombroski et al., 2020).

The implementation of mitigation measures to reduce the risk of vessel strike for cetaceans (Section 9.1) will help to reduce the risk of hearing impairment and disturbance from vessel noise. These vessel strike avoidance measures will prevent vessels from approaching within 100 metres of a southern right whale. Increased vessel noise throughout the four year and 11 months construction period may result in behavioural effects (e.g. avoidance / displacement) and / or a possible reduction of communication space (i.e. masking) to southern right whales, with masking of particular concern to female and calf pairs which rely on being able to communicate to ensure calf survival. However, the effects of noise impacts are expected to be short term throughout their period of occupancy (days to weeks), and animals are expected to recover once outside of impact ranges or once vessel activity has ceased. The presence of southern right whales is expected to be limited to transient individuals, and any possible effects from vessel noise are not expected to alter important behaviours (i.e. resting) or be significant at a population level.

Of particular relevance to the southern right whale is the potential for disturbance from noise emissions within the reproduction BIA. The vessel operations with potential to result in noise levels above the behavioural response threshold in this HCTS include export cable lay operations and OIV supporting installation of inshore WTGs. As detailed in the framework, these operations will be managed with adaptive management controls such as the reduction of DP thrusters to lowest safe level if SRW are observed in the precaution zone (Table 8-28).

8.1.4.6.3 Blue whales

The OWFA is outside of the 'Foraging: abundant food source/annual high use area' BIA for blue whales around the Bonney Upwelling (greater than 500 kilometres west of the OWFA), although is within with the eastern extent of a 'Known Foraging Area' BIA.

The Conservation Management Plan (CMP) for the Blue Whale (Commonwealth of Australia, 2015a) lists noise interference as a threat to the species, although it is also relevant that climate change is a threat to this species. It is a legal requirement of the CMP (Action Area A.2.3) that “anthropogenic noise in biologically important areas will be managed such that any blue whale continues to utilise the area without injury and is not displaced from a foraging area”. The Department of Climate Change, Energy, Environment and Water (DCCEEW), formerly the Department of Agriculture, Water and the Environment (DAWE) has published guidance on the definition of key terms within the Blue Whale CMP (DAWE, 2021). In accordance with this guidance, a whale is considered to be displaced from a foraging area if foraging behaviour is disrupted, regardless of whether the whale can continue to forage elsewhere within that foraging area. This guidance emphasises the need for mitigation measures to reduce the risk of displacement occurring within a foraging area. The current definition of injury for blue whales at the time of writing is both PTS and TTS, and any other form of physical harm arising from anthropogenic sources of underwater noise (DAWE, 2021).

As noted in Section 6.2.1, records of blue whales in the VBA and ALA databases are low in the Gippsland region. Though it is noted that no dedicated studies on blue whales had been conducted in this region prior to the MESP. Over a 2.5-year period, a single pygmy blue whale was visually sighted during the MESP in April, and acoustic detections confirmed the presence of NZ pygmy blue whales from April to February, and EIO pygmy blue whales from April to September, though both species had an absence of calls in July and August. Prior to the MESP study EIO pygmy blue whale song had not been detected east of Bass Strait (McDonald et al., 2006; McCauley et al., 2018). All acoustic detections of pygmy blue whale song were sporadic with only one singing animal detected at a given time per site, though up to four animals may have been in the detection area during their peak period of presence (early June).

The OWFA is within a ‘Known Foraging Area’ BIA for the blue whale; however, designation of this BIA is based on indirect evidence such as the occurrence of krill in proximity to the known location of whales (Commonwealth of Australia, 2015a). The OWFA and surrounding waters have relatively low productivity with negligible influence from nearby upwelling waters (Huang et al., 2019), and therefore it is not likely that blue whales would forage in the area. All detections of pygmy blue whale song (both populations) in underwater noise recordings collected during the MESP were for short periods only, a few hours to days, and there was no evidence that either population persisted in the area (Appendix A). More realistically EIO pygmy blue whales would forage in the Great Southern Ocean Upwelling System (GSACAS), including the ‘Foraging: abundant food source/annual high use area’ BIA at the Bonney Upwelling (Möller et al., 2020). Thums et al. (2022) investigated the usage of BIAs by pygmy blue whales in the EIO and found that not all designated foraging BIAs supported behaviours equally, and foraging may also occur outside of designated BIAs. The current DCCEEW AMSIS database considers the BIAs differently to the blue whale recovery plan, in that the entire area is now just a ‘foraging’ BIA without differentiation.

NZ pygmy blue whales are expected to forage in NZ waters (Möller et al., 2020), including the South Taranaki Bight where pygmy blue whales are known to be present year-round, with foraging behaviour regularly observed (Barlow et al., 2018). The presence of NZ pygmy blue whales in waters along the east coast of Australia (Balcazar et al., 2015; McCauley et al., 2018) is thought to be limited to whales migrating to possible breeding grounds in Tonga (Möller et al., 2020).

Pygmy blue whales typically occupy water depths of 50 to 150 metres, though can be found in waters as shallow as 20 metres and as deep as 1,500 metres (Double et al., 2014; Gill et al., 2011; McCauley & Jenner, 2010; Möller et al., 2020; Thums et al., 2022). During the MESP, EIO pygmy blue whale song was detected in waters around 30 metres depth, while NZ pygmy blue whale song was detected in waters further offshore around 60 metres depth. The single pygmy blue whale visually sighted was seen in 50 to 60 metres water depth (Appendix A). The known pygmy blue whale migration BIA extends out to the continental shelf edge, located over 100 kilometres from the OWFA at its nearest point.

Potential effects on blue whales

Piling activities

Few studies have investigated the response of blue whales to impulsive noise. Goldbogen et al. (2013) documented a fleeing response of blue whales to mid-frequency sonar noise. A later study by Southall et al. (2019) documented short-term changes in diving behaviour, small scale horizontal avoidance (extending a few kilometres) and / or the cessation of feeding activity in response to mid-frequency sonar; however, no response was found for shallow-feeding blue whales. Whales are less likely to call during active sonar; however, the long-term implications of disruptions in call production during foraging and other behaviours are currently not well understood (Melcón et al., 2012). It is possible that blue whales may stop calling in the presence of impact pile driving activities and consequently may not be detected using PAM methods.

Pirotta et al. (2019) modelled the simulation response of North Pacific blue whales to anthropogenic disturbance including noise and offshore developments. Blue whales were more resilient (i.e. little change to reproductive success or rate of mortality) to anthropogenic disturbance than to environmental change (e.g. climate change), with relatively localised disturbance (e.g. construction of an offshore wind farm) only showing an effect when involving the entire range of the population for a full year at high intensity, or when repeated every year for large portions of the year (Pirotta et al., 2019). However, the size of effect was strongly influenced by the importance of the disturbed location to the ecology of the whales. For example, relatively localised disturbance (e.g. construction of an offshore wind farm) could have large effects if occurring in areas that were critical for the survival of females, although effects tended to attenuate as long as females had the opportunity to compensate for reduced or lost feeding (Pirotta et al., 2019). As outlined above, the OWFA and surrounding waters do not provide significant foraging habitat for blue whales and therefore impacts to blue whales are expected to be much less than construction in an area of known importance, e.g. the Bonney Upwelling. Despite the limited potential for displacement of animals from foraging activities, mitigation measures will be developed and implemented to reduce the risk of displacement in accordance with the Blue Whale CMP.

The primary noise source associated with WTG foundation installation is the noise generated by impact piling and/or vibro-piling to drive the pile to target depth. Blue whales may be subjected to noise at levels predicted to cause behavioural disturbance such as avoidance in an area of approximately 5.6 kilometres around a pile for impact piling based on animal modelling with noise abatement in place (HSD, DBBC and MHS). The distance estimate for vibro-piling is not possible to determine at this stage as it is not possible to model with mitigations in place. The 5.6 km distance for impact piling using animal movement modelling is very small relative to the broad area over which blue whales migrate and forage. Although the more than 90 kilometres distance for unmitigated vibro-piling is extensive, it is considered an overly conservative estimate as set out in Section 8.1.4.5.1, will not be realised as mitigations will be used, and the large distance is offset by a substantially shorter pile drive time than for impact piling. The maximum pile drive time for impact piling is four hours, compared to approximately 30 minutes for vibro-piling. It should also be noted that only a single monopile will be installed at a time, limiting the disturbance area to blue whales.

There is potential for blue whales to experience TTS onset out to a distance of approximately 4.6 kilometres in shallow water and 1.34 kilometres in deep water from an impact driven pile with a DBBC, HSD and MHS in place using animal movement modelling predictions, which accounts for realistic behaviours (e.g. diving and foraging depth, swim speed and surface times) (Table 8-11). The animal results are being used to inform the impact assessment, however as a precautionary measure the results of the static modelling will be applied for adaptive management triggers for this species. The ranges to temporary hearing impairment for vibro-piling are substantially greater (up to ~37 kilometres) but these results are unmitigated and are considered conservative for the same reasons as described for impact piling.

Results from the MESP indicate that blue whales are not persisting in the area, but rather that the presence of blue whales will be limited to occasional migratory individuals during late Autumn and Winter. As a result, impacts will largely be limited to short-term, localised disturbance to a small number of individuals transiting the area. The nearshore location of the OWFA does not constrict the migration corridor for blue whales, and any deviation from this area is not expected to alter important behaviours. Regardless, a precautionary approach will be taken and a suite of effective mitigation measures will be implemented to reduce disturbance and prevent TTS onset to blue whales to align with the assessment criteria (Table 8-29).

Vessel operations

There is currently no audiogram produced for blue whales to indicate the hearing range or sensitivity to various frequencies for the species, although the ear morphology of mysticetes indicates a specialisation for lower frequencies (Commonwealth of Australia, 2015a). Several studies have recorded changes to blue whale behaviour when ship noise is present, including increased vocalisation, potentially to overcome the increased noise and facilitate continued communication, a response referred to as the Lombard effect (McKenna, 2001; Melcón, et al. 2012). However, these studies were focussed on commercial shipping traffic, which is already present originating from nearby Port Albert and Port Welshpool.

The response of blue whales to vessel noise is poorly understood, and most studies have focussed on the response of foraging whales, with limited information on migrating whales. McKenna (2001) found blue whales modified their vocalisations in response to increased noise from transiting ships, showing a partial Lombard effect whereby animals increased the amplitude of D-calls (often associated with foraging activity) by 0.4 dB for each one decibel increase in background noise level to maintain a high signal to noise ratio. However, at maximum background noise levels the signal to noise ratio was far lower than in low background noise levels, which may imply that whales have a limited ability to increase call amplitude

(McKenna, 2001). Similarly, Melcón et al. (2012) found the probability of detecting D calls in the presence of ship noise increased with increasing ship source level, suggesting the whales were able to increase the source level of calls to compensate for increased ship noise. Blue whale acoustic detectability also increased with ambient noise level off the west coast of South Africa (Shabangu et al., 2022). While this is evidence that blue whales can adjust to increased background noise, the biological implication of this vocalisation modification is unknown (McKenna,). Additionally, blue whales increased their time spent at the surface thereby reducing the time spent foraging when located within 900 metres from a ship (McKenna,).

While the OWFA is within a 'Known Foraging Area' BIA for blue whales (DCCEEW 2015), the OWFA and surrounding waters have relatively low productivity with negligible influence from nearby upwelling waters (Huang et al., 2019), and therefore it is not likely that blue whales would forage in the area. All detections of pygmy blue whale song (both populations) in underwater noise recordings collected during the MESP were for short periods only, a few hours to days, and there was no evidence that either population persisted in the area (Appendix A). Some D-calls were detected in the PAM baseline study, however, those found and confirmed to be produced by blue whales were in the presence of NZ pygmy blue whale song. Literature suggests that NZ pygmy blue whales feed in NZ waters (Torres 2013; Barlow et al., 2018; 2023; Warren et al., 2021), and therefore the calls detected could be opportunistic feeding or associated with another behaviour.

The implementation of mitigation measures to reduce the risk of vessel strike for LF cetaceans (Section 9.1.4) will help to reduce the risk of hearing impairment / disturbance from vessel noise. Continuous observations for whales and a minimum approach distance of 100 metres will prevent PTS onset (PTS not reached using animal movement modelling). Modelling of vessel noise indicated that TTS could occur out to a range of 210 metres and behavioural responses could extend out to approximately 11.6 kilometres, noting that actual responses are variable as described in Section 8.1.2. It should be noted that although it is not possible to model, the OIV will also be within the DBBC and so the extent of noise may be more limited than predicted. The primary driver of these relatively large effect ranges will be the large OIV on DP and the risk of TTS onset and behavioural disturbance in blue whales will be minimised by applying a suite of effective monitoring and management measures around each pile location (Section 8.1.5).

A second source of DP vessel noise is the cable laying activities, including the laying of inter-array cables within the OWFA and the export cable within the OECA. It is anticipated that there will only be one cable lay vessel in the project area at any one time.

Increased vessel noise throughout the four year and 11 months construction period may result in behavioural effects (e.g. avoidance / displacement) and / or a possible reduction of communication space (i.e. masking) to blue whales. However, the effects of vessel noise impacts are expected to be short term (hours to days) given that blue whales were not observed to persist in the OWFA during the MESP surveys. Further, the number of large vessels operating on DP within this area will generally be limited to two, i.e. a OIV and a cable lay vessel. Modelling was undertaken for this scenario for the first round of modelling, but as the WTG installation had the largest ranges subsequent modelling only included this vessel. As a result, impacts will be limited due to the small area of the noise footprint relative to the expansive BIA for foraging and the low productivity of the OWFA relative to annual high use foraging areas such as the Bonney Upwelling. The MESP indicates that the presence of blue whales will be limited to occasional migratory individuals, and any possible effects from vessel noise are not expected to alter important behaviours (i.e. foraging) or be significant at a population level.

8.1.4.6.4 Humpback whale

Humpback whales migrate up and down the east coast of Australia seasonally during the winter to spring months. There are no BIAs for the species in proximity to the OWFA; however, humpback whales were the most abundant baleen whale species recorded during the MESP (Appendix A).

Humpback whales occupying the OWFA and surrounding areas belong to the eastern Australian population. This population has demonstrated a rapid recovery from a few hundred individuals post-whaling, and numbers are predicted to reach at least 40,000 individuals between 2021 to 2026 (Noad et al., 2019). Humpback whales were the most dominant baleen whale species recorded during the MESP. It was estimated that up to 185 individuals may utilise the OWFA and surrounding waters on any one day (peak presence in early October), and up to 10,864 individuals may pass through the area during their annual migration (Appendix A).

Humpback whales migrate to calving grounds off northern Queensland seasonally each year, and almost half of all humpback whale sightings in the MESP observed individuals travelling. Gales et al. (2009) tracked

the southward movement of humpback whales from Eden, New South Wales, with a reported occupancy in waters surrounding the OWFA of zero to 100 hours. Adult humpback whales were sighted offshore of the OWFA during their northbound migration, while female and calf pairs, sometimes accompanied by an escort, were sighted closer to shore on the shallower edge of the OWFA during their southbound migration, with peak numbers in October (Appendix A). Humpback whales were sometimes observed feeding on surface krill swarms and baitballs, primarily during the spring months (September to November), though all feeding events were sighted in waters offshore of the OWFA, around Wilsons Promontory and to the northeast (Appendix A).

Given the rate of population increase, humpback whales were recently removed from the EPBC Act threatened species list, although they are still a protected migratory species. There is no statutory recovery plan in place for humpback whales and there is not a need for the same level of management precaution as applied to listed threatened species. As a result, the monitoring and mitigation measures for the humpback whale have been designed to prevent permanent hearing impairment (PTS) and minimise the risk of TTS and behavioural disturbance (Table 8-28).

Potential effects on humpback whales

Piling activities

There is limited information regarding the effects of impulsive noise on humpback whales. A study on seismic noise found that humpback whales did not demonstrate any abnormal behaviours, such as instances of a female separating from her calf or sustained bouts of high energy surface behaviours (indicative of a stress response) (Dunlop et al., 2017). Additionally, female and calf groups did not alter their dive or respiratory behaviour. However, a change in travel behaviour (slower progression southward mostly due to deviance off the normal route) was observed (Dunlop et al., 2017).

Humpback whales may avoid an area approximately 5.6 kilometres from the pile driving location with a DBBC in place throughout the duration of construction. However, pile driving activities will not cause a barrier to migration given that only a single pile will be driven at any time and the ensonified area will only extend to a very small proportion of the entire migration corridor. The broad migratory trajectory of southbound humpback whales was demonstrated in a satellite tagging study of 30 humpback whales on the east coast of Australia (Andrews-Goff et al., 2018). Further, although humpback whales may undertake opportunistic or supplemental foraging as they migrate, this area does not provide important foraging habitat, and any deviation from this area is not expected to alter important behaviours or prevent these foraging opportunities. Humpback whales could experience PTS onset within a distance of up to 770 metres when cumulative noise exposure over the duration of pile driving is taken into account. The TTS effect ranges were estimated at up to 3.56 kilometres at the deep piling location and 8.61 kilometres at the shallow location. However, these ranges are conservatively estimated with the assumption that humpback whales are stationary and in reality humpback whales have been shown to cover relatively large distances per day as they migrate through south-east Australia (Andrews-Goff et al., 2018) and as a result hearing impairment ranges are expected to be reduced. For example, animal movement modelling indicated that PTS and TTS effect ranges for humpback whales would be around 200 metres and up to 4.27 kilometres, respectively (Table 8-11). Further mitigation measures are required to limit disturbance to humpback whales, prevent PTS and minimise the risk of TTS in order to align with performance outcomes (Table 8-28) and these are also outlined in the Construction Noise Management Framework.

Vessel operations

Studies on humpback whales on the east coast of Australia in response to noise from a seismic vessel with the airguns turned off found whales showed varying responses ranging from no behavioural change to a decrease in dive duration, travel speed and the number of breaches (Dunlop et al., 2015, 2016, 2017a, 2017b, 2018). However, in a resting / nursery ground at the Exmouth Gulf on the west coast of Australia Sprogis et al. (2020) found that humpback whale swim speeds increased by 37 per cent, respiration rate doubled and the percentage of time mother's spent resting decreased by 30 per cent in the presence of a research vessel (simulated whale-watch scenario).

In Southeast Alaska, humpback whales were shown to increase the source level of their calls in response increasing ambient noise (i.e. Lombard response), including moderate levels of vessel noise, though it is almost certain that humpback whales have a maximum ambient noise threshold beyond which they can no longer increase their call amplitude (Fournet et al., 2018). A similar Lombard response was observed in migrating humpback whales on the east coast of Australia in response to wind noise (Dunlop et al., 2014). In Japan, humpback whales reduced sound production and temporarily stopped singing in response to passing ships (Tsuji et al., 2018).

A reduction or temporary absence of social sounds could be particularly detrimental for humpback whale mother and calf pairs which must maintain contact for calf survival. Dunlop (2019) reported a likely maximum communication distance of migrating humpback whales of four kilometres for low frequency vocalisations, reducing to about 1.5 kilometres for high frequency vocalisations. In situations where there is high wind noise (characterised by higher sea state) or noise from a vessel in close range (within two kilometres), the communication range was reduced to one kilometre (Dunlop, 2019). Additionally, there was a reduction in the likelihood that a calling group would join with its nearest neighbour in the presence of a vessel, although this was not attributed to signal masking but is likely linked to the physical presence of the vessel (Dunlop, 2019).

The implementation of mitigation measures to reduce the risk of vessel strike for cetaceans (Section 9.1) will help to reduce the risk of hearing impairment / disturbance from vessel noise. Vessels will not approach within 100 metres of a humpback whale, and therefore PTS onset will not occur. Increased vessel noise throughout the four year and 11 months construction period may result in behavioural effects (e.g. avoidance / displacement) and / or a possible reduction of communication space (i.e. masking) to humpback whales, with masking of particular concern to female and calf pairs which rely on being able to communicate to ensure calf survival. However, the effects of noise impacts are expected to be short term throughout their period of occupancy (days to weeks), and animals are expected to recover once outside of impact ranges or once vessel activity has ceased. Humpback whales have been shown to migrate in waters far seaward of the OWFA along the shelf edge (Figure 6-7) and the OWFA does not cover the entire migratory corridor, nor does it provide important foraging habitat. Therefore, any possible effects from vessel noise including any deviation from this area, are not expected to alter important behaviours or be significant at a population level.

8.1.4.6.5 Other mysticetes

There are no BIAs for other mysticetes in proximity of the OWFA and very few sightings in the Gippsland region, therefore the area is not expected to provide important habitat for these species. During the MESP, dwarf minke whales and Antarctic minke whales were detected visually and acoustically (Appendix A). A single Bryde's whale was visually detected, and the 'spot call' was frequently detected in acoustic recordings (Appendix A). The identity of the spot calling whales is currently unknown; however suggestions include the southern right whale, blue whale, sei whale and Antarctic minke whale (Leroy et al., 2017; Thomisch, 2017; Thomisch et al., 2019; Ward et al., 2017; Ward 2020). Recently, it has been suggested that the spot call is produced by a pygmy right whale (R. McCauley pers. comm.). Other mysticetes that were not detected during the MESP but could occur in the OWFA include the pygmy right whale, fin whale and sei whale (Section 6.2.4).

There is no recovery plan or listing advice for the dwarf minke whale, Antarctic minke whale, Bryde's whale or the pygmy right whale. The blue, fin and sei whale recovery plan (Department of Environment and Heritage (DEH), 2005) is no longer in effect (ended 2015); however, the approved conservation advice for the fin whale (TSSC, 2015a) and sei whale (TSSC, 2015b) list anthropogenic noise and acoustic disturbance as a minor threat to the survival of the species. There is no statutory recovery plan in place for these baleen whale species and there is not a need for the same level of management precaution as applied to listed threatened species. As a result, the monitoring and mitigation measures for these species have been designed to prevent permanent hearing impairment (PTS) and minimise the risk of TTS and behavioural disturbance (Table 8-28).

Dwarf minke whales regularly aggregate at the northern Great Barrier Reef between March and October, with peak sightings in June and July. They were visually sighted during the MESP in April and May and again in August and September, with calls detected in underwater noise recordings from March to November, agreeing with known timing at northern breeding grounds. Dwarf minke whales are typically coastal, occupying waters less than 200 metres depth and within 100 kilometres of the coast. Gill et al. (2015) reported sightings of minke whales in shelf waters of the Bonney Upwelling, with a mean depth distribution of 93 ± 79 metres.

All visual sightings of dwarf minke whales were of solitary animals and most acoustic detections estimated a single animal also, though it is possible larger pods of whales travelled in waters offshore of the OWFA. The presence of dwarf minke whale calls in underwater noise recordings was sporadic, never lasting more than a few days, indicating that whales travelled past the area relatively quickly (Appendix A).

The migratory behaviour of Antarctic minke whales is thought to be complex (Filun et al., 2020). However, for the most part the seasonal presence and distribution of Antarctic minke whales in different regions around the waters of Australia is largely unknown. Antarctic minke whale vocalisations were detected in acoustic recordings from July to March the following year, though calling was largely over in November. All calling

was sporadic, with increased presence in waters offshore of the OWFA indicating they preferentially pass in deeper waters. The peak occurrence of Antarctic minke whale calling was consistently over late-August to late-April, and almost always just a single animal calling. A single possible Antarctic minke whale was sighted during visual aerial surveys in waters offshore of the OWFA in June.

Other baleen whale species are mostly migratory i.e. they undertake seasonal movements between feeding and breeding areas. The seasonal presence of other mysticetes in the OWFA and surrounding waters is uncertain; however, as for other migratory species with known occupancy (e.g. southern right whales) it is expected that they may only occur in southern Australian waters for a period of months. During the MESP, a single Bryde's whale was sighted during visual aerial surveys in October 2020 in coastal waters (Appendix A).

Potential effects on other baleen whale species

Piling activities

There is limited information with respect to the potential effects of pile driving noise on other baleen whale species. Minke whales were found to show horizontal avoidance and moved at a faster speed in response to sonar, though not all whales exhibited a behavioural change (Durbach et al., 2021; Kvadsheim et al., 2017). However, some animals were found to reverse changes to their movement immediately after sonar had ceased (Durbach et al., 2021). Therefore, the effect of behavioural disruption on the individual and ultimately the population is dependent on whether behaviour ceases all together, or whether animals move elsewhere and continue their behaviour (Durbach et al., 2021). This is particularly important for foraging and breeding animals. However, it is noted that effects from sonar are likely to be smaller than for pile driving noise.

Most of the baleen whale species considered here are expected to be distributed primarily in deep offshore waters. Gill et al. (2015) reported sightings of sei and fin whales in shelf waters of the Bonney Upwelling, with a mean depth distribution of 160 ± 137 metres for sei whales and 162 ± 90 metres for fin whales. Similarly, Gill et al. (2008) documented a group of pygmy right whales in the Bonney Upwelling in 150 metre water depth. Bryde's whales have been recorded in shallower water depths ranging from 12 to 59.8 metres (mean 42 metres) in Hauraki Gulf, New Zealand (Wiseman et al., 2011), although they are also known to occur in waters up to 200 metres deep (DoEE, 2019). During the MESP, the single Bryde's whale was sighted in less than 20 metres water depth (Appendix A).

Other than the key baleen whale species assessed above (blue whale, southern right whale and humpback whale) the OWFA and surrounding waters do not represent important breeding, resting, migrating or foraging habitat for any other baleen whale species, and it is assumed that any presence in the area would be sporadic and primarily in deep water. Typical swim speeds for the baleen whales considered here are between two to 25 kilometres per hour, although may reach top speeds of up to 55 kilometres per hour (Andrews, 1916; Horwood, 1987; Heide-Jørgensen et al., 2001; Kato and Kayusa, 2002; Kemper, 2002; Clark et al., 2019). It is possible that animals would increase their swim speeds in response to impulsive noise (Goldbogen et al., 2013; Boisseau et al., 2021). There is limited information with respect to the effects of impulsive noise on baleen whale species, and in particular the effects of piling noise. Castellote et al. (2012) found evidence to suggest that fin whales moved away from a seismic (impulsive) airgun source in response to the noise source, and that singers were rarely detected until 14 days after the survey had ceased.

Other mysticetes may exhibit a behavioural response (i.e. increased swim speed) and / or avoidance of an area around 5.6 kilometres from the pile driving location throughout the duration of construction activities. Ranges to PTS and TTS for other mysticetes are 770 metres and up to 9 kilometres, respectively. However, these ranges are conservatively estimated with the assumption that whales are stationary, which is not the case as described above. Animal movement modelling indicated that for other mysticetes, PTS onset ranges were not reached within the limits of the model and TTS effect ranges would be up to 1.4 kilometres (Table 8-11). The OFWA is not known to provide important habitat for any other baleen whale species, and it is possible that most individuals would travel in waters offshore of the OWFA and outside ranges to exposure thresholds. Therefore, any potential impact will be limited to occasional transient individuals. Further mitigation measures are applied to all baleen whales to prevent disturbance to align with performance outcomes (Table 8-28).

Vessel operations

In response to increased vessel traffic during construction of an underwater gas pipeline in Ireland, minke whale presence decreased suggesting the whales were displaced, most likely due to noise disturbance (Anderwald et al., 2013). Similar to other mysticetes, minke whales were shown to exhibit a Lombard effect, increasing the source level of 'boing' calls in response to increased background noise levels, though they

were unable or unwilling to increase the source level of calls by the same amount as background noise (Helble et al., 2020). On the west coast of South Africa, acoustic detectability of Antarctic minke whale calls decreased with increasing ambient noise (Shabangu et al., 2022), and minke whale pulse train calls were subject to masking from vessels in Massachusetts Bay (Cholewiak et al., 2018).

Putland et al. (2018) found that routine vessel passage in a major shipping route in New Zealand resulted in a reduction in the communication space of Bryde's whales, particularly at lower frequencies between 40 to 100 Hz. The communication space appeared to be decreased for two hours before and after the vessel passage (Putland et al., 2018). Bryde's whales reportedly vocalise infrequently (Constantine et al., 2015) and therefore masking of vocalisations from vessel noise could affect social cohesion or impact breeding opportunities (Putland et al., 2018).

Vessel noise resulted in acoustic changes in fin whales, with whales reducing the frequency and duration of their 20 Hz call in the presence of shipping noise (Castellote et al., 2012). The 20 Hz call is hypothesised to be produced by males as a breeding display or by advertising patchily distributed prey (Croll et al., 2002). Shabangu et al. (2022) found that the detectability of fin whales calls on the west coast of South Africa increased with high ambient noise, indicating that whales may have increased their vocalisation rate in the presence of noise from vessels. Castellote et al. (2012) report that fin whales have a lower level of tolerance to impulsive noise than to shipping noise.

The implementation of mitigation measures to reduce the risk of vessel strike for cetaceans (Section 9.1) will help to reduce the risk of hearing impairment / disturbance from vessel noise. Vessel strike prevention measures will ensure vessel do not approach within 100 metres of a baleen whale, and therefore PTS onset will not occur. Increased vessel noise throughout the four year and 11 months construction period may result in behavioural effects (e.g. avoidance / displacement) and / or a possible reduction of communication space (i.e. masking) to other mysticetes. However, the effects of noise impacts are expected to be short term throughout their period of occupancy (days to weeks), and animals are expected to recover once outside of impact ranges or once vessel activity has ceased. The presence of other mysticetes is expected to be limited to occasional transient individuals, and any possible effects from vessel noise are not expected to alter important behaviours or be significant at a population level.

8.1.4.7 Impact assessment for odontocetes

Bottlenose dolphins and common dolphins were sighted year-round in the OWFA and surrounding waters during visual aerial surveys of the MESP (Section 6.2.5). Two possible striped dolphins were also sighted (Section 6.2.5.3). Two killer whales were sighted in July during visual aerial surveys in the MESP, and three killer whales were reported off Wilsons Promontory by local tourism operators (Section 6.2.5.5). There are no BIAs for dolphins or killer whales in proximity to the OPA, and no listing advice or recovery plans.

Bottlenose dolphin abundance was highest in nearshore waters, while common dolphin abundance was lowest inshore and increased with depth (Section 6.2.5). The majority of bottlenose dolphin and common dolphin sightings recorded individuals travelling, though resting / milling and feeding was also observed. The possible striped dolphins were observed feeding amongst a group of common dolphins (Section 6.2.5.3). Five bottlenose dolphin calves were sighted (Section 6.2.5.2).

Killer whales are most commonly found in cold, deep waters, although they are also observed along the continental slope and shelf, particularly near seal colonies (Bannister et al., 1996). There are no known aggregations or migratory routes of killer whales in Victorian waters; however, they have been reported to move seasonally to areas of food supply (Morris, 2004), with peak sightings in mid-winter (June / July (Mustoe, 2008)).

Odontocetes are much less sensitive to the low frequency noise associated with pile driving than baleen whales. The modelling predicts that hearing impairment could occur within a range of 60 metres during impact pile driving activities. The hearing impairment ranges for vibro-piling are predicted to be larger (up to six kilometres), although these results are unmitigated, and NAS will be applied to reduce these ranges and ensure the noise level limit is achieved if the vibro-piling method is used.

8.1.4.7.1 Noise effect ranges for odontocetes

The results of the underwater noise modelling for impact piling of monopiles and OSS jacket pin piles, vibro-piling of monopiles and vessels on DP are set out below for high frequency cetaceans in **Table 8-16A** dash denotes that the threshold was not reached within the minimum limit of the modelling resolution (20 m), indicating predicted horizontal distances of <20 m

Table 8-16, Table 8-18 Table 8-17, Table 8-18 and Table 8-19. These results provide maximum predicted effect ranges for PTS, TTS and behavioural response. The results for impact piling (monopile and jacket pin pile) represent the effect ranges predicted when a DBBC, HSD and MHS (monopiles) and DBBC and MHS (jacket pin piles) is utilised. Results with no mitigation applied from the early modelling (second round) are provided in Section 6.2 of Attachment I - Underwater noise modelling (RPS, 2025a). For the SEL 24-hour cumulative thresholds the modelling assumes that whales are stationary, i.e. there is no consideration of normal animal movement and resulting reduction in noise exposure over time.

Impact piling

A dash denotes that the threshold was not reached within the minimum limit of the modelling resolution (20 m), indicating predicted horizontal distances of <20 m

Table 8-16: Maximum predicted horizontal distances (R_{max}) to PTS, TTS and behavioural response thresholds for high frequency cetaceans to cumulative (multiple strike) noise exposure from pile driving of a single monopile with a DBBC, HSD and MHS in winter

Sound exposure threshold	R_{max} distance (km)			
	Shallow (MP1)	Intermediate (MP2)	Deepest (MP3)	Deep (MP4)
PTS onset				
193 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	-	-	-	-
TTS onset				
178 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	-	-	-	-
Behavioural response				
160 dB re 1 μPa (SPL) (unweighted)	5.64	5.18	2.37	2.72

A dash denotes that the threshold was not reached within the minimum limit of the modelling resolution (20 m), indicating predicted horizontal distances of <20 m

Table 8-17: Maximum predicted horizontal distances (R_{max}) to PTS, TTS and behavioural response thresholds for high frequency cetaceans to cumulative (multiple strike) noise exposure from pile driving of a jacket pin piles with a DBBC and MHS in winter

Sound exposure threshold	R_{max} distance (km)	
	Single jacket pile	Four pin piles
PTS onset		
193 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	-	-
TTS onset		
178 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	0.02	0.06
Behavioural response		
160 dB re 1 μPa (SPL) (unweighted)	2.60	N/A

A dash denotes that the threshold was not reached within the minimum limit of the modelling resolution (20 m), indicating predicted horizontal distances of <20 m

Vibro-piling

Table 8-18: Maximum predicted horizontal distances (R_{max}) to PTS, TTS and behavioural response thresholds for high frequency cetaceans to vibro-piling of a single monopile in winter

Sound exposure threshold	R_{max} distance (km)		
	Shallow (MP1)	Intermediate (MP2)	Deep (MP1)
PTS onset			
201 dB re 1 μPa^2 (SEL _{24h})	0.06	-	0.41
TTS onset			
181 dB re 1 μPa^2 (SEL _{24h})	2.90	0.38	6.45
Behavioural response			
120 dB re 1 μPa (SPL) (unweighted)	>90	>90	>90

A dash denotes that the threshold was not reached within the minimum limit of the modelling resolution (20 m), indicating predicted horizontal distances of <20 m

Vessels

Table 8-19: Maximum predicted horizontal distances ($R_{\max}$) in kilometres to PTS, TTS and behavioural response thresholds for high frequency cetaceans to vessel noise in winter

Sound exposure thresholds	$R_{\max}$ distance (km)	
	Scenario 1 WTG MP Inshore	Scenario 2 WTG MP Offshore
PTS onset		
201 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL24h)	-	0.02
TTS onset		
181 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL24h)	0.16	0.10
Behavioural response		
120 dB re 1 μPa (SPL) (unweighted)	15.60	12.00

A dash denotes that the threshold was not reached within the minimum limit of the modelling resolution (20 m), indicating predicted horizontal distances of <20 m

8.1.4.7.2 Potential effects on odontocetes

Piling activities

A number of studies have investigated the response of dolphins to pile driving noise. Paiva et al. (2015) observed fewer bottlenose dolphin detections during pile driving operations, and Graham et al. (2017) found that the probability of occurrence of bottlenose dolphins decreased during pile driving operations, as did the period of time bottlenose dolphins spent in the vicinity of construction works. Similarly, Hector's dolphins showed a clear avoidance reaction to pile-driving noise; however, detection rates recovered to pre-piling levels 50 to 83 hours after the cessation of piling (Leunissen, 2017). Indo-Pacific humpback dolphins were found to significantly increase their group swim speed during pile driving, even with the deployment of a bubble curtain, though this did not have a long-term effect on abundance in the area (Würsig et al., 2000). While bottlenose dolphins display short-term behavioural responses to pile driving, there have been no large-scale impacts reported on studied populations (e.g. Fernandez-Betelu et al., 2020).

Further, it is possible that dolphins could become desensitised to pile driving noise. For example, Graham et al. (2019) report that the behavioural response (extent of displacement) of harbour porpoise (a species more sensitive to piling noise than dolphins) diminished over time during a 10-month wind farm installation program, from 7.4 kilometres at the first location piled to 1.3 kilometres at the last location.

The response of killer whales to impulsive noise is unknown; however, it is possible that killer whales would behave in a similar manner to other dolphins, with possible avoidance of the area and a temporary behavioural response (e.g. increased swim speed). Similarly, it is possible that the response of killer whales to repeated pile driving noise would diminish over time (signs of habituation).

The noise modelling predicted that PTS and TTS onset thresholds would not be reached within the limits of the model during impact piling of monopiles with a DBBC, HSD and MHS in place. Furthermore, it is highly unlikely that any odontocete would remain within 60 metres of the pile driving location for a 24-hour period during consecutive installation of four jacket pin piles with a DBBC and MHS, and therefore it is not credible that PTS or TTS onset would be reached. Odontocetes could experience a behavioural response within 5.64 kilometres in shallow water, and 2.72 kilometres in deep water. Consequently, odontocetes may be displaced from the OWFA and surrounding waters during the construction period of four years and 11 months; however, it is possible that dolphins may demonstrate a level of habituation to the pile driving noise and due to the transient behaviour of killer whales, and any avoidance of a localised area is not expected to alter important behaviours.

Vessel operations

The majority of the literature looking at the response of dolphins to vessel noise is on bottlenose dolphins. Bottlenose dolphins have been observed to alter their whistle characteristics such as frequency range and duration, and increases in whistle production rate, in response to elevated noise or in the presence of vessels (Erbe et al., 2019). Fouda et al. (2018) found that bottlenose dolphins simplified their whistles in the presence of vessels, which may reduce the information content of these signals and decrease effective communication required for social cohesion.

Marley et al. (2017) found that bottlenose dolphins spent greater time travelling and less time socialising or resting in the presence of vessels. In the presence of tour boats, bottlenose dolphin groups with female and

calf pairs were less cohesive and coordinated, suggesting groups with calves are particularly sensitive to boat presence and noise (Guerra et al., 2014). However, bottlenose dolphin presence was positively correlated with the number of construction vessels during construction of an underwater gas pipeline in Ireland suggesting that vessel noise did not deter them from the construction area, though it is not clear whether dolphins were attracted to the vessels themselves, or whether prey availability had been effected at the time (i.e. increased prey) (Anderwald et al., 2013). In response to vessel-based preparation work prior to pile driving, harbour porpoise acoustic detection declined by up to 33 per cent in the 48 hours prior to piling, indicating displacement (Benhemma-Le Gall et al., 2023). While harbour porpoises are a more sensitive species it is possible that dolphins would behave in the same way.

In response to vessel noise, killer whales were shown to produce longer calls (Foote et al., 2004) and increase the amplitude of their calls by 1 dB for every 1 dB increase in background noise level (Holt et al., 2009), as was found for baleen whales. Williams et al. (2014) modelled the response of killer whales to ship noise, and found subtle responses (i.e. a minor change in respiration) were observed around received levels of 130 dB re 1 μ Pa (rms) and more severe responses (i.e. change in speed, direction and/or deviation) were hypothesised to occur at received levels above 150 dB re 1 μ Pa. Southern resident killer whales were more likely to feed when vessel noise was reduced (Williams et al., 2021).

Pirotta et al. (2012) report that vessel noise had a significant effect on the movement on another odontocete species, Blainville's beaked whales, while they were foraging, though there was no significant change in the duration of foraging periods. The authors suggest that a behavioural response could be detected at a minimum distance of 5.2 kilometres from the vessel (Pirotta et al., 2012).

The implementation of mitigation measures to reduce the risk of vessel strike for cetaceans (Section 9.1) will help to reduce the risk of hearing impairment / disturbance to odontocetes from vessel noise. Dolphins are transient, and it is highly unlikely that a dolphin will remain within 160 metres of a vessel for a full 24-hour period, and therefore PTS onset and TTS onset are not expected. Increased vessel noise throughout the four year and eleven months construction period could cause in a change in the behaviour and/or vocalisations of dolphins. However, the effects of noise impacts are expected to be short-term throughout their period of occupancy (days to weeks), and animals are expected to recover once outside of impact ranges or once vessel activity has ceased. Any possible effects from vessel noise are not expected to alter important behaviours or be significant at a population level.

8.1.4.8 Impact assessment for pinnipeds

The AUFS and NZFS have breeding colonies in proximity to the OWFA. Tracking data indicate that AUFS from the Rag Island colony occur regularly throughout the OWFA and surrounding waters en-route to foraging grounds in the north-east, with an estimated five percent of the population predicted to be in the OWFA at any one time (Section 6.2.7). Usage of the OWFA was highest during the mid / late-lactation stage (June to September). In contrast the OWFA and surrounding waters do not represent important foraging habitat for AUFS or NZFS from Kanowna Island and are therefore expected to occur much more infrequently (Appendix A).

Pinnipeds are much less sensitive to the low frequency noise associated with pile driving than baleen whales and the modelling predicts that hearing impairment ranges during impact piling will be limited to within 100 metres of piling activities. The hearing impairment ranges for vibro-piling are predicted to be larger (up to five kilometres), although these results are unmitigated, and NAS will be applied to reduce these ranges and ensure the noise level limit is achieved if the vibro-piling method is used.

8.1.4.8.1 Noise effect ranges for pinnipeds

The results of the underwater noise modelling for impact piling of monopiles and OSS jacket pin piles, vibro-piling of monopiles and vessels on DP are set out below for pinnipeds in Table 8-20, Table 8-21, Table 8-22 and Table 8-23. These results provide maximum predicted effect ranges for PTS, TTS and behavioural response. The results for impact piling (monopile and jacket pin pile) represent the effect ranges predicted when a DBBC, HSD and MHS (monopiles) and DBBC and MHS (jacket pin piles) is utilised. Results with no mitigation applied from the early modelling (second round) are provided in Section 6.2 of Attachment I - Underwater noise modelling (RPS, 2025a). For the SEL 24-hour cumulative thresholds the modelling assumes that whales are stationary, i.e. there is no consideration of normal animal movement and resulting reduction in noise exposure over time.

Impact piling

Table 8-20: Maximum predicted horizontal distances ($R_{\max}$) to PTS, TTS and behavioural response thresholds for pinnipeds in water to cumulative (multiple strike) noise exposure from pile driving of a single monopile with a DBBC, HSD and MHS in winter

Sound exposure threshold	$R_{\max}$ distance (km)			
	Shallow (MP1)	Intermediate (MP2)	Deepest (MP3)	Deep (MP4)
PTS onset				
185 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	-	-	-	-
TTS onset				
170 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	-	-	-	-
Behavioural response				
160 dB re 1 μPa (SPL) (unweighted)	5.64	5.18	2.37	2.72

A dash denotes that the threshold was not reached within the minimum limit of the modelling resolution (20 m), indicating predicted horizontal distances of <20 m

Table 8-21: Maximum predicted horizontal distances ($R_{\max}$) to PTS, TTS and behavioural response thresholds for pinnipeds in water to cumulative (multiple strike) noise exposure from pile driving of a jacket pin piles with a DBBC and MHS in winter

Sound exposure threshold	$R_{\max}$ distance (km)	
	Single jacket pile	Four pin piles
PTS onset		
185 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	-	-
TTS onset		
170 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	0.05	0.16
Behavioural response		
160 dB re 1 μPa (SPL) (unweighted)	2.60	N/A

A dash denotes that the threshold was not reached within the minimum limit of the modelling resolution (20 m), indicating predicted horizontal distances of <20 m

Vibro-piling

Table 8-22: Maximum predicted horizontal distances ($R_{\max}$) to PTS, TTS and behavioural response thresholds for pinnipeds in water to vibro-piling of a single monopile in winter

Sound exposure threshold	$R_{\max}$ distance (km)		
	Deep (MP5)	Intermediate (MP3)	Shallow (MP1)
PTS onset			
199 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	0.23	-	0.04
TTS onset			
179 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	5.00	0.18	2.20
Behavioural response			
120 dB re 1 μPa (SPL) (unweighted)	>90	>90	>90

A dash denotes that the threshold was not reached within the minimum limit of the modelling resolution (20 m), indicating predicted horizontal distances of <20 m

Vessels

Table 8-23: Maximum predicted horizontal distances ($R_{\max}$) in kilometres to PTS, TTS and behavioural response thresholds for pinnipeds in water to vessel noise in winter

Sound exposure thresholds	$R_{\max}$ distance (km)	
	Scenario 1 WTG MP Inshore	Scenario 2 WTG MP Offshore
PTS onset		
199 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	-	0.02
TTS onset		
179 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	0.14	0.09
Behavioural response		
120 dB re 1 μPa (SPL) (unweighted)	15.60	12.00

A dash denotes that the threshold was not reached within the minimum limit of the modelling resolution (20 m), indicating predicted horizontal distances of <20 m

8.1.4.8.2 Potential effects on pinnipeds

Piling activities

The response of otariid seals such as fur seals to pile driving noise has not been reported. However, some studies have documented the response of more hearing sensitive phocid seals, including grey seals and harbour seals. Russell et al. (2016) observed significant displacement of harbour seals (up to 25 kilometres) during periods when pile driving was taking place; however, distribution returned to pre-piling levels within two hours of the cessation of piling. Grey seals were found to reduce descent speed in response to pile driving, suggesting a transition from foraging (diving to the bottom) to more horizontal movement (Aarts et al., 2017). Although in some cases grey seals exposed to pile-driving at ranges of less than 30 kilometres returned to the location of pile driving on subsequent trips, suggesting the incentive (e.g. foraging) to use the area was greater than the potential deterring effect of pile driving (Aarts et al., 2017).

The noise modelling predicted that PTS and TTS onset thresholds would not be reached within the limits of the model during impact piling of monopiles with a DBBC, HSD and MHS in place. Moreover, fur seals are expected to behaviourally avoid piling noise and are considered highly unlikely to move within 160 metres of a pile driving location, let alone remain there for a full 24-hour period, during installation of four consecutive jacket pin piles with a DBBC and MHS. Therefore, impacts will be limited to a behavioural response. The extent of behavioural impacts is 5.6 kilometres during impact piling, less than the distance to the nearest fur seal colony at Rag Island (approximately 12.5 kilometres), and therefore pile driving is not expected to impact occupancy of this colony, or the further afield Kanowna Island colony.

During pile driving, AUFS from the Rag Island colony may deviate from the OWFA and surrounding waters while transiting further north to foraging areas; however, the OWFA represents only a small area of habitat occupied by these seals (Appendix A) and therefore impacts are not expected to alter important behaviours.

Vessel operations

Much of the research into the response of pinnipeds, and particularly fur seals, to vessel noise has focussed on airborne rather than underwater noise. However, Mikkelsen et al. (2019) report that a tagged grey seal altered its diving behaviour and ceased resting in response to vessel noise, and in another instance the seal descended to the bottom and remained stationary while the vessel passed, however these responses seemed to be limited to individual instances. In response to increased vessel traffic during construction of an underwater gas pipeline in Ireland, grey seal presence decreased suggesting they were displaced, most likely due to noise disturbance (Anderwald et al., 2013).

Jones et al. (2017) report that harbor seals in the Moray Firth were exposed to cumulative (SEL_{24h}) noise from shipping at levels between 170 and 189 dB re $1 \mu Pa^2.s$ (rms), with upper confidence limits of 206 dB re $1 \mu Pa^2$, above the TTS onset threshold above. It is likely that fur seals, and particularly those at Kanowna Island colonies, are regularly exposed to vessel noise given they forage in areas intersecting shipping lanes.

The implementation of mitigation measures to reduce the risk of vessel strike for pinnipeds (Section 9.1) will also reduce the risk of hearing impairment / disturbance to fur seals from vessel noise. It is highly unlikely that a fur seal would remain within 140 metres of a vessel for a full 24-hour period, and therefore PTS onset and TTS onset are not expected. Increased vessel noise throughout the four year and eleven months construction period could cause a change in the behaviour of fur seals in the area, and particularly AUFS at Rag Island. However, it is likely that fur seals are accustomed to vessel noise, and any possible effects from vessel noise are not expected to alter important behaviours or be significant at a population level.

8.1.4.9 Impact assessment for marine turtles

There is very limited historical presence of all marine turtle species in proximity to the OWFA, and no BIAs or critical habitats. During the MESP a single loggerhead turtle (probable species identification) was recorded in January and a single 'likely' leatherback turtle was recorded in April (Section 6.2.8). Therefore, the presence of marine turtles is likely to be limited to very occasional and transient individuals.

The recovery plan for marine turtles identifies noise interference as a threat and advises that noise generating activities within important inter-nesting habitat should be scheduled outside the nesting season. There are no nesting or inter-nesting habitats for marine turtles in the Gippsland region and there is therefore no potential for disruption of nesting or inter-nesting behaviours. The recovery plan also recommends the use of soft-start procedures and these will be implemented for all piling activities (Table 8-28).

8.1.4.9.1 Noise effect ranges for marine turtles

The results of the underwater noise modelling for impact piling of monopiles and OSS jacket pin piles, vibro-piling of monopiles and vessels on DP are set out below for marine turtles in Table 8-24, Table 8-25, Table 8-26 and Table 8-27. These results provide maximum predicted effect ranges for PTS, TTS and behavioural response. The results for impact piling (monopile and jacket pin pile) represent the effect ranges predicted when a DBBC, HSD and MHS (monopiles) and DBBC and MHS (jacket pin piles) is utilised. Results with no mitigation applied from the early modelling (second round) are provided in Section 6.2 of Attachment I - Underwater noise modelling (RPS, 2025a). For the SEL 24-hour cumulative thresholds the modelling assumes that whales are stationary, i.e. there is no consideration of normal animal movement and resulting reduction in noise exposure over time.

Impact piling

Table 8-24: Maximum predicted horizontal distances (R_{max}) to PTS, TTS and behavioural response thresholds for marine turtles to cumulative (multiple strike) noise exposure from pile driving of a single monopile with a DBBC, HSD and MHS in winter

Sound exposure threshold	R_{max} distance (km)			
	Shallow (MP1)	Intermediate (MP2)	Deepest (MP3)	Deep (MP4)
PTS onset				
184 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	0.09	0.09	0.09	0.09
TTS onset				
169 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	1.14	0.75	0.36	0.39
Behavioural response				
166 dB re 1 μPa (SPL) (unweighted)	2.95	2.35	1.12	1.34
Behavioural disturbance				
175 dB re 1 μPa (SPL) (unweighted)	0.62	0.46	0.17	0.28

Table 8-25: Maximum predicted horizontal distances (R_{max}) to PTS, TTS and behavioural response thresholds for marine turtles to cumulative (multiple strike) noise exposure from pile driving of a jacket pin piles with a DBBC and HSD in winter

Sound exposure threshold	R_{max} distance (km)	
	Single jacket pile	Four pin piles
PTS onset		
184 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	1.37	3.14
TTS onset		
169 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	8.71	16.5
Behavioural response		
166 dB re 1 μPa (SPL) (unweighted)	1.11	N/A
Behavioural disturbance		
175 dB re 1 μPa (SPL) (unweighted)	0.19	N/A

Vibro-piling

Table 8-26: Maximum predicted horizontal distances (R_{max}) to PTS, TTS and behavioural response thresholds for marine turtles to vibro-piling of a single monopile in winter

Sound exposure threshold	R_{max} distance (km)		
	Deep (MP5)	Intermediate (MP3)	Shallow (MP1)
PTS onset			
198 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	17.30	3.51	7.25
TTS onset			
178 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	64.40	25.50	83.20

Vessels

Table 8-27: Maximum predicted horizontal distances ($R_{\max}$) in kilometres to PTS, TTS and behavioural response thresholds for marine turtles to vessel noise in winter

Sound exposure thresholds	$R_{\max}$ distance (km)	
	Scenario 1 WTG MP Inshore	Scenario 2 WTG MP Offshore
PTS onset		
198 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL24h)	0.04	0.04
TTS onset		
178 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL24h)	7.05	4.80

A dash denotes that the threshold was not reached within the minimum limit of the modelling resolution (20 m), indicating predicted horizontal distances of <20 m

8.1.4.9.2 Potential effects on marine turtles

Marine turtles do not appear to use sound for communication, but may use sound for navigation, locating prey, avoiding predators and general environmental awareness (Dow Piniak et al., 2012). There have been few studies into marine turtle hearing sensitivity. Ridgeway et al. (1969) measured the response of green turtles to aerial and vibrational stimuli and found that they responded to aerial stimuli between 100 and 1000 Hz and vibrational stimuli between 30 and 700 Hz, with a maximum sensitivity between 300 to 700 Hz for both. Sub-adult green turtles responded to aerial tonal stimuli between 100 and 500 Hz (Bartol and Ketten, 2006). Dow Piniak et al. (2012) measured the response of leatherback turtle hatchlings in water and in air and found that they were able to detect sounds both in water and in air, responding to stimuli between 50 and 1200 Hz in water and 50 to 1600 Hz in air. Bartol et al. (1999) measured the hearing of juvenile loggerhead turtles and found they had a hearing range of 250 to 750 Hz, while adult loggerhead turtles responded to frequencies between 100 and 1131 Hz (Martin et al., 2012). Juvenile Kemp's ridley turtles responded to stimuli between 100 to 500 Hz (Bartol and Ketten, 2006). This demonstrates that marine turtle hearing sensitivity overlaps with the frequencies and source levels produced by many anthropogenic sources including pile driving, shipping and operating wind turbines, which suggests that leatherbacks are able to detect the sounds produced by these activities (Dow Piniak et al., 2012).

There is a scarcity of data regarding the response of marine turtles to acoustic exposure. Temporary exposure to loud noise may result in the avoidance of important habitats and in some situations physical damage to turtles (Commonwealth of Australia, 2017a); however, there are no studies of hearing loss in marine turtles due to exposure to loud noise and therefore the risk of PTS and TTS is unknown. McCauley et al. (2000) observed the response of caged green turtles and loggerhead turtles to an approaching seismic airgun and found that turtles increased their swimming activity (i.e. behavioural response – 166 dB) and began to behave erratically, which was interpreted as an agitated state above the behavioural disturbance threshold (175 dB). DeRuiter & Doukara (2012) reported that in response to a seismic airgun pulse, approximately seven percent of studied loggerhead turtles dove immediately following the airgun shot, which could be interpreted as an avoidance response (DeRuiter & Doukara, 2012).

The implementation of mitigation measures to reduce the risk of vessel strike for marine turtles (Section 9.1) will reduce the risk of hearing impairment / disturbance to marine turtles from noise generated during vessel operations and soft-start and delayed start-up procedures will limit disturbance from piling activities. The MESP data indicates that the OWFA and surrounding waters are not an important area for marine turtles, and therefore the probability of encountering them within around one kilometre of pile installation (impact piling of a monopile with a DBBC, HSD and MHS in place) and 40 metres from a vessel for a full 24-hour period is extremely low. Increased noise emissions throughout the four year and eleven months construction period could cause a short-term behavioural response for the small number of turtles that may swim into the noise footprint of an individual pile. For example, this may include a change in swimming direction or diving behaviour, though it is unclear whether noise from vessels would mask important acoustic cues for marine turtles. However, the presence of marine turtles is expected to be limited to highly occasional transient individuals, and any possible effects from noise are not expected to alter important behaviours or be significant at a population level.

8.1.5 Mitigation measures

Initial mitigation measures will apply through standard industry construction management practices to reduce construction piling noise as provided in Table 7-3.

As the OWFA and OECA overlap BIAs for two listed threatened whale species, the southern right whale and the blue whale, and anthropogenic underwater noise is identified as a threat to the recovery of these species there is a need to develop and implement additional mitigation measures, and to protect migratory and marine species in accordance with the MNES Significant Impact Guidelines. These additional measures are listed in Table 8-34 and notably include measures to reduce noise at the source as well as measures to effectively monitor and manage impacts to whales that enter the defined precaution zones. The final precautions zones will be defined Once pile diameters and noise abatement systems are confirmed further modelling will be undertaken and the extent of TTS will be recalibrated. The required monitoring distance required may be less at this time. While the current monitoring and mitigation framework is based on the impact piling results, vibratory piling is retained as an option if, prior to the commencement of construction, noise modelling with mitigations in place can be undertaken, the outcomes for noise mitigation and duration of piling are equal to or better than the outcomes for impact piling and this is a commercially and technically feasible option to deploy for the project..

In order to achieve reliable detection of whales within the effect zone for behavioural disturbance and TTS onset, two marine mammal observers will be required on multiple platforms that will each cover a five kilometre zone during periods of longer daylight hours (roughly September to March) to manage fatigue and ensure the effectiveness of continuous observations (Beach Energy, 2024). Monitoring to distances of 10 km has been undertaken on the Vineyard wind project, and was proposed to occur out to 7 km for the Woodside Scarborough Seismic Survey (EP available on the NOPSEMA website), However, at these large distances, It may not be possible to ascertain whether an animal is feeding, and therefore for all blue whale detections it is likely that it will need to be assumed that the animal may be foraging (Beach Energy, 2024).

More detailed information about the mitigation measures, monitoring and management that will be implemented to ensure that Assessment Criteria for the effects of construction noise on marine mammals and turtles are detailed in the Construction Underwater Noise Management Framework.

Table 8-28: Mitigation and monitoring measures for impacts associated with construction piling and vessel noise during the construction phase

ID	Mitigation/management measure	Description	Effectiveness
UWN-M03	Noise abatement system (NAS)	The project will implement the best available NAS techniques at the point of construction that meets the noise level limit (refer UWN-M04) and is feasible for the site's water depths, metocean conditions, pile size and vessels, as detailed in the Construction Underwater Noise Framework. Currently the NAS includes a Double Big Bubble Curtain (DBBC), to ensure the efficacy of this NAS the SOTS project team will have a DBBC management procedure in place that will involve hose drilling, testing and flushing, visual assessments of bubbles, connection maintenance, compressor pressure monitoring, metocean monitoring and reporting to ensure that piling continues only while the DBBC is functional.	Modelling and measures indicated NAS such as DBBC, HSD and MHS together provide effective noise reduction. This measure is consistent with advice provided in DCCEEW Guidance - Key environmental factors for offshore windfarm environmental impact assessment under the EPBC Act.
UWN-M04	Noise level limit for pile driving activities	Piling activities will be managed to ensure that the noise level at set distances are equal to, or less than, those defined in the pre-construction modelling as per the Construction Underwater Noise Framework. Therefore demonstrating that the noise levels / zones of effect correspond appropriately to the precaution zone (as detailed in the Construction Underwater Noise Framework).	This measure will ensure that precaution zone sizes are appropriate through targeted noise measurements at representative piling locations and that NAS is effective. Noise measurements will be in accordance with ISO 18406:2017 Underwater

ID	Mitigation/management measure	Description	Effectiveness
			acoustics — Measurement of radiated underwater sound from percussive pile driving (refer to MMT EMP for details of the noise measurement program and triggers for corrective action).
UWN-M05	Southern Right Whale Reproductive Biological Important Area Limit	Ensure SRW are not exposed to noise levels of greater than 140 dB SPL (impulsive piling) when within the Reproduction BIA between May to September.	Highly effective as it avoids noise exceeding behavioural response range within this Habitat Critical to Survival (HCTS) for the southern right whale.
	Ensure underwater noise levels of less than 140 dB SPL near the SRW reproduction BIA during the months of May to September, with range determined by the modelling results.	Where reasonably practicable, install piles on the offshore side of the project area during the months of May to September and inshore piles during October to April. If this is not reasonable practicable, management controls on piling operations would be as per the monitoring and adaptive management procedure for pile driving operations in Section 4.4 of the Construction Underwater Noise Framework.	Aligns with EPBC Act PS 2.1 Procedure A.1.
UWN-M06	Marine Fauna Observers (MFOs)	Sufficient MFOs and vessels deployed to ensure visible coverage of the precaution zone based on the final round of modelling, as per the Construction Underwater Noise Framework. Any crew that will be used as MFOs will be trained. All MFOs will be suitably qualified and experienced in accordance with EPBC Act PS 2.1.	Highly effective and standard practice for noise generating activities. The number of MFOs will reflect observation distances and ranges to behavioural disturbance and TTS thresholds. Aligns with EPBC Act PS 2.1 Procedure A.2 and B.1.
UWN-M07	Passive acoustic monitoring (PAM)	PAM systems will be used to support detection of vocalising species of whales that are not easily observed at the surface, and during low visibility conditions and at nighttime, noting that only some animals in a population might vocalise Long range detection method and real time systems will be investigated All PAM operators will be qualified and experienced.	Commonly used systems for vocalising marine fauna detections during low visibility and time-time conditions. Will require range validation and testing during implementation prior to use as a trigger for whale detection. Aligns with EPBC Act PS 2.1 Procedure B.5.
UWN-M08	Pre-start-up marine mammal surveillance	A 30 minute pre-start whale surveillance period will apply before the commencement of the soft start procedure at each piling location with sufficient trained and experienced Marine Fauna Observers to ensure coverage of the precaution zone and supplemented by a PAM array.	Aligns with EPBC Act PS 2.1 Procedure A.3.1 and B.4 (with the addition of PAM to ensure effective whale detection).
UWN-M09	Start-up Delay Procedure	If a whale, dolphin, pinniped or turtle is detected within the relevant precaution zone of a piling location, start-up will be delayed until marine fauna has been confirmed to have left the zone or a period of 30 mins has elapsed since the last detection.	Delaying start-up will be effective at preventing close-range noise exposure to marine mammals and turtles. Aligns with EPBC Act PS 2.1 Procedure A.3.3.
UWN-M10	Operations procedure	Species specific precaution zones will be under continuous surveillance (visual and acoustic) during all pile driving operations (low power and full operations). The size of the precaution zones will be refined in response to pre-construction noise modelling and in-field noise verification around representative piling locations.	Aligns with EPBC Act PS 2.1 Procedure A.3.4, B.3 and B.4. Refer to the MMT EMP for the design of the marine fauna detection program.

ID	Mitigation/management measure	Description	Effectiveness
		If piling is paused for operational reasons, marine fauna observations should continue and if marine fauna are detected within their precaution zones, re-start should be delayed until the precaution zone is clear of marine fauna. Once the precaution zone is clear for a period of 30 minutes, soft start procedures can be recommenced.	The ongoing effectiveness of whale detections will be monitored and optimised in accordance with the MMT EMP. This measure is consistent with advice provided in DCCEEW Guidance - Key environmental factors for offshore windfarm environmental impact assessment under the EPBC Act.
UWN-M11	Stop Work Procedure	If marine fauna are detected within the relevant precaution zone (define by pre-construction modelling as per the Construction Underwater Noise Framework) for each species, pile driving should cease or hammer energy reduced to the lowest feasible level when safe to do so. The pile driving operation must not resume until the animal has moved out of the precaution zone or has not been sighted for 30 minutes. Following this, operations may resume following the stop work procedure that will be developed prior to construction.	Effectiveness will largely be limited by the potential for delays in mitigation action when it is not safe to cease pile driving or reduce hammer energy. The MMT EMP will include a protocol for decision making on shutdown or reduced hammer energy. Aligns with EPBC Act PS 2.1 Procedure A.3.5 This measure is consistent with advice provided in DCCEEW Guidance - Key environmental factors for offshore windfarm environmental impact assessment under the EPBC Act.
UWN-M12	Night-time monitoring	Effective detection of whales at night will be achieved through a combination of a PAM array and 360 degree scanning thermal infra-red (IR) cameras (or similar) on support vessels ensuring coverage of the precaution zone. Whale detections at night will trigger the mitigation measures outlined in UWN-M09, UWN-M10 and UWN-M11 above.	The effectiveness of novel detection techniques such as thermal IR cameras will be validated before implementation. Where effectiveness cannot be validated, night-time and low visibility procedures will be applied (UWN-M13). Aligns with EPBC Act PS 2.1 Procedure B.1 and B.5.
UWN-M13	Night-time and low visibility procedures	If three or more whales are detected within the relevant precaution zone (as detailed in the Construction Underwater Noise Framework) on any day, piling activities will be ceased at night-time (as soon as safe to do so) during non-daylight hours, in the event that no effective night time detection is available. Piling can recommence in daylight hours the following day, and night operations can continue that night as long as less than three shutdown events are observed within the precaution zone during daylight hours.	This measure sets out a clear trigger to cease night-time operations when effective night-time / low visibility monitoring is not available or validated, and whalea have been detected during the day / good visibility conditions. There may be times where piling is commenced during the day and it is not safe to immediately cease piling at sunset. In this event, piling will cease as soon as safe to do so. Aligns with EPBC Act PS 2.1 Procedure A.3.6.

ID	Mitigation/management measure	Description	Effectiveness
UWN-M14	Adaptive management procedure for whales	An adaptive management procedure will be implemented if behaviour, occurrence or abundance is different to what has been predicted for the noise management, as detailed in the Construction Underwater Noise Framework. Examples of behavioural triggers include: • Three or more SRW or BW abundance recorded in the precaution zone • Repeated or sustained (>30 minutes) blue whale feeding activity is observed by qualified MFOs within or adjacent to the construction precaution zone for blue whales. • A Southern Right Whale (SRW) mother and calf pair are observed resting by qualified MFOs within or adjacent to the construction precaution zone for SRW Examples of adaptive management include: • Larger precaution zones that can be realistically managed • Long range surveys • Increased observation platforms and/or methods • Increased coverage of MFOs • Additional NAS • Modified NAS	This measure accounts for the possibility that behaviour, re-occurrence or abundance is different to predicted and enables different or additional mitigation measures to be included. This measure is consistent with advice provided in DCCEEW Guidance - Key environmental factors for offshore windfarm environmental impact assessment under the EPBC Act.
UWN-M15	Installation of export cable within southern right whale Biologically Important Area	If reasonably practicable, the project will avoid installing the export cable within the SRW reproduction BIA during the months of May to September. If this is not reasonably practicable, and a SRW is detected by the vessel MFO, DP will be powered down to the lowest possible safe setting. DP will not be powered up until at least 30 minutes has elapsed since the most recent sighting of a SRW. This measure is designed to limit noise from operations during periods when southern right whales are utilising the area.	Monitoring for behavioural disturbance within and around the SRW BIA during the reproductive season will ensure that the activity will not prevent SRW from utilising the BIA. It is not possible to commit to avoid the SRW season completely as timing will be subject to vessel availability.

8.1.6 Residual impacts

The potential impacts to the marine mammal and turtle receptors are described above. With the addition of additional mitigation measures in place residual impacts are not expected to occur therefore there would be no significant impacts on behaviour, migration, foraging and / or survival rates, resulting in an overall Minor level of residual impact (Table 8-29).

Table 8-29: Consequence associated with underwater noise emissions during the construction phase

Potential Impact	Receptor	Receptor sensitivity	Initial consequence	Additional mitigation	Consequence
Hearing impairment (PTS and TTS onset), masking and behavioural disturbance	Blue whale Humpback whale Other mysticetes	High	Major (B) (Magnitude = Medium)	UWN-M03 UWN-M04 UWN-M06 UWN-M07 UWN-M08 UWN-M09 UWN-M10 UWN-M11 UWN-M12 UWN-M13	Minor (D) (Magnitude = Negligible)

Potential Impact	Receptor	Receptor sensitivity	Initial consequence	Additional mitigation	Consequence
				UWN-M14	
Hearing impairment (PTS and TTS onset), masking and behavioural disturbance	Southern right whale	High	Major (B) (Magnitude = Medium)	UWN-M03 UWN-M04 UWN-M05 UWN-M06 UWN-M07 UWN-M08 UWN-M09 UWN-M10 UWN-M11 UWN-M12 UWN-M13 UWN-M14 UWN-M15	Minor (D) (Magnitude = Negligible)
Hearing impairment (PTS and TTS onset), masking and behavioural disturbance	Odontocetes - dolphins Pinnipeds Marine Turtles	Low	Negligible (E) (Magnitude = Low)	UWN-M03 UWN-M04 UWN-M06 UWN-M08 UWN-M09 UWN-M10 UWN-M11 UWN-M12 UWN-M14	Negligible (E) (Magnitude = Negligible)

8.1.7 Evaluation of residual impacts against assessment criteria

Table 8-30 contains an evaluation of the residual impacts of construction piling noise to mammal and turtle receptor groups, against the assessment criteria defined for the project (refer Section 0). The residual impacts for this impact pathway do not exceed any of the defined assessment criteria and there is a high degree of confidence in these predictions (Table 5-8).

Table 8-30: Evaluation of residual impacts against assessment criteria for construction piling noise during the construction phase

Assessment criteria	Evaluation	Confidence/ uncertainty
Principles of ESD AC1: Biological diversity and productivity of the environment is not compromised because of the project.	Underwater noise from construction activities will be mitigated to reduce the risk of auditory impairment or behavioural disturbance to marine mammals and turtles to an acceptable level. A precautionary approach has been taken for the SRW reproduction BIA/HCTS (between May and September) such that a conservative behavioural disturbance threshold (140 dB SPL weighted) has been adopted, and this noise limit will not be exceeded within the BIA. Underwater noise from piling could result in a change in the behaviour and/or vocalisations of marine mammals and turtles. However, effects are expected to be short-term throughout the period of occupancy of animals (days to weeks) and limited to disruption to	High confidence - UWNM using site-specific data for parameters that are known to influence impact ranges - sound source verification study to validate UWNM results - large monitoring range with triggers for shutdown based on animat modelling with adaptive management triggers for BW and SRW to revert to static if required - implement NAS during installation of piles that meets the noise level limits defined in UWN-M04; maintenance procedure to ensure effective functionality of selected NAS - precautionary approach for SRW reproduction BIA / HCTS by adoption of conservative

Assessment criteria	Evaluation	Confidence/ uncertainty
	migration with no impact on breeding success or the survival of individuals. The project is not inconsistent with the Principles of ESD.	behavioural disturbance thresholds • implementation of EPBC PS2.1 Part A and B Standard and Additional Measures • additional measures for export cable installation within the SRW reproduction BIA • highly precautionary approach for UWN disturbance from piling.
Conservation Management and Recovery Plans • AC2: The project will be managed such that residual impacts and / or risks will not be inconsistent with the objectives of the Conservation Management Plan for the Blue Whale, including application of the "Guidance on key terms" and the requirements of the following relevant Action Areas defined within: – Action Area A2 – assessing anthropogenic noise, specifically that anthropogenic noise will be managed such that any blue whale continues to utilise biologically important areas without injury and is not displaced from a foraging area	Underwater noise from construction activities was assessed as having a Minor consequence to blue whales, however this is due to the High sensitivity of the species, and with the application of all mitigation measures the magnitude of impacts is Negligible (i.e. localised). The project has reduced the risk to an acceptable level that blue whales continue to use the area without injury and are not displaced from the foraging area. Underwater noise from piling could result in a change in the behaviour and/or vocalisations of blue whales. However, effects are expected to be short-term throughout the period of occupancy of animals (few hours to days) and will not be present once the activity has ceased. The presence of blue whales in the OPA and surrounding waters is expected to be limited to occasional migratory individuals, and no impact on the survival of individuals or the population is expected. The project is not inconsistent with the Conservation Management Plan for the Blue Whale.	
• AC3: The project will be managed such that residual impacts and/or risks will not be inconsistent with the objectives of the National Recovery Plan for the Southern Right Whale including the requirements of the following relevant Action Areas: – Action Area A5 – assessing, managing and mitigating impacts to southern right whales from anthropogenic underwater noise, specifically that anthropogenic noise will be managed such that it does not prevent any southern right whale from utilising biologically important areas or habitat critical to the survival of a species or cause auditory impairment	Underwater noise from construction activities was assessed as having a Minor consequence to southern right whales, however this is due to the High sensitivity of the species, and with the application of all mitigation measures the magnitude of impacts is Negligible (i.e. localised). A precautionary approach has been taken for the southern right whale reproduction BIA/HCTS (between May to September) such that a conservative behavioural disturbance threshold (140 dB SPL weighted) has been adopted, and this noise limit will not be exceeded within the BIA. Underwater noise from piling could result in a change in the behaviour and/or vocalisations of southern right whales and possibly lead to a reduction in communication space which could be particularly detrimental for female and calf pairs. However, effects are expected to be short-term throughout the period of occupancy of animals (days to weeks) and will not be present once the activity has ceased. The presence of southern right whales in the OPA and surrounding waters is expected to be limited to occasional migratory and/or resting individuals, and no	

Assessment criteria	Evaluation	Confidence/ uncertainty
	impact on the breeding success or the survival of individuals or the population is expected. The project is not inconsistent with the National Recovery Plan for the Southern Right Whale.	
Significant Impact Guidelines (threatened species) • AC4: The project will not have a significant impact on Threatened (Endangered and Vulnerable) Species as defined in the MNES Significant Impact Guidelines 1.1	Underwater noise from construction activities will be mitigated to ensure that noise generated by piling will not disrupt breeding cycles, interfere with population abundance or recovery, or affect habitat availability, quality and occupancy such that there are population level effects on threatened species. A precautionary approach has been taken for the SRW reproduction BIA/HCTS (between May and September) such that a conservative behavioural disturbance threshold (140 dB SPL weighted) has been adopted, and this noise limit will not be exceeded within the BIA. Underwater noise from piling could result in a change in the behaviour and/or vocalisations of marine mammals and turtles. However, effects are expected to be short-term throughout the period of occupancy of animals (days to weeks) and limited to disruption to migration with no impact on breeding success or the survival of individuals. The project is not inconsistent with the Significant Impact Guidelines.	
Significant Impact Guidelines (migratory species) • AC7: The project will not have a significant impact on Migratory Species as defined in the MNES Significant Impact Guidelines 1.1.	Underwater noise from construction activities will be mitigated to ensure there is no real chance or possibility that an important habitat is modified or the lifecycle of an ecologically significant proportion of a population of marine mammals and turtles is disrupted. Underwater noise from piling could result in a change in the behaviour and/or vocalisations of marine mammals and turtles. However, effects are expected to be short-term throughout the period of occupancy of animals (days to weeks) and limited to disruption to migration with no impact on breeding success, the survival of individuals or populations. The project is not inconsistent with the Significant Impact Guidelines.	
Significant Impact Guidelines (Commonwealth marine areas) • AC8: The project will not have a significant impact on Commonwealth Marine Areas as defined in the MNES Significant Impact Guidelines 1.1.	Underwater noise from construction activities will be mitigated to ensure that there is no real chance or possibility that important habitat for marine mammals and turtles is disturbed or that there will be a substantial adverse effect on a population of a marine species or cetacean including its life cycle and spatial distribution. Underwater noise from piling could result in a change in	

Assessment criteria	Evaluation	Confidence/ uncertainty
	the behaviour and/or vocalisations of marine mammals and turtles. However, effects are expected to be short-term throughout the period of occupancy of animals (days to weeks) and limited to disruption to migration with no impact on breeding success or the survival of individuals or populations. The project is not inconsistent with the Significant Impact Guidelines.	

8.2 Routine discharges (MMT-I002)

8.2.1 Project activities

Vessels will need to routinely discharge small volumes of liquid and solid waste into the marine environment during construction activities. These include the following, which are managed through the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and the *Navigation Act 2012*, to ensure compliance with international obligations (MARPOL):

- **Food waste** – the average volume of putrescible waste (less than 25 millilitres) from each vessel depends largely on the number of vessel crew and is usually around 1 to 2 kilograms per person per day (NERA, 2018). Discharge would occur whilst in transit, as far as practical, but always more than three nautical miles from the nearest land.
- **Deck drainage** – consisting of seawater (from waves / spray), rainwater and deck wash-down water. This may include liquids that have been accidentally spilled on decks, for example, small quantities of oil, grease, and detergents.
- **Bilge waters** – including deck drainage captured in a closed-loop system (for example bunded areas) and machinery / engine space oily water that has been directed to the oily water separator for removal of oil prior to discharge (whilst in transit) of the treated water once the discharge is less than or equal to 15 parts per million oil-in-water (OIW) as required by Marine Order 91. The oil is returned to shore for reuse / disposal.
- **Sewage and grey water (i.e. showers, laundry, and dishwashing)** – the volume of discharge would largely depend on the number of vessel crew. Treated sewage (comminute and disinfected) and grey water would be disposed of in accordance with Marine Order 96 with the discharge occurring no less than three nautical miles from nearest land.
- **Cooling water** – seawater can be used directly in the machinery engines and other vessel equipment as a cooling measure through heat exchange. Seawater is drawn from the ocean, where it is de-oxygenated and sterilised by electrolysis (release of chlorine from the salt solution) and then circulated as coolant for various equipment through the heat exchangers. It is then discharged to the ocean and may contain low concentrations of residual biocide and scale inhibitors if these are used to control biofouling and scale formation.
- **Brine (hyper-saline water)** – which is created through the vessel's desalination process that creates freshwater for drinking, showers, and cooking. This is achieved through reverse osmosis or distillation. Both processes result in the discharge of seawater with elevated salinity. The freshwater produced is then stored in tanks on-board. The amount of discharge from bilge tanks depends on vessel characteristics including size, engine room design and preventative maintenance schedules.

8.2.2 Impact assessment

Marine mammals and turtles may be impacted by routine discharges through:

- A decline in water quality in the immediate vicinity of the discharge, including an increase in turbidity of surrounding waters

- Introduction of marine pest species leading to a decline in health
- Temporary toxicity to fauna through bilge water discharges.

Indirect effects on changes in prey distribution and abundance are addressed in further detail in Section 8.5.

Routine discharges from large vessels may entail changes to water quality, however, with the total quantities of allowable discharges set through the MARPOL Convention (see Annex I, IV, V), in combination with the implementation of mitigation measures outlined in Table 7-3 and Table 8-31, it is expected these will be highly localised and restricted to the immediate area surrounding the discharge. Research shows that the impact of nutrient enrichment from offshore sewage discharges is considerably less pronounced in open marine environments compared to enclosed areas (McIntyre and Johnston, 1975). Given the open area of the OWFA, discharges are expected to disperse and dilute rapidly.

Monitoring of vessel sewage discharges has demonstrated that a 10 cubic metres discharge over 24 hours from a stationary source in shallow waters can reduce to approximately 1 per cent of its original concentration within just 50 meters from the discharge point (Woodside, 2008). This may have localised and short-term effects on the benthic and fish fauna, some of which are prey of marine mammals or components of their trophic system, however, the effects are not likely to impact at the individual or population levels in any measurable way. Overall, dilution after marine disposal occurs swiftly, with studies indicating a dilution factor of 1 in 1000 within 30 minutes (Costello and Read, 1994).

Deck drainage and treated bilge water, which may contain various chemicals, oils, greases, and solid materials, are expected to dilute quickly in the water column (Shell, 2010), especially as vessels are typically in motion during discharge, facilitating mixing. Although these discharges can increase turbidity near the discharge point, they are anticipated to disperse rapidly, with concentrations significantly decreasing with distance.

The discharge of ballast water from large vessels has the capacity to introduce marine pest species. This is addressed in project technical reports on benthic habitats and fish (Technical Report B: Benthic Ecology and Technical Report C: Fish and Invertebrates). A range of mitigation measures (refer Technical Report B) will be implemented to reduce the risk of introduced marine pests, however within the open sea environment of the OWFA, introduced marine pests are not considered to have a realistic potential for direct impacts (including impacting the health and survivability) on non-benthic foragers. Marine turtles (including the loggerhead and green turtle) and the Australian fur seal are considered benthic foragers and therefore have the potential to be impacted. Invasive marine species are discussed further in Technical Report B.

Bilge tanks potentially contain small volumes of hydrocarbons, detergents, solvents, and chemicals. The oily water separator then treats this water to MARPOL requirements before discharging overboard. The small volumes and low concentrations of oily water from bilge discharges may temporarily reduce water quality. Engine chemicals, including methyl tertiary butyl ether (MTBE), evaporate relatively quickly in surface waters (EPA, 2008), while others, like various polycyclic aromatic hydrocarbons (PAH) are low in solubility and can bind with organic / inorganic matter and deposit in bottom sediments (Mosisch and Arthington, 2001). Therefore, direct impacts to marine mammals and turtles, including acute or chronic toxicity, through ingestion or absorption are not expected, however, more research is needed in the area of indirect impacts (Burgin et al., 2011).

Only water-based drilling fluids (such as those containing xanthan gum and bentonite, or low toxicity alternatives) will be used for marine drilling activities, including trenchless installation of the shore crossing (at Reeves Beach) and drilling monopiles in the OWFA in the event of pile refusal. Low toxicity fluids will limit potential environmental harm, including impacts to sensitive marine receptors associated with decreased water quality.

The blue, southern right, fin and sei whales have management plans or conservation / listing advice in place for Australian waters. These discuss the threat of acute and chronic chemical discharge, mainly relating to accidental hydrocarbon release (e.g. accidental hydrocarbon releases), and pollution (persistent toxic pollutants). Accidental hydrocarbon release is discussed in Section 9.2. Regular exposure to chemical pollution from sewage and industrial discharges put mysticetes at risk of bioaccumulation (e.g. the accumulation of substances in an organism) and biomagnification (e.g. the increase in concentration of a substance in an organism) (DCCEEW, 2022). The threat of bioaccumulation and biomagnification through routine discharge is relatively small for mysticetes as their main prey is low on the food chain and ephemeral in nature, reducing opportunity for pollutants to accumulate (DCCEEW, 2015). In addition, some species, for example southern right whales, rarely feed in their coastal distribution, decreasing the risk of chemical pollution via ingestion of contaminated prey in these areas. Pollution impacts are considered a minor threat with only localised impacts for marine mammals and turtles (TSSC, 2015a, b).

Both the Conservation Management Plan for the Blue Whale and the national recovery plan for the southern right whale identify marine pollution by acute and chronic chemical discharge as a threat (DoE 2015, DCCEE 2024). However, due to the low toxicity of planned discharges, their rapid dilution as a result of oceanic conditions, and management of discharges in accordance with the MARPOL Convention, impacts are not predicted to occur to southern right whales or foraging blue whales or krill that they forage on. Chemical pollution from sewage and other discharges is additionally identified as a threat to southern right whales, particularly within their reproduction BIAs / HCTS where regular exposure may occur. An additional measure of no routine discharges within the southern right whale BIA (between May to September) has been adopted to ensure no impact while this species occupies this BIA.

Similarly, for fin and sei whales, their conservation advice (TSSC 2015a, b) do not specify routine discharges, however habitat degradation from marine development is listed as a threat to both species. In addition, the maintenance and improving of existing legal and management protected is a conservation and management action. Indicating these species are under high levels of protection and activities must not threaten the ongoing protection of these species.

Poor water quality due to chemical discharge is covered in the recovery plan for marine turtles (Commonwealth of Australia, 2017a). Long-term exposure can compromise the health of marine turtles, leading to diseases and pathogens. Whilst more studies are needed to determine the exact risk pollution poses on marine turtle populations, legislation and protocols, including MARPOL, are in place to reduce the threat of pollution through vessel discharge.

While there is no recovery plan or listing advice in place for the Australia and New Zealand fur seals, the NZFS is listed as Vulnerable under the FFG Act. Routine discharges may impact foraging and / or health of these species and therefore have been assessed.

Receptor sensitivity to routine discharges for marine mammals and turtles was assessed as Low with behaviour (foraging, reproduction and survival) unlikely to be affected by routine discharges in a measurable way. Impacts related to routine discharges are expected to be of low spatial extent, intermittent and short-term duration. As activities will only occur in a small proportion of the total OWFA at any one time, it is expected that there will be no disruption of marine mammal or turtle behaviour with no impact on population viability. The initial and residual impact is considered Negligible (E).

8.2.3 Mitigation measures

Initial mitigation measures will apply through standard industry vessel management practices to vessel routine discharges as provided in Table 7-3. Additional mitigation is required given the presence of sensitive receptors, including State and Australian marine protected areas and the southern right whale reproduction BIA / HCTS (occupied from May to September). This will also apply to any vessels transiting to / from port en-route to the offshore project area.

Table 8-31: Mitigation and management measures for impacts associated with routine discharges from project vessels

ID	Mitigation/management measure	Description	Effectiveness
VES-M08	Vessel discharge controls Routine discharges	- No routine discharges within 500 m of the boundaries of State or Australian marine parks, the southern right whale reproduction BIA / HCTS (between May and September), or if a marine mammal or turtle is within 500 metres of the vessel. - No routine waste discharges from vessels within State Waters.	Although discharges disperse after entering the water, this mitigation will reduce the likelihood of vessel discharges encountering sensitive receptors

8.2.4 Residual impacts

Residual impacts to the marine mammal and turtle receptors are described above. With existing protocols in place for managing routine discharges (i.e. MARPOL, chemical assessment), residual impacts are not expected to occur therefore there would be no significant impacts on behaviour, migration, foraging and / or survival rates, resulting in an overall Negligible level of residual impact (Table 8-32).

Table 8-32: Consequence associated with routine discharges during the construction phase

Potential Impact	Receptor	Receptor sensitivity	Initial consequence	Additional mitigation	Consequence
Reduced water quality leading to changes in fauna behaviour / health	All marine mammals and turtles	Low	Negligible (E) (Magnitude = Negligible)	VES-M08	Negligible (E) (Magnitude = Negligible)

8.2.5 Evaluation of residual impacts against assessment criteria

Table 8-33 contains an evaluation of the residual impacts of routine discharges from vessels during the construction phase to marine mammal and turtle receptor groups, against the assessment criteria defined for the project (refer Section 0). The residual impacts for this impact pathway do not exceed any of the defined assessment criteria and there is a high degree of confidence in these predictions (Table 5-8).

Table 8-33: Evaluation of residual impacts against assessment criteria

Assessment criteria	Evaluation	Confidence/ uncertainty
Principles of ESD • AC1: Biological diversity and productivity of the environment is not compromised because of the project.	Routine discharges were assessed as having a Negligible consequence which is not considered as having the potential to result in serious or irreversible impacts to biological diversity or productivity. A precautionary approach has been taken in the case of AMPs, State MPAs, the SRW reproduction BIA/HCTS (between May and September) and if a marine mammal is within 500 metres of the vessel, with an additional measure of no routine discharges near sensitive receptors. The project is not inconsistent with the Principles of ESD.	High confidence • Australia's legislation safeguards the coastal and marine environments from the threat of pollution through regulation of vessels under the <i>Protection of the Sea (Prevention of Pollution from Ships) Act 1983</i> which invokes requirements of the MARPOL Convention relating to discharge of noxious liquid substances including oil, sewage, putrescible waste, garbage. These requirements are enacted through AMSA's Marine Orders which will apply to all vessels operating in Australian Commonwealth and State waters on the SOTS project. • Vessels coming into Australia from overseas to work on the SOTS project (e.g. piling installation vessels) will be familiar with the requirements of Australia's pollution prevention legislation given that the MARPOL Convention is an internationally adopted convention. • Precautionary approach taken to prevent routine discharges within and/or near AMPs, State MPAs, SRW reproduction BIA / HCTS and if a marine mammal / turtle is within 500 m of the vessel. • Commitment to chemical assessments of all chemicals proposed to be used on the SOTS project during construction to ensure the lowest toxicity, most biodegradable and least accumulative chemicals are selected for use.
Significant Impact Guidelines (threatened species) • AC4: The project will not have a significant impact on Threatened (Endangered and Vulnerable) Species as defined in the MNES Significant Impact Guidelines 1.1.	Routine discharges will be intermittent, of no or low toxicity and of low volumes, with the discharges predicted to mix rapidly with the surrounding waters returning to a pre-impacted state without any long-term impacts to water quality. Impacts are not predicted to occur to marine mammals or turtles or their prey. Routine discharges will be managed using standard industry protocols (i.e. MARPOL). An additional measure of no routine discharges near sensitive receptors has been adopted to ensure no impact, including if a marine mammal or turtle is within 500 metres of the vessel. The project is not inconsistent with the Significant Impact Guidelines for threatened species.	
EP Act General Environmental Duty • AC6: The project will be managed to prevent pollution from routine and/or accidental discharges to the marine environment	Routine discharges will be intermittent, of no or low toxicity and of low volumes, with the discharges predicted to mix rapidly with the surrounding waters returning to a pre-impacted state without any long-term impacts to water quality. Routine discharges will be managed using standard industry protocols (i.e. MARPOL) and an the implementation of an additional measure of no routine discharges near sensitive receptors to ensure no impact. The project is not inconsistent with the General Environmental Duty under the EP Act.	

Significant Impact Guidelines (migratory species)

- **AC7:** The project will not have a significant impact on Migratory Species as defined in the MNES Significant Impact Guidelines 1.1.

Routine discharges will be intermittent, of no or low toxicity and of low volumes, with the discharges predicted to mix rapidly with the surrounding waters returning to a pre-impacted state without any long-term impacts to water quality. Impacts are not predicted to occur to marine mammals or turtles or their prey. Routine discharges will be managed using standard industry protocols (i.e. MARPOL). An additional measure of no routine discharges near sensitive receptors, including within the southern right whale BIA (between May to September), has been adopted to ensure no impact. The project is not inconsistent with the Significant Impact Guidelines for migratory species.

Significant Impact Guidelines (Commonwealth marine areas)

- **AC8:** The project will not have a significant impact on Commonwealth Marine Areas as defined in the MNES Significant Impact Guidelines 1.1.

Routine discharges will be intermittent, of no or low toxicity and of low volumes, with the discharges predicted to mix rapidly with the surrounding waters returning to a pre-impacted state without any long-term impacts to water quality. Routine discharges will be managed using standard industry protocols (i.e. MARPOL). An additional measure of no routine discharges near sensitive receptors, including AMPs, State MPAs and the SRW reproduction (between May to September), has been adopted to ensure no significant impacts to marine mammals or turtle habitats. The project is not inconsistent with the Significant Impact Guidelines for Commonwealth Marine Areas.

8.3 Seabed disturbance and sediment plumes (MMT-I003)

8.3.1 Project activities

Wind farm construction activities typically cause small-scale disturbances to benthic habitat and the re-suspension of sediments. The resulting sediment plume in the water column may result in temporary and localised impacts to marine mammals and turtles, depending on sediment type, extent of disturbance, frequency / duration of the activity, and construction methods used (Bergström et al., 2013). Sediment type determines the extent of sediment plumes as coarser sediments typically resettle quickly after disturbance (within hours), while finer sediments can remain suspended in the water column for days. Sediment types across the OWFA range from fine sand to gravelly sands and sandy gravels, with a pattern of fine sands in the north-east of the OWFA, transitioning to coarser, gravelly sands and sandy gravels in the south-west.

Construction activities that may cause disturbance to benthic habitat and create a sediment plume in the water column can be grouped into four main categories:

- Seabed preparations: boulder clearance, pre-lay grapnel run, seabed levelling and sand wave clearance
- Vessel activities: deployment of jack-up vessel legs and anchoring
- Cable installation: trenching installation of subsea cables and HDD shore crossing
- Foundation drilling (should it be required due to piling refusal).

8.3.2 Impact assessment

The potential impacts from seabed disturbance and sediment plumes that are relevant to population-level assessment are:

- Disruption to migration, breeding and / or feeding events within the area affected by project activities

- Alteration of foraging behaviour
- Decrease in abundance within the project area
- Decline in species diversity within the project area.

Cable installation (including HDD) and drilling (for pile refusal) are the major source of suspended sediment plumes during construction activities. Sediment dispersion and suspension modelling was conducted to determine the potential influence of trenching and drilling on the marine environment with the results discussed in Technical Report B: Benthic Ecology. The results showed the spatial extent of plumes resulting from drilling are considerably greater than those resulting from subsea cable trenching. However, seabed disturbance and sediment plumes arising from all other activities during the construction period also have potential to contribute to increased suspended sediment concentrations and turbidity, though not at the same scale.

Instantaneous suspended sediment concentrations due to drilling were highest nearest to the sea surface, due to drilled material being transported via a riser and discharged overboard the drilling rig at the sea surface, though elevated suspended sediment concentrations were evident across the full water column. Due to the intensity of the initial concentration of suspended sediment at the drilling discharge point, it took several tidal cycles for the plume to dissipate below the reporting thresholds. Suspended sediment concentrations of five milligrams per litre were observed to a maximum distance of approximately 9.5 kilometres, encompassing a swept area of approximately 16.6 square kilometres. This area represents the estimated effects distance, which could potentially affect Australian fur seals that are predominantly benthic foragers on the continental shelf in Bass Strait. Due to the release being at the water surface the full water column is exposed to elevated suspended sediment concentrations until the plume dissipates below reporting thresholds.

Modelling of sediment dispersal due to trenching, for the construction of both the export cable and inter-array cable, showed suspended sediment concentrations were generally highest near the seabed, closest to the source of disturbance. For export cable trenching, suspended sediment concentrations within resulting plumes were uniform throughout the water column in shallower water but constrained to the bottom 10 metres of the water column in deeper water (greater than 15 metres). Suspended sediment concentrations of five milligrams per litre were observed to a maximum distance of approximately 0.7 kilometres, encompassing a swept area of approximately 5.1 square kilometres. For the subsea cable trenching, suspended sediment concentrations were consistently constrained to the bottom ten metres of the water column, though this is likely a reflection of deeper bathymetry at the modelled site (greater than 15 metres). Suspended sediment concentrations of five milligrams per litre were observed to a maximum distance of approximately 0.3 kilometres, encompassing a swept area of approximately 0.7 square kilometres. Due to the low level of initial suspended sediment concentrations resulting from the subsea cable trenching, plumes dissipated below the reporting thresholds within hours in both scenarios (see Technical Report B: Benthic Ecology for full discussion of modelling results), resulting in lower overall potential for impact to marine mammals and turtles.

For most marine mammal and turtle species these impacts are not expected to be significant because they and their habitat are typically widespread. Species that are likely to be most impacted are benthic foragers, including the Australian fur seal, loggerhead turtle and green turtle. Fur seals locate prey using vision and senses on their whiskers, unlike other marine mammals (e.g. cetaceans) that use sonar systems (sound) to sense their environment and prey (Au et al., 2000). For this type of foraging behaviour, an increase in turbidity may decrease foraging efficiency if prey is more difficult to locate within the water column (Todd et al., 2015). Vision acuity in captive harbour seals (*Phoco vitulina*) was found to decrease substantially with increasing levels of turbidity (Weiffen et al., 2006). However, in darker waters seals are able to locate prey using sensitive long whiskers (vibrissae) on their snout, allowing them to detect motion in the water and follow the movement of prey when vision is impaired (Adachi et al., 2022). Whilst literature is currently limited on how foraging ability is impacted due to seabed disturbance from offshore development, it is unlikely to have a substantial direct impact on marine mammals that are able to utilise other forms of foraging techniques (Todd et al., 2015).

The impact of seabed disturbance and sediment plumes on marine turtles is relatively unknown with few studies addressing the issue in scientific literature. However, with increasing offshore developments, the impact to marine turtle health and behaviour is fundamental in providing appropriate mitigation strategies. The literature that does exist has found a change in marine turtle movement and dive behaviour, with individuals undertaking longer and deeper dives during offshore construction activities (Whitlock et al., 2017). The same study found no indication of injury or mortality during construction activities, noting the mitigation measures in place likely prevented this consequence from occurring. It is also worth noting, that

due to the current lack of data on the impact of seabed disturbance and sediment plumes on marine turtles, it is encouraged that development projects consider tracking threatened or migratory species during different stages of the project, as well employing marine fauna observers, to quantify behaviour change and habitat use to better inform future environmental impact assessments to ensure the conservation of such species (Whittock et al., 2017).

The recovery plan for marine turtles in Australia (Commonwealth of Australia, 2017a) outlines the potential of habitat modification (e.g. increased turbidity and sedimentation) from offshore development activities to displace marine turtles from important foraging locations, resulting in reduced fitness and reproductive output (Shimada et al., 2016). While there are no foraging BIAs for marine turtles within the Bass Strait, south-east Australia is noted as a potential foraging hotspot for the leatherback turtle (Hays et al., 2023). Given the low productivity of the OWFA compared to waters further offshore, it is unlikely that leatherback turtles will be foraging inside the OWFA on a regular occurrence. In addition, leatherback turtles forage mainly on gelatinous zooplankton within the water column (Dodge et al., 2014), while loggerhead and green turtles are predominantly benthic foragers feeding on benthic invertebrates (loggerhead turtle) (DoE, 2025), seagrasses and algae (green turtle) (Arthur et al., 2007). Any impacts on marine turtles due to seabed disturbance is likely to be localised to the operational area and at a small scale (Kraus et al., 2019).

In the United Kingdom, studies have looked at the impact of coastal development on local delphinid populations. The results indicate a clear avoidance and displacement of dolphins from foraging areas when construction activities are taking place (Pirotta et al., 2013). It is unclear, however, the exact stimulus behind the response, indicating that disturbance may be due to increase vessel activities, noise emissions or seabed disturbance. Dolphins exhibit plasticity in their foraging behaviours (Shane, 1990), indicating the ability of delphinids to adapt to their environment. In Florida, bottlenose dolphins purposefully create sediment plumes while foraging to disturb the seabed floor and concentrate prey in sediment plumes (Lewis and Schroeder, 2003). While delphinid species do not have specific recovery or management plans, there are numerous policy statements and guidelines outlining management for such species (Commonwealth of Australia, 2017c; DCCEW, 2023). Habitat degradation through anthropogenic disturbances is outlined as a threat to delphinid species, particularly those occurring with narrow habitat niches. However, as project activities will only occur in a small portion of the OWFA at any one time, the impact of seabed disturbance and sediment plumes on dolphin species is likely to be low.

Receptor species have been assessed and divided by foraging behaviour, with benthic foragers being assessed as more sensitive (Medium) to seabed disturbance and sediment plumes than other foraging behaviours (Low). Mysticetes are unlikely to be impacted by seabed disturbance and sediment plumes due to their foraging ecology. The most likely impact for these groups of species is indirect through changes in prey distribution and abundance, which is discussed in Section 8.5.

8.3.3 Mitigation measures

Standard industry management practices will apply to seabed disturbance as provided in Table 7-3. No additional mitigation measures are considered necessary because the consequence for this impact pathway is Negligible.

8.3.4 Residual impacts

The residual impacts to marine mammal and turtle receptor groups following implementation of initial mitigation measures is Negligible for odontocetes, pinnipeds, marine turtles (Table 8-34).

Table 8-34: Consequence associated with seabed disturbance and sediment plumes during the construction phase

Potential Impact	Receptor	Receptor sensitivity	Initial consequence	Additional mitigation	Consequence
Reduced water quality leading to changes in fauna behaviour / health	Odontocetes – dolphins Pinnipeds – Australian fur seal Marine turtles	Low	Negligible (E) (Magnitude = Negligible)	N/A	Negligible (E) (Magnitude = Negligible)

8.3.5 Evaluation of residual risks against assessment criteria

Table 8-35 contains an evaluation of the residual impacts of seabed disturbance and increased turbidity to marine mammal and turtle receptor groups against the assessment criteria defined for the project (refer Section 0). The residual impacts associated with seabed disturbance impacts during construction of the project do not exceed any of the defined assessment criteria and there is a high degree of confidence in these predictions (Table 5-8).

Table 8-35: Evaluation of residual impacts against assessment criteria for seabed disturbance and sediment plumes during the construction phase

Assessment criteria	Evaluation	Confidence/ uncertainty
Principles of ESD • AC1: Biological diversity and productivity of the environment is not compromised because of the project.	Seabed disturbance and increased suspended sediment concentrations resulting from the project will be short-term in duration and localised in the context of the range over which marine mammals and turtles forage. The associated impacts are unlikely to affect biological diversity and productivity, with limited to minor disruption of individual foraging marine mammals and turtles predicted, namely benthic foragers, within the vicinity of project activities. No impact on breeding success or the survival of individuals is predicted. The project is not inconsistent with the Principles of ESD.	High confidence • Localised spatial extent, intermittent and medium-term duration of effect. • Limited to a small proportion of the total OPA at any one time and expected that marine mammals and turtles in the vicinity of these activities will be affected directly and are expected to return to the area once the activity has ceased. • Large foraging ranges for benthic and pelagic foraging species (e.g. fur seals, marine turtles, blue whales).
Significant Impact Guidelines (threatened species) • AC4: The project will not have a significant impact on Threatened (Endangered and Vulnerable) Species as defined in the MNES Significant Impact Guidelines 1.1.	Seabed disturbance and increased suspended sediment concentrations resulting from the project will be localised in the context of the range over which marine mammals and turtles forage and short-term in duration. The associated impacts are unlikely to interfere with the recovery of species, with limited to minor disruption of foraging marine mammals and turtles, namely benthic foragers, within the vicinity of project activities. No impact on breeding success or the survival of individuals is predicted. The project is not inconsistent with the Significant Impact Guidelines for threatened species.	
Significant Impact Guidelines (migratory species) • AC7: The project will not have a significant impact on Migratory Species as defined in the MNES Significant Impact Guidelines 1.1.	Seabed disturbance and increased suspended sediment concentrations resulting from the project will be localised in the context of the range over which marine mammals and turtles forage and short-term in duration. The associated impacts are expected to be negligible, with limited to minor disruption of foraging marine mammals and turtles, namely benthic foragers, within the vicinity of project activities for the period of occupancy (days to weeks). No impact on breeding success or the survival of individuals is predicted to occur. The project is not inconsistent with the Significant Impact Guidelines for migratory species.	
Significant Impact Guidelines (Commonwealth marine areas) • AC8: The project will not have a significant impact on Commonwealth Marine Areas as defined in the MNES Significant Impact Guidelines 1.1.	Seabed disturbance and increased suspended sediment concentrations resulting from the project will be localised, within the vicinity of project activities. It is expected that water quality within foraging habitat for marine mammals and turtles will be affected. These effects are expected to be short-term in duration, with any plumes generated predicted to dissipate within several tidal cycles once the activities have been completed and no measurable long-term impacts on habitat. The project is not inconsistent with the Significant Impact Guidelines for Commonwealth Marine Areas.	

8.4 Artificial light emissions (MMT-I004)

8.4.1 Project activities

During construction, artificial light will be present within the marine environment from the following sources / activities within the marine environment:

- Vessels – during transit to and from port and whilst undertaking construction activities, either moving (e.g. cable burial) or stationery (e.g. WTG installation)
- Temporary cardinal and special marks around the perimeter of the OWFA or part of the windfarm where construction is ongoing, to indicate a construction area. Cardinal markers indicate the direction of safe water
- Temporary navigational safety lighting installed on partially constructed infrastructure that is present above the water.

Lighting and other markings are incorporated in accordance with wind farm operational requirements, and aviation and marine navigation safety regulations, as listed in Section 7.1.

8.4.2 Impact assessment

The *National Light Pollution Guidelines for Wildlife* (DCCEEW, 2023) outlines the process to be followed where there is the potential for artificial lighting to affect wildlife. The aim of the guidelines is that artificial light is managed so wildlife is:

- Not disrupted within, nor displaced from, important habitat
- Able to undertake critical behaviours such as foraging, reproduction and dispersal (Commonwealth of Australia, 2023).

The guidelines recommend undertaking a light impact assessment where important habitat for listed species sensitive to light are located within 20 kilometres of the light source. Important habitats are those areas necessary for an ecologically significant proportion of a listed species to undertake important activities such as foraging, breeding, nesting, or migration. The 20-kilometre threshold provides a precautionary limit based on identified effects of skyglow on marine turtle hatchlings, observed to occur at 15 to 18 kilometres away (Commonwealth of Australia, 2023). Subsequently, the 20-kilometre light buffer around the OWFA is highly conservative.

Vessels are a dynamic source of light pollution in the marine environment, often brightly lit and temporarily increasing light levels in otherwise relatively dark areas (Austad et al., 2023). However, there are no important habitats for marine turtles (i.e. nesting beaches) in proximity to the OWFA, and their presence in the OWFA and surrounding waters is expected to be limited to highly occasional transient individuals. A single leatherback and a single loggerhead turtle were observed during the 24-month baseline survey program (Appendix A). Therefore, marine turtles are unlikely to be affected by artificial light emissions from the project activities.

8.4.3 Mitigation measures

Navigational warning lighting for vessels is required for compliance with *Prevention of Collisions Convention* (Marine Order 30) and the *Navigational Safety Act 2012*. Any steady light sources used on vessels will be managed in compliance with relevant COLREGS, the International Convention for the Safety of Life at Sea (SOLAS) and the *National Light Pollution Guidelines for Wildlife* (e.g. directional and shielded lights).

Standard industry vessel management practices will apply to artificial light emissions as provided in Table 7-3. No additional mitigation measures are considered necessary because the consequence for this impact pathway is Negligible.

8.4.4 Residual impacts

The residual impacts to marine turtles following implementation of initial mitigation measures is Negligible (Table 8-36).

Table 8-36: Consequence associated with artificial light emissions during the construction phase

Potential Impact	Receptor	Receptor sensitivity	Initial consequence	Additional mitigation	Residual Consequence
Change in fauna behaviour	Marine turtles	Low	Negligible (E) (Magnitude = Negligible)	VES-M01 LIT-M01	Negligible (E) (Magnitude = Negligible)

8.4.5 Evaluation of residual impacts against assessment criteria

Table 8-37 presents the evaluation of the residual impacts of artificial light emissions on marine mammal and turtle receptor groups against the assessment criteria defined for the project (refer Section 0). The residual impacts associated with this impact pathway do not exceed any of the defined assessment criteria and there is a high degree of confidence in these predictions (Table 5-8).

Table 8-37: Evaluation of residual impacts against assessment criteria

Assessment criteria	Evaluation	Confidence/uncertainty
Principles of ESD AC1: Biological diversity and productivity of the environment is not compromised because of the project.	Artificial light emissions are to be localised, intermittent and short-term duration. Whilst habitat within the OWFA and surrounds will be affected by artificial light emissions, few marine mammals are sensitive to these effects. Regarding marine turtles, who are sensitive to artificial light particularly at early life stages, the absence of sensitive habitat in combination with their occasional and transient occurrence within the OWFA indicates they're unlikely to be impacted by artificial light emissions. Therefore, biological diversity and productivity will not be affected. Notwithstanding, the precautionary approach is applied and any artificial light emissions will be managed using standard industry protocols (i.e. COLREGS and in accordance with the National Light Pollution Guidelines for Wildlife). The project is not inconsistent with the Principles of ESD.	High confidence - Absence of sensitive habitats (i.e. nesting beaches for marine turtles) - Occasional, transient occurrence of sensitive species (i.e., marine turtles) within the OWFA. - All project vessels and structures (e.g. WWTs, OSS') will meet relevant legislative requirements for the safety of navigation.
Significant Impact Guidelines (threatened species) AC4: The project will not have a significant impact on the environment as defined in the MNES Significant Impact Guidelines 1.1 for Threatened (Endangered and Vulnerable) Species.	Artificial light emissions are identified as a key threat for some threatened species, such as marine turtles, whilst few marine mammals are sensitive to these effects. Artificial light emissions generated by the project activities are expected to be localised, intermittent and short-term duration (nighttime only) and will be managed using standard industry protocols (i.e. COLREGS and the National Light Pollution Guidelines for Wildlife). They will not interfere with the recovery of a species. Given there are no important marine turtle habitats within or surrounding the OWFA, and the occasional, transient presence of marine turtles within the OWFA, artificial light emissions will not cause significant impacts to any marine mammals or turtles, with no impact to breeding success or the survival of individuals. The project is not inconsistent with the Significant Impact Guidelines for threatened species.	
Significant Impact Guidelines (migratory species) AC7: The project will not have a significant impact on the environment as defined in the MNES Significant Impact Guidelines 1.1 for Migratory Species.	Artificial light emissions are identified as a key threat for some migratory species, such as marine turtles, whilst few marine mammals are sensitive to these effects. Artificial light emissions generated by the project activities are expected to be localised, intermittent, short-term duration (nighttime only) and, for migratory species, limited to the period of occupancy (nighttime only, across days to weeks). They will also be managed using standard industry protocols (i.e. COLREGS and the National Light Pollution Guidelines for Wildlife). Given there are no important marine turtle habitats	

Assessment criteria	Evaluation	Confidence/uncertainty
	within or surrounding the OWFA, and the occasional, transient presence of marine turtles within the OWFA, artificial light emissions will not cause significant impacts to any marine mammals or turtles, with no impact to breeding success, the survival of individuals or species distribution. The project is not inconsistent with the Significant Impact Guidelines for migratory species.	
Significant Impact Guidelines (Commonwealth marine areas) • AC8: The project will not have a significant impact on the environment as defined in the MNES Significant Impact Guidelines 1.1 for Commonwealth Marine Areas	Artificial light emissions are to be localised, intermittent and short-term duration and will be managed using standard industry protocols (i.e. COLREGS and the National Light Pollution Guidelines for Wildlife. Whilst habitat within the OWFA and surrounds will be affected by artificial light emissions; few marine mammals are sensitive to these effects. Regarding marine turtles, who are sensitive to artificial light particularly at early life stages, the absence of sensitive habitat in combination with their occasional and transient occurrence within the OWFA indicates they're unlikely to be impacted by artificial light emissions, with no impact to biodiversity or ecological function/integrity. The project is not consistent with the Significant Impact Guidelines for Commonwealth Marine Areas.	

8.5 Changes in prey distribution and abundance (MMT-I007)

Indirect impacts of wind farm construction on marine mammal and turtle species are complex and not well covered in scientific literature. However, studies relating to the direct impacts of offshore industrial development on prey species is more numerous. Generally, offshore developments can cause a reduction in species biomass, abundance, and biodiversity (Todd et al., 2015). Depending on activity type, local geological and environmental conditions and species, changes in prey distribution and abundance will vary in temporal scale. Marine mammals and turtles are likely to respond to small-scale changes by moving to alternate or nearby foraging grounds, changing predominant prey species and / or increasing time spent foraging (Nøttestad et al., 2015, Speakman et al., 2020, Todd et al., 2015, Webster et al., 2024). However, this is highly species specific and will depend on adaptability, foraging ecology and population size and location (Todd et al., 2015).

Marine mammal and turtle prey species include krill and other invertebrates (including benthic invertebrates) and pelagic fish species (e.g. baitfish). Changes to prey distribution and abundance can occur due to a number of reasons, including but not limited to habitat degradation, noise levels, toxins and pollutants (e.g. a change in water quality from planned or accidental discharges), and seabed disturbance and sedimentation (Barnes et al., 2019, Last et al., 2011, Weilgart, 2018). Potential impacts to prey species during construction of the project range from short-term behavioural change to direct or indirect mortality (Thomsen et al., 2006).

Small spatial and temporal changes that have the ability to impact prey distribution and abundance are unlikely to have significant consequences to marine mammal and turtles (Todd et al., 2015). However, large-scale and repeated disruptions have the potential to have substantial impacts that affect the entire food web (Todd et al., 2015). Impacts are dependent on a range of factors including the source of impact, location and life history stage of individual prey species at the time of impact. In addition, it is highly species specific, depending on species biological and ecological characteristics (including foraging ecology).

8.5.1 Project activities

The following identified hazards during the construction phase were identified as potential impacts to prey species (Technical Report C: Fish and Invertebrate):

- Underwater noise emissions
- Habitat change resulting from installation of project infrastructure
- Seabed disturbance and sediment plumes, particularly during installation of transmission cables

- Light emissions and routine discharges from project vessels
- Accidental hydrocarbon release from collision of a project vessel.

The impacts on prey species will depend on the type, location and timing of construction activity (Todd et al., 2015). For example, trenching to install subsea infrastructure will impact all marine organisms associated with the seabed, however, benthic fauna and demersal fish that strongly associated with bottom substrates are at a higher risk of disturbance compared to highly mobile species (Todd et al., 2015). Therefore, predators that are benthic foragers are those most likely be impacted from this activity. In addition, construction activities undertaken in spawning areas, breeding grounds or habitats where young fish, eggs or larvae are likely to occur can impact the survival rate of organisms and therefore the population structure and growth of prey species (Drabble, 2012).

8.5.2 Impact assessment

8.5.2.1 Summary of potential impacts to prey species

8.5.2.1.1 Underwater noise emissions

Underwater noise emitted during pile driving could result in localised mortality (within 30 metres) or recoverable injury (within 60 metres) to fish species, or temporary threshold shift at greater ranges of up to eight kilometres (Technical Report C: Fish and Invertebrates). Potential impacts from vessel noise would be overshadowed by pile driving activities, as ranges to recoverable injury (20 metres) and TTS (20 metres) from this source are much smaller (Technical Report C: Fish and Invertebrates). Bony fish, a prey item of fur seals, with a swim bladder are most susceptible to noise emissions, as are site-attached fish assemblages rather than mobile species. Recoverable injuries are unlikely to cause mortality, however individual fish may be more susceptible to other causes of mortality during recovery, for example through a decreased capacity to avoid predators. For mobile fish the main effects of noise emissions would be a behavioural response, which may include changes in swimming behaviour and orientation, startle reactions and altered schooling patterns and distribution. Noise levels that are low enough not to cause a behavioural response may cause auditory masking or interference with detection of biologically important sounds (e.g. courtship). While it is likely that the abundance of fish species may decrease during the construction phase, the consequence to their populations would be negligible (Technical Report C: Fish and Invertebrates).

Phytoplankton and zooplankton as well as the eggs, larvae and pre-settlement juveniles of many bony fish and invertebrate species form the basis of marine food webs providing prey species to top predators like marine mammals and turtles. Impacts of noise emissions on plankton include direct mortality, developmental abnormalities, decreased growth rates and delays in metamorphosis and settlement (Hawkins et al., 2017; Weilgart, 2018). Nevertheless, in considering the potential impacts at a broader spatial scale, primary productivity within the project area is low relative to localised areas of high productivity such as the Eden Upwelling in the north Gippsland. These areas support secondary production of zooplankton, and the EAC and local-scale currents play an important role in replenishment of fish populations regionally (Kelly et al., 2016; VEAC, 2019). Therefore, based on the low level of planktonic biomass exposed to noise emissions and capacity for replenishment, the consequence of noise emissions to plankton are expected to be localised and short-term, with minor population level effects.

8.5.2.1.2 Electromagnetic interference

Electromagnetic fields (EMF) are generated by the flow of current passing through power cables from both electric and magnetic fields. The level of electromagnetic interference (EMI) (i.e. the interference arising from emitted electromagnetic fields) produced from the cable depends on a variety of design and installation factors including current flow, type of current (AC vs DC), distance between cables, cable insulation, number of conductors, configuration of cable and burial depth (Taormina et al., 2018).

EMI will be emitted by the projects subsea cables. A full understanding of the effects of EMI on marine mammal prey species is uncertain, though it is possible that site-attached fish may be unable to recolonise areas previously disturbed or lost during installation of the cable in the construction phase. As cables are buried it is likely that very little habitat would be affected. While the response of benthic invertebrates to EMI may reduce the health of individuals, given the broad distributions of these species' populations, consequences are expected to be negligible. Benthic fish may habituate to EMI over time, and the drive for prey is likely to override possible minor behavioural responses, and therefore potential behavioural effects of

EMI are not expected. Refer to Technical Report C: Fish and Invertebrates for further detail on the impacts of EMI on marine mammal prey species.

While the impacts of EMI on marine mammal prey species is considered in detail during the operations phase, prior to burial of the subsea cables it will be necessary to undertake a series of electrical and operational tests to ensure their integrity and performance. This may include insulation resistance testing, partial discharge monitoring and thermal performance assessments. To safeguard the exposed cables protection measures, including temporary cable coverings, exclusion zones and / or active monitoring will be implemented. Following this testing, the cables will be buried to the design depth (refer Table 7-1) in preparation for the operation phase.

8.5.2.1.3 Habitat change

Installation of project infrastructure including WTG and OSS foundations, scour protection and cable protection (rock armour or concrete mattresses) may result in the loss of approximately three-square kilometres of sediment-based habitat to be replaced with hard-substrate habitat (Technical Report B: Benthic Ecology). For fish species that rely on sediment-based habitats the impacts may be negative through the reduction in available habitat and possible barriers to movement, although for many other species, in particular generalist feeders and higher trophic level species, the change in habitat may be beneficial (i.e. increased abundance of prey species) (Technical Report C: Fish and Invertebrates). For example, wind farms in the North Sea have been shown to trigger the growth of blue mussel populations on WTGs that now provide a large available food source, previously non-existent, which attract fish and crabs, and in turn sea turtles and marine mammals (NYSERDA, 2017).

There are also expected to be hydrodynamic changes resulting from modification of wind fields and water flow around or across installed structures. Hydrodynamic changes may affect the distribution of baitfish and plankton (Technical Report C: Fish and Invertebrates), potentially impacted higher order predators like mysticetes whales that feed on zooplankton and baitfish. However, given the size of the OWFA relative to the broader Gippsland area, the broad distribution of these species and natural high rates of planktonic mortality and turnover, population-level impacts are expected to be negligible (Technical Report C: Fish and Invertebrates).

8.5.2.1.4 Seabed disturbance and sediment plumes

It is expected that installation of subsea cables inclusive of their shore crossing would be the main source of seabed disturbance and sediment plumes during the construction period, with the contribution of all other activities being insignificant in comparison. Seabed disturbance is likely to result in mortality of sessile and low mobility organisms (including small crustaceans, polychaetes, molluscs and echinoderms) within the disturbance area (Technical Report B: Benthic Ecology). These species are prey to fish species of conservation importance and themselves are prey to larger marine predators including marine mammals. However, it is expected that this loss of biota would be insignificant and temporary as species are expected to recolonise disturbed areas after installation activities have ceased. Larger crustaceans (e.g. crabs), octopus species, and bivalves (e.g. scallops) have some capacity to move away from disturbance activities and therefore avoid direct mortality (Technical Report C: Fish and Invertebrates).

Impacts of suspended sediments on biota include shading of seagrass, clogging of feeding and respiration organs in filter feeders and a decrease in fertilisation, larval survival, and settlement of benthic site-attached organisms, thereby impacting higher order predators such as bony fish, which are prey of fur seals (Vaselli et al., 2008; Deagle et al., 2009). Benthic fauna are generally adapted to minor, temporary increases in suspended sediments. While there is potential for individuals to be adversely impacted, only minor population-level effects are expected (Technical Report C: Fish and Invertebrates). Suspended sediment in the water column can cause physiological stress and injury to non-benthic fish; however, individuals are sufficiently mobile to move away from plumes and therefore impacts may only occur in exceptional circumstances (Technical Report C: Fish and Invertebrates).

8.5.2.1.5 Light emissions and routine discharges from project vessels

Responses of fish to artificial light emissions vary greatly between species and are influenced by both their biological and ecological characteristics, as well as the type of lighting (for example intensity, colour and duration). Squid and various planktonic organisms are attracted to artificial light, which may lead to increased predation rates, and / or temporary disruptions in diel vertical migrations (Technical Report C: Fish and

Invertebrates). Cephalopods are prey species to various marine mammals and turtles, including dolphins, fur seals, loggerheads, leatherbacks and green turtles (Deagle et al., 2009; Owen et al., 2011; Commonwealth of Australia, 2017a). the impacted area would generally be confined to the surface layer in close proximity to each vessel and temporary because the vessels would not be stationary for extensive periods (up to four hours per location during piling operations), therefore, impacts to prey distribution and abundance would likely be undetectable at the population level (Technical Report C: Fish and Invertebrates).

Routine discharges of food waste can cause temporary localised nutrient enrichment near the surface waters close to the discharge, which has the potential to influence plankton abundance (Technical Report C: Fish and Invertebrates). Fish in the immediate vicinity of the discharge may experience behavioural or physiological changes such as temporary avoidance or attraction, temporary stress, depending on the species. However, given the small volumes of discharge, rapid dispersion and localised effects, impacts are likely to be negligible (Technical Report C: Fish and Invertebrates).

8.5.2.1.6 Accidental hydrocarbon release from collision of a project vessel

In the event of an accidental hydrocarbon release, most of the spilled oil is buoyant and therefore fish living in the water column or on the seabed will typically only have limited exposure to hydrocarbons and are able to move away from the area to avoid direct contact. However, if the spill enters shallow or confined waters the impacts to fish, particularly shellfish and other immobile species, can be considerable. Phytoplankton and zooplankton, which make up different trophic levels for higher predators like cetaceans, are generally resilient to the impacts of an accidental hydrocarbon release at the community-level despite being highly vulnerable at the individual level (Murawski et al., 2021; Technical Report C: Fish and Invertebrates).

8.5.2.2 Summary of potential impact on marine mammals and turtles

8.5.2.2.1 Blue whale

Blue whales feed almost exclusively on krill (Gill, 2002; Guilpin et al., 2019). The OWFA is within a blue whale 'foraging' BIA, and both East Indian Ocean (EIO) pygmy blue whale and New Zealand (NZ) pygmy blue whale vocalisations were detected in acoustic recordings during the MESP baseline survey. In addition, one blue whale was visually sighted just outside the OWFA, mostly likely being that of a pygmy blue whale (Appendix A). The OWFA and surrounding waters have relatively low productivity with negligible influence from surrounding upwelling areas (Huang and Wang, 2019), and therefore it is unlikely that pygmy blue whales or ABW would forage in the area. Further to this, all detections of pygmy blue whale song (both populations) in underwater noise recordings collected during the MESP were for short periods only, a few hours to days, and there was no evidence that either sub-species persisted in the area and were engaged in feeding (Appendix A). The OWFA and surrounding waters are not likely to provide foraging habitat for blue whales. However, as the OWFA is within a BIA of 'foraging' for the blue whale this species is included in the impact assessment for this pathway.

8.5.2.2.2 Southern right whale

Southern right whales (southern right whales) primarily feed on planktonic species (e.g. krill), though may also feed on small schooling baitfish. They occupy waters off the southern Australian coastline predominantly during the months of May to November to calve, mate and rest, and are not known to feed while in Australian waters. The OWFA and surrounding waters are not likely to provide foraging habitat for southern right whales and therefore this species is not included in the impact assessment for this pathway.

8.5.2.2.3 Humpback whale

Humpback whales primarily feed on planktonic species (e.g. krill), though may also feed on small schooling baitfish. Humpback whales were observed feeding on 14 occasions during the MESP baseline survey, including five feeding events on krill, one feeding event on baitfish and eight feeding events on unidentified prey species (Appendix A). An additional seven 'possible feeding' events were observed (Appendix A). Opportunistic feeding by eastern Australian humpback whales during their southbound migration while still in Australian waters has been recorded since 1996 (Gill et al., 1998; Owen et al., 2017; Pirota et al., 2021) and may be a common strategy for these whales (Eisenmann et al., 2016). All humpback whale feeding events recorded during the MESP were sighted outside of the OWFA (Appendix A).

The OWFA and surrounding waters may provide habitat for opportunistic feeding by humpback whales. Therefore, changes in prey distribution and abundance may affect feeding humpback whales, however, given the broad distribution of prey species any change in their distribution and abundance in the OWFA is likely to have a negligible impact.

8.5.2.2.4 Other mysticetes

Smaller mysticetes such as Antarctic minke whale, dwarf minke whale and Bryde's whale feed on planktonic species (e.g. krill, copepods, and crabs) and small schooling baitfish. Antarctic minke whales predominantly feed on Antarctic krill in the Southern Ocean, with very little consumption of Australian krill and baitfish species (Uchida et al., 2021). Consequently, it is highly unlikely that Antarctic minke whales would feed in the OWFA and surrounding waters, therefore this species is not included in the impact assessment for this pathway.

Birtles et al. (2015) found that dwarf minke whales spent considerable time (greater than 1.5 weeks) moving around the Bass Strait during their southern migration, potentially foraging. A single dwarf minke whale sighted in April during the MESP baseline survey was observed feeding on surface krill swarms (Appendix A), indicating they may also opportunistically feed on their northern migration to breeding grounds.

Bryde's whales occur exclusively in temperate to tropical waters and therefore must forage in these less productive waters (Bannister, 2018). A single Bryde's whale was sighted during the MESP, possibly feeding on baitfish, although they were not seen near the whale (Appendix A). As the OWFA does not represent an important foraging habitat for these species, only foraging here opportunistically, these species were assessed having a 'low' sensitivity to this impact pathway.

The OWFA and surrounding waters are not likely to provide foraging habitat for Antarctic minke whales, pygmy right whales, fin whale or sei whale, though may provide habitat for opportunistic feeding by dwarf minke whales and Bryde's whales. The distribution of baitfish and plankton in the OWFA may be affected during construction of the project due to underwater noise emissions, habitat change and sediment plumes. Routine discharge of food waste may temporarily increase nutrients at localised areas with the OWFA, thereby increasing plankton abundance, while light emissions could act to attract various planktonic organisms. Changes in prey distribution and abundance may affect feeding mysticetes, however, given the broad distribution of plankton and baitfish species, any change in their distribution and abundance in the OWFA is likely to have negligible impact.

8.5.2.2.5 Odontocetes – dolphins

Odontocete (dolphin) species, such as killer whales and smaller dolphins (e.g. bottlenose and common dolphins) predominantly feed on epipelagic (upper ocean zone) schooling and mesopelagic (middle ocean zone) teleost fishes, squids and other cephalopods, crustaceans and other benthic invertebrates. Two, possibly three, killer whales were sighted during the MESP baseline survey (Appendix A), though none were observed feeding.

Bottlenose and common dolphins were present in all months of the year during the MESP baseline survey and were reported feeding in 13 and 23 per cent of sightings, respectively (Appendix A). Two 'like striped dolphins' were recorded during the MESP, reportedly feeding amongst a group of common dolphins (Appendix A). Common, bottlenose and striped dolphins primarily feed on schooling teleost fishes including sardines, anchovies, pilchards and mackerel, though bottlenose dolphins and striped dolphins may also occasionally feed on squid and small crustaceans (e.g. crabs).

The OWFA and surrounding waters are not known to provide critical foraging habitat for dolphin species, though dolphins were observed feeding during the MESP. The distribution of baitfish in the OWFA may be affected during construction of the project due to underwater noise emissions, habitat change and sediment plumes. Fish abundance may decrease in the event of introduction of IMS due to increased competition or increase as a result of installation of project infrastructure leading to aggregation of prey species. Squid may be attracted to artificial light sources providing increased foraging opportunity for some dolphin species. Changes in prey distribution and abundance may affect feeding dolphins, however, given the broad distribution of prey species (baitfish, squid, and crabs), any change in their distribution and abundance in the OWFA is likely to have negligible impact on foraging odontocetes.

8.5.2.2.6 Pinnipeds

Fur seals were present in all months of the year during the MESP baseline survey, either AUFS and / or NZFS (Appendix A). AUFS are benthic foragers and predominantly feed on a variety of bony fish and cephalopod species (octopus and squid). Tracking data indicate that AUFS from the Rag Island colony occur regularly throughout the OWFA and surrounding waters en route to foraging grounds in the north-east, while the OWFA and surrounding waters do not represent important foraging habitat for AUFS from Kanowna Island (Appendix A). NZFS are epipelagic foragers and predominantly feed on a variety of bony fish and squid species. A small number of NZFS from the Kanowna Island colony may be present in the OWFA and surrounding waters; however, the OWFA and surrounding waters do not represent important foraging habitat for these seals (Appendix A).

8.5.2.2.7 Marine turtles

Marine turtles predominantly feed on jellyfish, cephalopods (octopus and squid) and benthic invertebrates, as well as seagrass and algae. The Bass Strait is reportedly a foraging hotspot for leatherback turtles with one sighted during the MESP baseline survey, therefore they have been assessed as having a medium sensitivity to this impact pathway. The OWFA and surrounding waters are not likely to provide important foraging habitat for other marine turtle species, and consequently changes in prey distribution and abundance are not considered to impact for these species.

8.5.3 Mitigation measures

Standard industry management practices will apply to changes in prey distribution and abundance during construction as provided in Table 7-3. No additional mitigation measures are considered necessary because the consequence for this impact pathway is Negligible.

8.5.4 Residual impacts

The residual impacts to marine mammal and turtle receptor groups associated with a change in prey distribution and abundance during the construction following implementation of initial mitigation measures is Minor to Negligible (Table 8-38).

Table 8-38: Consequence associated with change in prey distribution and abundance during the construction phase

Potential Impact	Receptor	Receptor sensitivity	Initial consequence	Additional mitigation	Consequence
Reduced habitat and water quality leading to change in prey distribution and abundance (indirect impact)	Blue whale Humpback whale Odontocete – dolphins Marine turtles - leatherback	Medium	Minor (D) (Magnitude = Low)	N/A	Minor (D) (Magnitude = Low)
Reduced habitat and water quality leading to change in prey distribution and abundance (indirect impact)	Other mysticetes Pinnipeds	Low	Negligible (E) (Magnitude = Low)	N/A	Negligible (E) (Magnitude = Low)

8.5.5 Evaluation of residual impacts against assessment criteria

Table 8-39 presents the evaluation of the residual impacts of changes in prey distribution and abundance to marine mammal and turtle receptor groups against the assessment criteria defined for the project (refer Section 0). The residual impacts associated with this impact pathway do not exceed any of the defined assessment criteria and there is a high degree of confidence in these predictions (Table 5-8).

Table 8-39: Evaluation of residual impacts against assessment criteria for changes in prey distribution and abundance

Assessment criteria	Evaluation	Confidence / Uncertainty
Principles of ESD AC1: Biological diversity and productivity of the environment is not compromised because of the project.	Changes in prey distribution and abundance are expected to be localised. Given the broad distribution of key prey species, such as plankton and many bony fish and invertebrates, any change in their distribution and abundance in the OWFA is likely to have negligible impact on foraging marine mammals and turtles. Should they occur, impacts are expected to be short-term (days to weeks) with no impact on breeding success or the survival of individuals. Therefore, biological diversity and productivity will not be affected. The project is not inconsistent with the Principles of ESD.	High confidence - Absence of important foraging grounds within the OWFA for most species, as evidenced by the MESP baseline surveys. - Localised spatial extent of effect centred around the area of activity, with previous distribution patterns able to resume once activities are completed. - Large foraging ranges for benthic and pelagic species (e.g., fur seals, marine turtles, blue whales) coupled with broad distribution of key prey species (e.g., plankton and many bony fish and invertebrates).
Significant Impact Guidelines (threatened species) AC4: The project will not have a significant impact on the environment as defined in the MNES Significant Impact Guidelines 1.1 for Threatened (Endangered and Vulnerable) Species	Changes in prey distribution and abundance are expected to be localised. Given the broad distribution of key prey species, such as plankton and many bony fish and invertebrates, any change in their distribution and abundance in the OWFA is likely to have negligible impact on foraging marine mammals and turtles. The associated impacts are unlikely to interfere with the recovery of a species. Should they occur, impacts are expected to be short-term (days to weeks) with no impact on breeding success or the survival of individuals. The project is not inconsistent with the Significant Impact Guidelines for threatened species.	
Significant Impact Guidelines (migratory species) AC7: The project will not have a significant impact on the environment as defined in the MNES Significant Impact Guidelines 1.1 for Migratory Species	Changes in prey distribution and abundance are expected to be localised. Given the broad distribution of key prey species, such as plankton and many bony fish and invertebrates, any change in their distribution and abundance in the OWFA is likely to have negligible impact on foraging marine mammals and turtles. Should they occur, impacts are expected to be short-term (days to weeks) and, for migratory species, limited to the period of occupancy (days to weeks) with no impact on breeding success, the survival of individuals or species distribution. The project is not inconsistent with the Significant Impact Guidelines for migratory species.	
Significant Impact Guidelines (Commonwealth Marine Area) AC8: The project will not have a significant impact on the environment as defined in the MNES Significant Impact Guidelines 1.1 for Commonwealth Marine Areas	Changes in prey distribution and abundance are expected to be localised at the location of activity during construction. It is expected that prey species may move away from the area of activity, but could move back once activities have been completed. These effects are expected to be short-term (days to weeks) with no long term impacts on habitats of prey individuals or populations. The project is not inconsistent with the Significant Impact Guidelines for Commonwealth Marine Areas.	

9 CONSTRUCTION RISK ASSESSMENT – ACCIDENTS

9.1 Vessel strike (MMT-R001)

9.1.1 Existing vessel traffic

Vessel traffic within or adjacent to the OWFA includes commercial vessels travelling between major ports (within shipping channels), coastal trading vessels, vessels servicing oil and gas fields, commercial fishing vessels, tourism vessels (including charter fishing), recreational fishing vessels, other recreational vessels and survey vessels (for example oil, gas and offshore wind exploration).

The size and speed of vessels varies. Offshore support vessels (OSVs) are typically 50 to 100 metres in length and transit at speeds less than 12 knots. Commercial fishing vessels active in the area are typically 14 to 30 metres in length and transit less than 10 knots. Recreational fishing vessels are typically fast, small boats 5.5 to 7 metres in length, while charter vessels may be up to nine metres in length. Charter vessels typically transit at speeds of 20 knots or more given small seas. Daily passenger ferries transit between Tasmania and Melbourne, Devonport and Burnie, travelling at speeds of 15 to 20 knots (Spirit of Tasmania travels at around 28 knots). Bulk vessels transporting freight to and from Tasmania and the mainland typically travel at up to 12 knots.

OSVs regularly transit the OWFA en-route between BBMT / Port Anthony in Corner Inlet and the oil and gas installations in eastern Bass Strait (it is the most direct route). Within the offshore export cable area (OECA), commercial vessels transit from Corner Inlet to the oil and gas ATBA, with an average of one to two movements recorded from AIS per day (AMSA, 2021). Some of these vessels traveling to the oil and gas fields do transit through the OWFA as shown in Figure 9-1. Most existing oil and gas platforms and associated infrastructure are to be decommissioned in coming years (refer Section 14 for assessment of cumulative impacts). Future OSV traffic to maintain active infrastructure and decommissioning activities is expected to be similar to current levels.

Commercial fishing vessels currently operate (fish) within or transit through the OWFA en-route to or from local ports (such as Port Welshpool, Port Albert, Lakes Entrance). Fishing activity in the region including the OWFA is relatively low and it is likely that there is less than one commercial fishing vessel in the area on any given day.

Recreational fishing is a popular activity in the region and there are several recreational fishing charter operators active in the area. Marine mammal visual aerial surveys conducted in 2020 to 2021 sighted an average of 17 recreational fishing or charter fishing vessels in and around the OWFA per survey day. They were most concentrated to the northwest of the OWFA, closer to the entrance to Corner Inlet and Port Albert.

There is a major shipping lane around seven nautical miles (approximately 12.5 kilometres) south of the OWFA through which around 300 ships per month pass). Most of these vessels will visit one of Victoria's main ports (Port of Melbourne, Geelong, Hastings and Portland), while some may be travelling to or from ports in SA, WA or Tasmania. A smaller number of ships are coastal trading vessels transporting goods to and from domestic ports. Existing vessel traffic in the vicinity of the project during 2023 is shown in Figure 9-1.

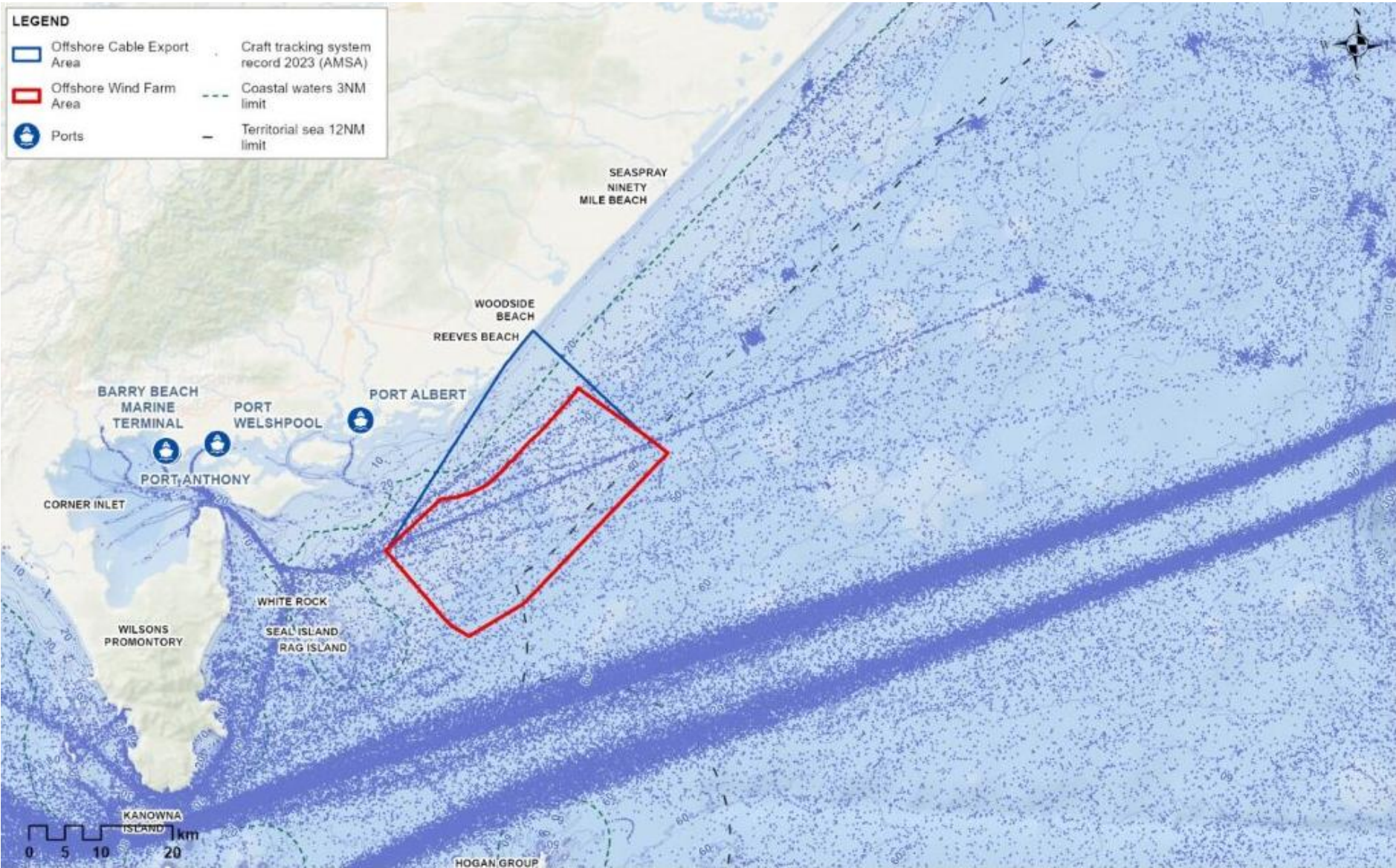


Figure 9-1: Existing vessel traffic in vicinity of the project (AMSA 2023 AIS data) and port and terminal locations near the OWFA

9.1.2 Project activities

Vessel strike, or collisions between vessels and marine mammals and turtles, could occur whenever vessels are active at sea during construction of the offshore wind farm. Vessel strikes can be fatal or near fatal (reducing the fitness of individual animals in the long term) in a worst-case scenario, however strike incidents that cause debilitating injury to animals but are not necessarily fatal may still be highly impactful to the individual and prevent it from undertaking biologically important behaviours. The risk of vessel strike is not unique to the SOTS Project due to the large number of vessels that operate in the area already. This section examines the incremental increase in vessel strike risk due to the project and appropriate mitigations.

Installation of project infrastructure would require a range of vessels including self-elevating ‘jack-up’ vessels or heavy lift dynamically positioned (DP) vessels used to install the foundations, wind turbines and substations, cable laying vessels used to install subsea cable, and installation support vessels such as transportation freighters and barges, trenching vessels, dive and ROV support vessels, special operation vessels, crew transfer vessels (CTVs) and tugboats.

The MDS described in Table 7-1 represents the largest scale and extent of the project (147 WTGs, five substations, eight export cables and inter-array and interlink cables). This scenario also results in the highest potential vessel movements due to the greatest amount of infrastructure to be installed. The port(s) to be used are not yet selected, with options outlined in Chapter 4 – Project description of the EIS and in Chapter 4 – Victorian works project description of the EES, will take up to four years and eleven months and it is assumed that vessels will be operating within the OWFA 24 hours a day, seven days a week, 365 days per year for the full construction period.

When considering the potential risk for vessel strike, the characteristics of the vessel (e.g. size and speed) and vessel movements (e.g. in transit between port and OWF, within OWF) must both be evaluated (Barkaszi et al., 2021). During construction, vessels can be divided into two groups based on their likelihood of causing a fatality due to striking a marine mammal or turtle:

- Vessels generally travelling less than 12 knots (installation vessels, cable lay vessel, platform support vessel, ROV) – less likely to cause a fatality due to striking a marine mammal or turtle (Vanderlaan and Taggart, 2007)
- Vessels generally travelling at up to 20 knots (CTV) – more likely to cause a fatality due to striking a marine mammal or turtle. (Vanderlaan and Taggart, 2007).

The largest vessels (greater than 100 metres long) will have typical transit speeds less than 12 knots and speeds less than 6 knots within the OWFA. These include:

- Offshore installation vessels or heavy lift vessels that will be used to install foundations, WTGs and substations
- Trenching and cable laying vessels that will be used to install inter-array and export cables
- General cargo carriers that will be used to deliver WTG components and cables from their place of manufacture to the project’s construction port(s).

CTVs will be the smallest, fastest vessels used during construction, and will operate at speeds of up to 25 knots between the local ‘construction management’ ports of Corner Inlet (BBMT or Port Anthony — currently used by the offshore oil and gas industry) and the OWFA on a daily basis, weather permitting. The MDS is for up to 7,820 CTV transits to / from the OWFA during the four years and eleven months construction phase. Larger construction vessels cannot access Corner Inlet due to the shallow channel depth. CTVs are considered at higher risk of disturbing marine fauna due to their higher speed and the larger number of transits to and from the local Port of Corner Inlet and within the OWFA.

Vessel movements to local ports transit the same or nearby routes to those that will be used by project vessels, namely the route to the Port of Geelong, routes between Tasmania and Victoria and the Port of Corner Inlet. Figure 9-1 shows the vessel traffic within the project area during December 2023 (AMSA, 2023). Further description of the vessel activity in the region and existing shipping lanes is contained in Technical Report P - Shipping and Navigation.

Overall, outside of the OWFA there is a low-level projected increase in construction vessel traffic above existing levels due to the project. More significant increases in vessel traffic however will occur within Corner Inlet (where ports proposed to be used are located) and within the OWFA particularly in the case of CTVs. In the construction phase, for instance, there is the potential for as many as 15 project vessels to be present at

the same time. This number allows for phased commissioning and operation of the WTGs at the back end of the construction period, with both construction and operations vessels in field at the same time. In reality the number of vessels in the area will be much lower for most of the construction period.

Construction vessels

Construction vessel activities for the project are expected to include up to 8,320 trips over the entire construction period, comprising:

- 7,820 construction management vessel trips e.g. service operation vessels (SOVs) and CTVs, to and from the construction management ports (BMMT and Port Anthony) in Corner Inlet.
- 500 large construction vessel trips e.g. foundation and turbine installation vessels, to and from the construction feeder ports (Port of Geelong and Port of Bell Bay).

These activities are defined as a 'vessel trip' which entails a round trip in which a vessel leaves port and comes back, and a 'movement' which involves both trips to the OWFA and movements of vessels within that area e.g. from one piling position to another.

9.1.3 Risk Assessment

A vessel strike is defined as a collision with a bow or hull resulting in blunt trauma, injuries inflicted by propellers, and a vessel colliding with a breaching animal (Van Waerebeek et al., 2007). The likelihood of vessel strike on cetaceans and other marine megafauna is generally considered to increase as the number, size and speed of vessels increases, and the number of animals increase. The larger and faster a vessel, the more likely that a strike incident will occur, and that it will result in a fatality or long-term loss in fitness (Laist et al., 2001; Izzo and Gillanders, 2015). Larger vessels have less visibility, are less manoeuvrable and take longer to slow or stop. Higher speed reduces the time available to take evasive action, as well as leading to more forceful impacts. Lethal vessel strikes occur or are most likely when vessels are travelling above 10 to 12 knots (Laist et al., 2001; Ritter and Panigada, 2019), however, Vanderlaan & Taggart (2007) show the probability of lethal injury at 12 knots remains high (0.5), with a notable reduction only at lower speeds (e.g. 0.2 at 8.6 knots). Additionally, Barkaszi et al. (2021) found vessel size (>80m) is a key predictor of lethality, while speed plays a greater role for smaller vessels.

Understanding of true vessel strike rates, trends, the types of vessel most likely to strike animals, and mortality rates is limited by the nature of the data (Izzo and Gillanders, 2015; DoEE, 2017b; Peel et al., 2018). Most historical and contemporary strikes are considered to have either gone undetected or unreported. There are a number of sources of bias in data that has been recorded, particularly in which types of vessel report strikes, and in many cases uncertainties about which species were struck (Peel et al., 2018).

Vessel strikes most commonly occur in areas where there are seasonally or year-round aggregations or high densities of marine mammals and busy vessel traffic, with species' behavioural traits such as long periods spent at the surface and slow movement also contributing (DoEE, 2017b; Erbe et al., 2020; Izzo and Gillanders, 2015; Peel et al., 2018; Redfern et al., 2020). Available data from around the world shows that of the large whales, species such as humpback, right, sperm, and fin whales are most likely to be struck due to these factors (DoEE, 2017b; Izzo and Gillanders, 2015; Peel et al., 2018; Smith et al., 2020a). However, different species of large whales can exhibit differential vulnerability to vessel strike due to movement patterns, swimming, and diving behaviour during the day, but diurnal patterns show all have a similar vulnerability during the night (Calambokidis et al., 2019; Keen et al., 2019).

There is little evidence for effective avoidance or evasive action by large whales when vessels are approaching (Laist et al., 2001; Izzo and Gillanders, 2015; DoEE, 2017a; Ritter and Panigada, 2019). Trials of acoustic warning technology for southern right whales has shown it to be ineffective (Izzo and Gillanders, 2015). Furthermore, whales may behave unpredictably around vessels or have lowered awareness while engaged in mating, nursing or resting behaviour, or when they are unwell (DoEE, 2017a).

Where predicted impacts are significant (or unacceptable), mitigations identified by various studies (MEPC, 2009; Izzo and Gillanders, 2015; IMO, 2016; Cates et al., 2017; Ritter and Panigada, 2019; WWF, 2021) that have been shown to effectively reduce the likelihood and / or severity of vessel strike include:

- Reducing overlap between areas with high vessel traffic and high whale densities.
 - This may include permanent, seasonal or dynamic routing measures

- Reducing vessel speeds in spatially and temporally explicit ways
- Permanent, seasonal or dynamic speed restrictions
- Awareness and monitoring of whales
- Increase awareness of whale presence, behaviour and identification
- Monitoring to inform active mitigation through routing and speed restriction.

However, a recent study by Kelley et al. (2021) found that there is no reasonable transiting speed at which large vessels could strike a whale without fatally injuring an animal and that vessels of all sizes maintain a threat to seriously injure or fatally injure an animal. Kelley et al. (2021) suggest that reducing co-occurrence of large vessels and whales is the only practical measure to reduce risk of a fatal strike. While for small vessels, there are more opportunities to mitigate a fatal vessel strike due to crew proximity to and visibility of the ocean surface, greater manoeuvrability and responsiveness in a last-minute detection and avoidance of a vessel strike. A combination of speed restrictions and having crew posted to watch for surfacing whales may be an effective way to reduce the incidence of a fatal vessel strike for small vessels (Kelley et al., 2021; Schoeman et al., 2020).

Vessel strikes can also be a serious threat to human welfare and safety, and have significant economic impacts to multiple maritime industries, such as vessel loss (Smith et al., 2020a; Ransome et al., 2021).

9.1.3.1 Blue whale

There are two recognised subspecies of blue whale in the Southern Hemisphere: Antarctic ‘true’ blue whale (ABW) (*B. m. intermedia*) and pygmy blue whale (pygmy blue whale) (*B. m. brevicauda*). In southern Australia the pygmy blue whale is most often encountered in areas of high productivity around recently upwelled water. However, they are a highly mobile and wide-ranging species and may be encountered while travelling between productive areas in western Victoria (Bonney upwelling) and upwelling areas along the shelf edge in eastern Bass Strait. The OWFA is within a blue whale ‘foraging’ BIA. However, the OWFA and surrounding waters have relatively low productivity with negligible influence from surrounding upwelling areas (Huang and Wang, 2019) and therefore is unlikely to provide important foraging habitat.

Both the NZ and EIO pygmy blue whale populations were acoustically detected during the MESP baseline survey, though only sporadically and there was no evidence that either population persisted in the area or were engaged in feeding (Appendix A). Migrating pygmy blue whales are known to occupy deeper waters, though few may come into shallower waters along the 30-metre depth contour. The presence of pygmy blue whales in the OWFA and surrounding waters is expected to be limited to occasional individuals during the winter to spring months.

McKenna et al. (2015) conducted a study of blue whales in a commercial shipping lane in California and found that whales displayed a dive response (i.e. shallow dive during surface period) in the path of oncoming ships, but no evidence of lateral avoidance. There are historic records of five vessel strikes involving blue whales in southern hemisphere waters (Peel et al., 2018) with two records of likely fatal ship strikes recorded near the Bonney Upwelling from stranded animals (Commonwealth of Australia, 2015a).

The Conservation Management Plan for the Blue Whale states that impact from vessel strike on an individual could have a significant, potentially population scale effect due to their low population numbers, though the uncertainty in actual numbers is acknowledged (Commonwealth of Australia, 2015a). Action Area A.4 (minimising vessel collision) in the management plan outlines activities that increase vessel traffic in areas where blue whales occur must consider the risk of vessel strike and mitigation measures implemented where appropriate.

The OWFA and the routes taken by project vessels between local and regional ports do not overlap known high-use areas for the blue whale, however blue whales may occasionally be encountered over the four year and eleven-month construction period as they transit to and from areas of higher productivity, particularly during the early winter months. To comply with the blue whale Conservation Management Plan, mitigation measures for vessel strike are outlined in Section 9.1.4. Additionally, in the event that a blue whale is sighted, the caution zone will be increased to 500 metres and the vessel speed reduced to five knots within this caution zone where safe to do so.

9.1.3.2 Southern right whale

The nearshore distribution of southern right whales, particularly along the south-east coast of Australia, overlap waters frequented by coastal trading vessels, commercial fishing vessels and recreational vessels. The OWFA is within the coastal distribution range for southern right whales including BIAs for migration (April to October) and for reproduction (May to September), which spans the entire Gippsland coast and extends across all of Victoria (DCCEEW, 2024b). Australian nursery grounds are occupied from May to November, and a female-calf pair generally remain within the calving ground for two to three months (Charlton et al., ; Watson et al., 2021; DCCEEW, 2022). Habitat critical to the survival of the species (HCTS) for southern right whales has been identified as all reproductive BIAs across the species range (DCCEEW, 2024b). These habitats are necessary for the continuation of vital life history stages, including mating, calving and nursing (DCCEEW, 2024b).

Southern right whales from both the eastern and western subpopulations were sighted in waters surrounding the OWFA during the MESP baseline survey (Appendix A). This indicates that southern right whales from both subpopulations may occur in the OWFA and surrounding waters, though it is likely southern right whales from the western subpopulation are only in the area temporarily while transiting west. A total of seven individual southern right whales were sighted during aerial surveys of the MESP baseline survey, comprising three female and calf pairs and one unaccompanied adult (Appendix A). southern right whale female and calf pairs are particularly vulnerable to vessel strike due to their aggregation in near shore waters and strong site fidelity to aggregation sites.

Most ship strikes reported for southern right whales in Australian waters have occurred in the central and western parts of their range where the densest aggregations form (Izzo and Gillanders, 2015). Within season timing of vessel strikes on southern right whales was between mid-June and mid-November, with the greatest number of strikes in August, in line with peak arrival at aggregation grounds (Charlton et al., 2019a).

Southern right whales are at increased risk of vessel strike due to their inconspicuous profile, lack a dorsal fin, slow swimming behaviour and long periods spent at the surface (DoEE, 2017b). Direct mortality from ship strike is a main threat to the critically endangered NARW. As a result, mandatory speed restrictions of 10 knots or less are required when transiting through migratory routes and calving and nursery grounds during times when NARWs are likely to be present.

Vessels used in project construction may encounter southern right whales seasonally over the four year and eleven month construction period, particularly those vessels that frequently transit the nearshore coastal zone (CTVs: approximately 20 to 30 metres in length, approximately 7,820 vessel movements over the four years and eleven month construction period, support vessels approximately 60 to 90 metres in length, approximately 150 vessels movements back to port over the four years and eleven months construction period). Given the small population size of the eastern subpopulation of southern right whales (less than 300 individuals; Stamation et al., 2020) and little evidence of recovery, the loss of an individual could be significant (DSEWPAC, 2012).

The National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (Commonwealth of Australia, 2017c) as well as the National Recovery Plan for southern right whale (DCCEEW, 2024b) outlines strategic framework to mitigate the risk of vessel strike. Action Area A.6 in the recovery plan identifies vessel strike management as a very high priority threat. These documents outline the importance of spatial and temporal consideration to southern right whale BIAs, as well as likely behaviours (e.g. reproduction) within an area, vessel characteristics and movement patterns. The National Strategy for Reducing Vessel Strike on Cetaceans suggests regulating vessel routes, implementing speed restrictions and exclusion zones if necessary. In the case of large cetaceans (e.g. southern right whales), slowing vessel speeds and avoidance manoeuvres may be necessary if the individual is close to the vessel.

To comply with the southern right whale recovery plan, mitigation measures for vessel strike are outlined in Section 9.1.4. As southern right whales are a protected species, listed as Endangered under the EPBC Act and have BIAs near the OWFA, extra mitigation measures are necessary. The risk of injury / mortality to southern right whales from vessel strike will be managed through the implementation of vessel speed restrictions including slow speeds in the 'reproduction' BIA (vessels must operate at speeds of less than 10 knots) during peak calving months of May to September. Additionally, in the event that a southern right whale is sighted, the caution zone will be increased to 500 metres and the vessel speed reduced to five knots within this caution zone where safe to do so.

9.1.3.3 Humpback whale

Humpback whales migrate up and down the east coast of Australia, passing through the Bass Strait during their northbound and southbound migration, and through existing major shipping lanes and coastal traffic routes. Humpback whales occur more regularly in the OWFA than other mysticetes, with over 10,000 individuals estimated to occur in the OWFA and surrounding waters during their southbound migration (Appendix A). Humpback whales are most likely to be encountered and occur in higher densities from April to November along the east coast of Australia between Gabo Island and Newcastle (construction port) where the continental shelf is narrow.

Humpback whales were visually sighted offshore of the OWFA on their northbound migration (April to August), while sightings generally occurred closer to shore, on the shallower edge of the OWFA during their southbound migration (September to December). This is consistent with the literature, which suggests that humpback whales travel further offshore during their northward migration and closer inshore during their southern migration while travelling with calves. Almost half of all humpback whale sightings during visual aerial surveys of the MESP were of individuals travelling, though whales were also observed feeding and displaying surface-active social behaviours (Appendix A).

Globally, humpback whales are the second most predominant species involved in vessel strikes (Jensen et al., 2004). While in the southern hemisphere, humpback whales are involved in the majority (59 percent) of vessel strike incidents (Peel et al., 2018). This potentially is due to their large spatial overlap with shipping lanes and general distribution within 20 kilometres from the coastline and in water depths less than 200 metres (Van Waerebeek et al., 2007; Peel et al., 2018). The timing of vessel strike incidents coincides with the migratory pattern of humpback whales, with vessel strike incidents peaking in August when this species is migrating and / or has reached breeding grounds in Australian coastal waters (Peel et al., 2018).

Humpback whales are making a strong recovery from historical whaling and were recently (in 2022) removed from the threatened species list due to their population increase and growth rate (TCSS, 2022). Their coastal distribution and increase in population size make them particularly susceptible to collisions with vessels (Peel et al., 2018). In addition, increased time at the surface and use of shallow waters for resting and nursing by cow/calf pairs make them particularly vulnerable to vessel strikes during the southern migration (Bejder et al., 2019; Mayaud et al., 2022).

Vessels used in project construction will likely encounter humpback whales seasonally over the four year and eleven month construction period, where vessel strike is a possibility. The Listing Advice for humpback whales (TSSC, 2022) lists vessel disturbance and strike as a current and future threat, where mitigation measures should be put in place where necessary. To comply with the humpback whale listing advice, mitigation measures for vessel strike are outlined in Section 9.1.4. As humpback whales make up the majority of vessel strike incidents in Australia and are abundant in the OWFA, they will be covered under additional mitigation measures for protected species. Additional mitigation measures relevant to all protected and mysticete species are outlined in Section 9.1.4.

9.1.3.4 Other mysticetes

Other mysticetes that may occur in the OWFA and surrounding waters include three species recorded during the MESP baseline survey: Bryde's whale, dwarf minke whale and Antarctic minke whale (Appendix A), as well as fin whales, sei whales and pygmy right whales. It is expected that these species will occur seasonally.

Dwarf minke whales and Antarctic minke whales are expected to occur in waters offshore of the OWFA, with very limited presence in the OWFA (Appendix A). Bryde's whales were visually sighted in nearshore waters north-east of the OWFA (Appendix A). Therefore, the presence of these mysticetes in the OWFA is expected to be limited to highly occasional individuals, with most passing offshore of the OWFA with no interaction with project vessels.

Global data show a small number of records of vessel strikes involving minke whales relative to other species, and there are a few records from Australia since 1997. This low rate of strikes is unlikely to be significant at the population level, especially in Australia where they are not considered threatened.

There are around ten records globally of vessel strikes involving Bryde's whale since 1997, but none from Australia (Peel et al., 2018). Historically, there are records of 13 vessel strikes involving Bryde's whales in the Southern Hemisphere (Van Waerebeek et al., 2007). Vessel strikes do not appear to constitute a significant threat to populations of this species. Similarly, there are a small number of records globally of

vessel strikes on sei whales (Peel et al., 2018) but none in Australia, they do not appear to be particularly vulnerable to vessel strike.

Fin whales are over-represented in whale strike data in the Northern Hemisphere, though there are few records from Australia (Peel et al., 2018). The high strike numbers in the Northern Hemisphere are attributed to the larger population and the large degree of overlap between foraging areas and dense vessel traffic (Peel et al., 2018). In Australian waters, the low number of strikes is attributed to their heavy historical exploitation and the lack of overlap between their distribution in deeper waters away from busy vessel traffic lanes (Peel et al., 2018).

There are few records of vessel strikes involving pygmy right whales globally since 1997 (less than five) and a similarly small number in Australian waters (Peel et al., 2018). The rate of vessel strikes on this species does not appear to constitute a significant threat to their population.

The conservation advice for fin and sei whales (TSSC, 2015 a, b) both list vessel strike as a minor threat, noting the impact will most likely be localised. However, the threat may potentially increase in the future if populations increase alongside shipping and fisheries.

The OWFA and the routes taken by project vessels between local and regional ports do not overlap known areas of high-use for these species of mysticetes, and their presence encountered over the four year and eleven month construction period is expected to be limited to occasional transient individuals, mostly offshore of the OWFA. Whilst the likelihood of encountering other mysticetes in the OWFA is low the implementation of vessel strike mitigation is important if these species are encountered. To comply with the relevant conservation advice, mitigation measures for vessel strike are outlined in Section 9.1.4.

9.1.3.5 Odontocetes (dolphins)

Dolphins were present year round in the OWFA and surrounding waters, according to the MESP baseline survey. Bottlenose dolphins were most commonly sighted in nearshore, shallow waters while common dolphins were commonly sighted in offshore waters outside of the OWFA (Appendix A). Most dolphins were recorded travelling, though feeding and resting were also observed (Appendix A). Five bottlenose dolphin calves were sighted over March and April (Appendix A). Two possible striped dolphins were sighted in group of feeding common dolphins, and two killer whales were sighted during visual aerial surveys in July, with a possible third 'like-killer whale' sighted in April. Killer whales may be present in the OWFA; however, their presence is expected to be limited to occasional transient individuals or small groups.

There is little available data on the incidence of vessel strike on dolphins and other odontocetes in the Victorian region, but the low number of records from New South Wales (nine) and Tasmania (ten) (DoEE, 2017b) suggest that rates are insignificant relative to population sizes. Risks to small species appear to be greatest in shallow or intertidal waters, which are not within the operating area of vessels to be used on the project. Dolphins and other small to medium sized odontocetes may also be better at avoiding vessel strike due to both their agility and habituation to vessels (dolphins frequently approach vessels, engage in bow riding and wake surfing) (Barkaszi, et al., 2021). Lusseau (2003) suggest that male bottlenose dolphins respond to boats as soon as they are present, while females increased their mean diving interval only when interactions became intrusive. In the Northern Hemisphere vessel strike trauma was identified as a leading cause of death of stranded killer whales (Raverty et al., 2020). However, a study in New Zealand found that a killer whale subject to suspected ship strike (severe propellor wound) was able to heal and survive despite the injury (Visser & Fertl, 2000).

Vessels used in project construction may encounter odontocetes, and particularly dolphins, during the four years and eleven month construction period. However, it is expected that odontocetes would be able to manoeuvre out of the way of vessels as to avoid being hit, therefore the likelihood of vessel strike on dolphin species is very low. Mitigation measures for vessel strike are outlined in Section 9.1.4. However, due to the manoeuvrability of delphinid species and their ability to make rapid and unpredictable movements, when dolphins are bow- or wake-riding, vessels should maintain course and speed as long as it is safe to do so or until the animal(s) leave the vicinity of the vessel.

9.1.3.6 Pinnipeds

Two pinniped species, the Australian fur seal (AUFS) and New Zealand fur seal (NZFS) are known to occur in the Gippsland region and have breeding colonies in proximity to the OWFA.

Fur seals were present in all months of the year during the MESP baseline survey (Appendix A). Tracking data indicate that that AUFS from the Rag Island colony occur regularly throughout the OWFA and surrounding waters, while the OWFA and surrounding waters do not represent important foraging habitat for AUFS or NZFS from Kanowna Island (Appendix A).

Fur seals may be able to avoid being struck due to both their alertness when on the surface (they rarely sleep at sea due to the threat of predation from sharks), agility and habituation to vessels. There is little evidence for vessel strike being a significant source of mortality in fur seals, and it is very unlikely to be an issue for Victorian fur seal populations (J. Arnould, pers. comm.).

Vessels used in project construction may encounter fur seals during the four years and eleven month construction period. However, it is expected that they would be able to manoeuvre out of the way of vessels as to avoid being hit. Mitigation measures for vessel strike are outlined in Section 9.1.4.

9.1.3.7 Marine turtles

There are no BIAs or important habitats for marine turtles in proximity to the OWFA, and only a single loggerhead turtle was sighted during the MESP baseline survey (Appendix A).

The risk of vessel strike for small marine megafauna like turtles appear to be greatest in shallow or intertidal waters (DoEE, 2017b) but have not been shown to cause population level declines in isolation from other threats. The areas in which turtles are most vulnerable are shallow and intertidal waters over foraging areas (particularly for species that forage on seagrasses) or around rookeries, are not within the operating area of vessels to be used on the project.

The Recovery Plan for marine turtles outlines vessel disturbance (and mortality due to strike) as an important threat to marine turtles in Australia. Queensland reported 897 marine turtle deaths resulting from wounds relating to vessel strike between 2000 to 2011 (Commonwealth of Australia, 2017a). This was the most common cause of death in marine turtles for this time period (Meager and Limpus, 2012).

The presence of marine turtles in the OWFA and surrounding waters is expected to be limited to highly occasional transient individuals, and therefore it is considered highly unlikely that project vessels will encounter marine turtles during the construction phase. To comply with the recovery plan for marine turtles, mitigation measures for vessel strike are outlined in Section 9.1.4.

9.1.4 Mitigation measures

Initial mitigation measures which will be implemented to reduce the risk of vessel strike on marine mammals and turtles are outlined in Table 7-3.

SOTS is committed to continual risk reduction, with additional mitigation and management measures provided in Table 9-1 and outlined below.

Vessel strike will be managed through the implementation of:

- Use of vessel movement corridors and vessel management plans implemented prior to construction for vessels transiting from and to the OWFA
- Operating at the minimum safe speed when transiting
- Project vessels working on the transmission cable in the southern right whale Biologically Important Area (BIA) for reproduction will maintain a speed of less than 10 knots) during peak calving months of May to September.
- Training necessary crew onboard smaller project vessels to identify marine mammals and turtles
- Implementation of Commonwealth EPBC Regulations 2000 Part 8, Victorian State Wildlife (Marine Mammal) Regulations 2019, and the Australian National Guidelines for Whale and Dolphin Watching for all project vessels as follows:
 - Vessels should be maneuvered with care around whales and dolphins, and erratic vessel behaviour around animals should not occur
 - Vessels must not enter the 'no approach zone' and must not wait in front of the direction of travel of an animal or pod of animals:

- For whales: within 100 metres to the side and 300 metres in front and to the rear of an adult whale)
- For dolphins: within 50 metres to the side and 150 metres in front and to the rear of an adult dolphin)
- No more than three vessels allowed within the 'caution zone' (within 300 metres either side of a whale, and within 150 metres either side of a dolphin)
- Vessels must not enter the caution zone when a calf is present
- Vessels must not enter the caution zone if a whale shows signs of disturbance
- Whales that are calving, accompanied by young, resting or feeding should not be approached
- Implementation of the Wildlife (Marine Mammal) Regulations 2019 (Victorian state legislation) for seals:
 - Vessels must not approach within 30 metres of a seal, if the seal is on land or a haul out; or within 5 metres if the seal is on water infrastructure.
- Vessel speeds within the caution zone of a whale or dolphin must be maintained at a constant speed that does not exceed five (5) knots if with VIC State waters (Wildlife (Marine Mammal) Regulations 2019), and six (6) knots if within Commonwealth waters (EPBC Regulations 2000)

Table 9-1: Mitigation and management measures for impacts associated with vessel strike from project vessels

ID	Mitigation / management measure	Description	Effectiveness
VES-M09	Vessel crew environmental induction	Crew on all project vessels undertaking activities during operation of the OWF must be trained to identify large baleen whales at sea, understand guideline distances and speeds and be on watch during voyage to OWF for strike avoidance purposes.	Increases the knowledge and expertise of all crew onboard, with the aim of increasing the chances of early detection Any incidents of vessel strike will be observed and reported.
VES-M10	Restricted speed in southern right whale reproduction Biologically Important Area	Project vessels working on the transmission cable in the southern right whale Biologically Important Area (BIA) for reproduction will maintain a speed of less than 10 knots) during peak calving months of May to September.	Reduces the likelihood (Rockwood et al., 2020) and consequence (Laist et al., 2001) of vessel strike to southern right whales transiting slowly in the BIA, and particularly vulnerable female and calf pairs (Winkler et al., 2020)
VES-M11	Adaptive management procedure for southern right whales and blue whales	Vessels will watch and act for the presence of southern right whales and blue whales during all project phases. If a southern right whale or blue whale is sighted: - increased caution zone to 500 m - reduced vessel speed to 5 knots within the caution zone.	Reduces the likelihood and consequence of vessel strikes to southern right whales and blue whales.

9.1.5 Residual risk

Table 9-2: Consequence associated with the increased risk of vessel strike from project vessels during the construction phase

Event (ID no.)	Receptor	Receptor sensitivity	Initial risk rating	Additional mitigation	Residual Risk Rating
Vessel strike leading to direct injury / mortality	Blue whale	High	Low Consequence = Moderate (C) (Magnitude = Low, Likelihood = Unlikely)	VES-M09 VES-M11	Low Consequence = Moderate (C) (Magnitude = Low, Likelihood = Rare)
Vessel strike leading to direct injury / mortality	Southern right whale	High	Low Consequence = Moderate (C) (Magnitude = Low, Likelihood = Unlikely)	VES-M09 VES-M10 VES-M11	Low Consequence = Moderate (C) (Magnitude = Low, Likelihood = Rare)
Vessel strike leading to direct injury / mortality	Humpback whale Other mysticetes	Medium	Low Consequence = Minor (D) (Magnitude = Low, Likelihood = Unlikely)	VES-M09	Very low Consequence = Minor (D) (Magnitude = Low, Likelihood = Rare)
Vessel strike leading to direct injury / mortality	Odontocete – dolphins Pinnipeds Marine turtles	Low	Low Consequence = Negligible (E) (Magnitude = Low, Likelihood = Rare)	VES-M09	Very low Consequence = Minor (D) (Magnitude = Low, Likelihood = Rare)

9.1.6 Evaluation of residual impacts against assessment criteria

An evaluation of the residual impacts against the assessment criteria in Section 0 is provided in Table 9-3.

Table 9-3: Evaluation of residual impacts against assessment criteria for increased risk of vessel strike from project vessels

Assessment criteria	Evaluation	Confidence / uncertainty
Principles of ESD AC1: Biological diversity and productivity of the environment is not compromised because of the project.	Vessel strike is highly unlikely to be so prevalent from project activities that there is a population effect on any marine mammal or turtle species such that biological diversity or productivity is affected because it is more likely to affect individuals. The exceptions to this include species with low abundance estimates, such as the eastern subpopulation of southern right whales and possibly blue whales, where the loss of an individual could have a significant population level effect. Notwithstanding, the precautionary approach is applied and the risk of injury / mortality from vessel strike will be minimised through the implementation of vessel speed restrictions and best practice measures for monitoring	High confidence - All project vessels will comply with the requirements of the EPBC Regulations 2000 Part 8, Wildlife (Marine Mammal) Regulations 2019, the Australian National Guidelines for Whale and Dolphin Watching, and the National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna. - Project Vessel Management Plan. - All project personnel (including vessel crew) will be inducted onto the project and all responsibilities relevant to the prevention of the risk of vessel strike with marine

Assessment criteria	Evaluation	Confidence / uncertainty
	marine fauna (e.g. MFOs). Likewise, specific measures will apply to manage the risk of injury/mortality for southern right whales and blue whales such that vessel strike to any marine mammal or turtle is not expected to occur. The project is not inconsistent with the Principles of ESD.	mammals will be clearly communicated and understood. - Additional precautionary vessel speeds for vessels transiting through the SRW reproduction BIA / HCTS. - Management procedure for blue whales and SRW – reduce vessel speed and increased precaution zone.
Conservation Management Plan for the Blue Whale AC2: The project will be managed such that residual impacts and / or risks will not be inconsistent with the objectives of the Conservation Management Plan for the Blue Whale, including application of the “Guidance on key terms” and the requirement of Action Area A4 – minimising vessel collisions	Vessel strike due to the project activities was assessed as having a low risk to blue whales. Vessel strike is considered a threat to the recovery of blue whales, if sufficient number of individuals in the population lose reproductive fitness or are killed, though the uncertainty in population estimates is acknowledged. Vessel strike is unlikely given the low likelihood of occurrence of blue whales within the OWFA, which is expected to be limited to occasional migratory individuals. Notwithstanding, the risk of injury / mortality from vessel strike will be minimised through the implementation of vessel speed restrictions and best practice measures for monitoring marine fauna (e.g. MFOs) such that vessel strike is not expected to occur. The project is not inconsistent with the Conservation Management Plan for the blue whale.	
National Recovery Plan for the Southern Right Whale AC3: The project will be managed such that residual impacts and / or risks will not be inconsistent with the objectives of the National Recovery Plan for the Southern Right Whale including the requirement of Action Area A6 – manage, minimise and mitigate the threat of vessel strike	Vessel strike due to the project activities was assessed as having a low risk to southern right whales. Vessel strike is considered a threat to the recovery of southern right whales, particularly the smaller eastern population, if sufficient number of individuals in the population lose reproductive fitness or are killed. Vessel strike is unlikely given the low number of individuals recorded within the OWFA during the aerial surveys of the MESP, though they are considered likely to occur and are known to be difficult to (visually) detect due to their inconspicuous profile. On this basis, and in accordance with the southern right whale recovery plan, the risk of injury/mortality will be managed through the implementation of vessel speed restrictions, including slow speeds in the ‘reproduction’ BIA during peak calving months of May to September, and best practice measures for monitoring marine fauna (e.g. MFOs). Additional measures will also apply in the event that a southern right whale is sighted, in which case the caution zone will be increased to 500 metres and the vessel speed reduced to five knots within this caution zone where safe to do so, such that vessel strike is not expected to occur. The project is not inconsistent with the National recovery plan for the southern right whale.	
Significant Impact Guidelines (threatened species) AC4: The project will not have a significant impact on Threatened (Endangered and Vulnerable)	Vessel strike is not considered a threat to population viability for species that have larger populations, however it could have a significant population level effect for species with low abundance estimates such as the eastern subpopulation of	

Assessment criteria	Evaluation	Confidence / uncertainty
Species as defined in the MNES Significant Impact Guidelines 1.1	southern right whales, and possibly blue whales. No impacts to the recovery of species are predicted. Vessel strike is unlikely given the low likelihood of occurrence of threatened species of marine mammals and turtles and the risk of injury / mortality from vessel strike will be managed through the implementation of vessel speed restrictions and best practice measures for monitoring marine fauna (e.g. MFOs) such that vessel strike is not expected to occur. No significant impacts are predicted to threatened species.	
EPBC Regulations (multiple) AC5: The project will be managed to prevent vessel strike with marine fauna.	The project will implement a Vessel Management Plan and align with practices and approach distances outlined in the guidelines. The project is not inconsistent with the EPBC Regulations 2000 Part 8, Wildlife (Marine Mammal) Regulations 2019, and the Australian National Guidelines for Whale and Dolphin Watching. The project will implement measures described in the National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna.	
Significant Impact Guidelines (migratory species) AC7: The project will not have a significant impact on Migratory Species as defined in the MNES Significant Impact Guidelines 1.1	Vessel strike is not considered a threat to population viability for species that have larger populations, however it could have a significant population level effect for species with low abundance estimates such as the eastern subpopulation of southern right whales, and possibly blue whales. Vessel strike is unlikely given the low likelihood of occurrence of migratory species of marine mammals and turtles and the occasional and mostly transient nature of their presence. The risk of injury / mortality from vessel strike will be managed through the implementation of vessel speed restrictions and best practice measures for monitoring marine fauna (e.g. MFOs) such that vessel strike is not expected to occur, with no impact on breeding success or individuals. The project is not inconsistent with the Significant Impact Guidelines for migratory species.	
Significant Impact Guidelines (Commonwealth marine areas) AC8: The project will not have a significant impact on Commonwealth Marine Areas as defined in the MNES Significant Impact Guidelines 1.1	Vessel strike is highly unlikely to be so prevalent from project activities that there is a population effect on any marine mammal and turtle species such that biological diversity or productivity is affected because it is more likely to affect individuals. The exceptions to this include species with low abundance estimates, such as the eastern subpopulation of southern right whales and possibly blue whales, where the loss of an individual could have a significant population level effect. The risk of injury/mortality to all marine mammals and turtles will be managed through the implementation of vessel speed restrictions, including slow speeds in the southern right whale 'reproduction' BIA during peak calving	

Assessment criteria	Evaluation	Confidence / uncertainty
	months of May to September, and best practice measures for monitoring marine fauna (e.g. MFOs). Additional measures will also apply in the event that a southern right whale is sighted, in which case the caution zone will be increased to 500 metres and the vessel speed reduced to five knots within this caution zone where safe to do so, such that vessel strike is not expected to occur, with no long term impacts on habitat or populations. The project is not inconsistent with the Significant Impact Guidelines for Commonwealth Marine Areas.	

9.2 Accidental hydrocarbon release (MMT-R002)

9.2.1 Project activities

Accidental spillage of hydrocarbons affecting the marine and coastal environments could occur from vessel collision, spills on deck reaching the environment, and at sea re-fuelling accidents. A review of the Australian Transport Safety Bureau's marine safety database of vessel incidents since August 1991 identified no collision, grounding or sinking of a vessel whilst engaged in similar risk-level oil and gas industry activities (ATSB, 2018). While a very low likelihood event, vessel collision releasing hydrocarbons is considered the maximum credible spill scenario. The unlikely nature of the scenario is due to the high skill level of crew onboard vessels in the offshore construction industry as well as the application of standard maritime law, such as COLREGS (see Table 7-3).

Project construction vessels are likely to be fuelled with a diesel-like fuel, for example marine gas oil (MGO), carried in separate fuel tanks that are inter-connected and isolatable. In the event of a vessel collision that results in a ruptured fuel tank the entire contents of the tank could be released to the ocean; however, the total loss is likely to be reduced by isolating the compromised tank and transferring fuel to adjacent tanks. Although project vessels have not been confirmed, large installation vessels of the type required to install wind turbines carry up to 4,000 cubic metres of MGO in multiple fuel tanks. Individual fuel tanks in these vessels typically hold a maximum of about 300 cubic metres.

A quantitative assessment of the potential effects of an accidental hydrocarbon release from a project vessel (Attachment II – Oil spill modelling summary) provides the basis of this assessment of spill impacts to marine mammals and turtles. The assessment was based on a maximum credible spill scenario involving the rupture of a single tank and release of 300 cubic metres of MGO to sea over a six-hour period. Spill modelling was undertaken for two spill locations along the nearshore boundary of the OWFA. At both locations 100 repeat spill simulations were run for summer (September to April) and winter (May to August). This process demonstrated considerable variability in the direction and extent of an accidental hydrocarbon release as a consequence of prevailing weather and oceanographic conditions. Any MGO spilled from the offshore wind farm would likely drift relatively small distances (less than 50 kilometres) as floating oil before concentrations reduced below 1 gram per square metre (averaged over areas of 0.16 square kilometres) through a combination of entrainment, evaporation, and dispersal. This outcome was consistent for both the winter and summer month spill samples and can be largely attributed to the high frequency of wind conditions that will trigger entrainment of the MGO oil mixtures. MGO fuel at the surface will spread rapidly in the direction of the prevailing wind and surface currents. Evaporation contributes to a substantial proportion of removal of the spilled MGO on the surface during calm conditions, while entrainment of droplets within the water column will increasingly contribute to removal of surface oil as wind speed increases. Surface oil is expected to become fully entrained within 14 days.

9.2.2 Risk assessment

In the event of an accidental hydrocarbon release, marine mammals and turtles may be impacted by the following pathways:

- Surface oil which affects animals when surfacing

- Entrained oil which affects animals swimming / foraging usually down to approximately ten metres below sea surface
- Shoreline accumulation which affects animals which utilise these areas (e.g. pinnipeds)

Through these pathways the following impacts can occur:

- Direct physical injury
- Direct toxicity through ingestion of oil and / or contaminated prey
- Indirect impacts through effects on prey species e.g. changes in distribution.

Much of the research on impacts to marine fauna from accidental hydrocarbon releases is based on large-scale accidental hydrocarbon releases (e.g. Deep Water Horizon approximately 500,000 cubic metres) and limited information exists on smaller scale or MGO spills. For marine mammals and turtles, surfacing in floating oil can lead to oil contact with sensitive areas (e.g. eyes, mouth and respiratory system) creating irritation and potentially cell damage. Volatile compounds evaporating from surface oil may be inhaled by marine mammals and turtles, particularly when the oil is fresh and relatively unweathered. Inhalation of these compounds may cause damage to internal respiratory structures (Helm et al 2014). Marine mammals may also indirectly ingest oil products through the consumption of prey that accumulate polycyclic aromatic hydrocarbons (PAHs) (i.e. invertebrates); however, ingestion of contaminated prey is unlikely to occur at large quantities and individual fitness may be temporarily reduced with no long-term impacts expected. (Matkin et al 2008; Ober, 2010). Physical injury or ingestion / inhalation could also occur when exposed to entrained or accumulated oil.

The severity of impacts to marine mammals and turtles may vary depending on the location and source of spill, volume of spill, and spill characteristics (e.g. composition, trajectory, intensity, timing (season) and duration. Given the nature of MGO, and the dilution and dispersion from natural weathering processes such as ocean currents, the extent of exposure will be limited in area (less than 50 kilometres) and duration and impacts to marine mammals and turtles are likely to be lower than those described above. Direct impacts are discussed below whilst indirect impacts (e.g. effect on prey species) are discussed in Section 8.5.

9.2.2.1 Cetaceans

As air-breathing mammals, cetaceans are vulnerable to sea surface oiling as they are required to surface for survival. They are also vulnerable to entrained oil if they are swimming or foraging in the spill area. Cetaceans could be exposed to the potential impacts of oil through consumption (directly or through prey), by inhaling volatile compounds when surfacing to breathe, through dermal contact (skin), or maternal transfer of contaminants to embryos (NRDA, 2012; Hook et al., 2016). Surface feeding mysticetes (e.g. humpback whales) are particularly vulnerable when feeding as they filter feed by skimming the surface for krill, ingesting surface oil and fouling their baleen plates. Fouling from MGO is likely to be very short-term (less than 40 seconds) and is therefore expected to have very minimal consequences. However, ingestion of contaminated prey or reduced feeding opportunities due to a reduction in prey populations may have consequences for affected individuals (Helm et al., 2014; Michel et al., 2010).

Oil thickness thresholds may be used as an indicator to predict impacts to cetaceans. Modelling by French-McCay (2009) identifies that a 10 to 25 micrometre oil thickness threshold has the potential to impart a lethal dose on marine species; however, also estimates a 0.1 per cent probability of mortality to cetaceans if they encounter these thresholds based on the proportion of the time spent at surface level. MGO has a very low viscosity and would not achieve less than or equal to 10 micrometre oil thickness, even if spilled under very calm conditions. Any spilled MGO is likely to rapidly disperse to thin films, and lethal doses for marine species are not expected to occur.

Due to the presence of important habitats (BIAs) for southern right whales and blue whales, and abundant use of the OWFA and surrounding waters by humpback whales, making them particularly vulnerable to impacts of oil, a detailed assessment of potential impacts to these species as a result of an accidental hydrocarbon release, is provided below. All other mysticete species are grouped as 'other mysticetes' Odontocetes that may be present in the OWFA have been assessed in groups as 'dolphins' which are common and abundant within the OWFA, and 'other odontocetes' whose presence is more sporadic (Appendix A).

9.2.2.1.1 Blue whale

There are very few historical sightings of blue whales in the Gippsland. A single blue whale was observed during the MESP on April 4, 2023. The individual was observed stationary in the water, unusual in blue whales, which rarely stop moving (Gill, pers. Comms. 2023). The individual was located approximately 30 kilometres from the coastline, in 50 to 60 metre water depths, just outside the offshore project area, on the eastern side of Wilsons Promontory (transect E3). From visual observation and expert advice, it is likely the individual was a pygmy blue whale subspecies. Despite only a single visual sighting throughout the whole baseline survey period, NZ pygmy blue whale and EIO pygmy blue whale vocalisations were detected sporadically in acoustic recordings (Appendix A). All detections of pygmy blue whale song (both populations) in underwater noise recordings collected during the MESP were for short periods only, a few hours to days, and there was no evidence that either sub-species persisted in the area and were engaged in feeding (Appendix A). Pygmy blue whales may transit the OWFA to areas of greater productivity to the north-east (e.g. Upwelling East of Eden KEF), or while migrating to possible breeding grounds off Tonga (Möller et al., 2020). The presence of blue whales in the OWFA and surrounding waters is expected to be limited to occasional individuals during the winter to spring months.

The risk of localised impacts (i.e. temporary skin irritation) to blue whales from an MGO spill from collision of a project vessel will be managed through vessel traffic management and the implementation of an OPEP. While the duration of construction may be up to four years and eleven months, any contact with MGO will be of extremely short duration and given the nature of MGO and the dilution and dispersion properties, any effects to individual blue whales are expected to be minimal and unlikely to have population level impacts.

9.2.2.1.2 Southern right whale

The OWFA and surrounding waters do not represent a recognised aggregation area for southern right whales, and it is unlikely that whales will aggregate in the area in future due to a restricted memory of calving habitat and a lack of conspecifics (Pirzl, 2008). Instead, southern right whales may transit the OWFA and surrounding waters en route to calving and aggregating sites in western Victorian waters and/or the New South Wales south coast (e.g. Eden, Jervis Bay). Seven southern right whales were sighted during the MESP; two cow calf pairs and an unaccompanied adult in shallow inshore waters north-east of the OWFA, and a third cow calf pair sighted in offshore waters seaward of the OWFA. Sightings occurred inshore in June and July and offshore in September, agreeing with the known time of arrival and departure at aggregation sites (Charlton et al., 2019a).

The accidental hydrocarbon release modelling (Attachment II – Oil spill modelling summary) indicated an almost certain probability (96 to 100 per cent) of entrained hydrocarbon contact and film contact (i.e. surface oil) at concentrations where harmful effects to marine mammals may occur within the southern right whale BIA year-round (RPS, 2021). Southern right whales spend a large amount of time in shallow waters (less than 20 metres deep) 'logging' at the surface, often moving slowly, making them more vulnerable to contact with surface slicks. Short-term injury (e.g. skin irritation) could occur; however, it is not expected to have long-term impacts. Any southern right whales present in the OWFA are likely to be travelling with young calves that are required to feed (suckle) regularly for survival, and therefore calves may ingest small amounts of entrained oil during feeding. Adult southern right whales are not known to feed while in Australian waters.

Southern right whales could occur in the OWFA and surrounding waters between March and December (in particular May to November) and could be exposed to a MGO spill. However, the risk of localised impacts (i.e. temporary skin irritation) to southern right whale from an MGO spill from collision of a project vessel will be managed through vessel traffic management and the implementation of an OPEP. While the duration of construction may be up to four years and ten months, any contact with MGO will be of extremely short duration and given the nature of MGO and the dilution and dispersion properties, any effects to individual southern right whales are expected to be minimal and unlikely to have population level impacts.

9.2.2.1.3 Humpback whale

There are no BIAs for humpback whales in proximity to the OWFA; however, humpback whale population numbers are high, predicted to reach at least 40,000 individuals between 2021 to 2026 (Noad et al., 2019), and they were the most dominant mysticete species recorded during the MESP baseline survey (Appendix A). Humpback whale sightings typically occurred in offshore waters during April to July / August and closer to shore on the shallower edge of the OWFA in September to December (Appendix A), consistent with the

literature which suggests humpback whales travel further offshore during their northward migration and closer inshore during their southern migration while travelling with calves (Noad et al., 2011). Almost half of all humpback whale sightings observed individuals travelling, with an increased number of individuals observed within the survey area on their southbound migration. Humpback whales were also observed feeding and displaying surface-active social behaviours.

Humpback whales occur more regularly in the OWFA than other mysticetes. If an accidental hydrocarbon release occurred during the months of April to December, humpback whales may be vulnerable to impacts from surface oil or entrained oil. Short-term injury (e.g. skin irritation) could occur; however, it is not expected to have long-term impacts. Feeding individuals may consume contaminated prey (e.g. krill); however, the level of contamination is likely to be low, given that humpbacks are migrating through the area and any feeding events are likely to be opportunistic and sporadic. The quantity of contaminated prey consumed is not expected to be sufficient to lead to health consequences for individuals. Humpback whales are more vulnerable during their southern migration (September to early December) when they travel at slower speeds in shallow coastal waters with calves, and therefore may be exposed to an MGO spill for longer period.

The risk of localised impacts (i.e. temporary skin irritation, consumption of contaminated prey) to humpback whales from an MGO spill from collision of a project vessel will be managed through vessel traffic management and the implementation of an OPEP. While the duration of construction may be up to four years and eleven months, any contact with MGO will be of extremely short duration and given the nature of MGO and the dilution and dispersion properties, any effects to individual humpback whales are expected to be minimal and unlikely to have population level impacts.

9.2.2.1.4 Other mysticetes

Six other mysticetes may occur in the OWFA and surrounding waters (refer to Section 6.2.4), three of which were recorded during the MESP: Bryde's whale, dwarf minke whale and Antarctic minke whale (Antarctic minke whale) (Appendix A). The seasonal presence of other mysticetes such as the fin whale and pygmy right whale is uncertain; however, it is expected that they may only occur for a period of months.

The OWFA and surrounding waters do not represent any known important breeding, resting or foraging habitat for any other mysticete species, and it is assumed that any presence in the area would be sporadic and primarily in deep water. The risk of localised impacts (i.e. temporary skin irritation) to other mysticetes from an MGO spill from collision of a project vessel will be managed through vessel traffic management and the implementation of an OPEP. While the duration of construction may be up to four years and eleven months, any contact with MGO will be of extremely short duration and given the nature of MGO and the dilution and dispersion properties, any effects to individual mysticetes are expected to be minimal and unlikely to have population level impacts.

9.2.2.1.5 Odontocetes (dolphins)

Dolphins were present in the OWFA year-round. Common dolphin peak presence was recorded in September and November, and bottlenose dolphin presence peaked in June and September. Two 'like striped dolphins' were sighted in September. The predominant behaviour for dolphins was travelling, followed by feeding and resting. Five bottlenose dolphin calves were sighted over March and April and one common dolphin calf was sighted in August (Appendix A). During the MESP common dolphin sightings were distributed mostly in offshore waters outside of the OWFA, while bottlenose dolphins were more commonly sighted in inshore waters (Appendix A). Two killer whales were sighted during visual aerial surveys in July, with a possible third 'like-killer whale' sighted in April. Killer whales may be present in the OWFA; however, their presence is expected to be limited to occasional transient individuals or small groups.

The seasonal presence of other odontocetes such as the Risso's dolphin is uncertain; however, it is expected that they may only occur for short periods of time.

No studies have documented the impacts of an MGO spill on dolphins. Information on the impacts to dolphins from accidental hydrocarbon releases is known from large-scale spill events, orders of magnitude much larger and released over a much longer period than that possible during the project. These impacts include physical injury (e.g. skin irritation), long-term health impacts (e.g. lung disease) and mortality (Litz et al., 2014; Venn-Watson et al., 2015a; Venn-Watson et al., 2015b). The gravity of impacts is far greater for resident populations (Wells et al., 2017). Dolphin residency has not been recorded in the OWFA or surrounding areas.

The OWFA is not known to provide important habitat for dolphin species; however, given that dolphins are present in the OWFA year-round, they may be exposed to surface or entrained oil whilst travelling or feeding. Bottlenose dolphins are more likely to come into contact with hydrocarbons if the spill is in the inshore area of the OWFA, whilst common dolphins would be more vulnerable if the spill was further offshore. Dolphins may be vulnerable to ingestion of contaminated prey (e.g. fish and pelagic invertebrates); however, the level of contamination is expected to be low with no long-term health impacts expected.

The risk of localised impacts (i.e. temporary skin irritation, consumption of contaminated prey) to dolphins from an MGO spill from collision of a project vessel will be managed through vessel traffic management and the implementation of an OPEP. While the duration of construction may be up to four years and eleven months, any contact with MGO will be of extremely short duration and given the nature of MGO and the dilution and dispersion properties, any effects to individual dolphins are expected to be minimal and unlikely to have population level impacts.

9.2.2.2 Pinnipeds

Pinnipeds utilise all three risk pathways identified above: time spent at the surface, time spent below surface, swimming and foraging, and time spent on the shore during hauling out, and therefore may be more vulnerable to impacts from an MGO spill. Information on the impacts to pinnipeds from accidental hydrocarbon releases is known from large-scale spill events, orders of magnitude much larger and released over a much longer period than that possible during the project. Potential impacts include direct oiling, skin or eye irritation and inhalation or ingestion of volatile compounds (AMSA, 2011).

Ingestion of oil by pinnipeds can occur directly; however, most pinnipeds reportedly do not lick or groom themselves (Geraci and Aubin, 1988), therefore ingestion is more likely through oil-contaminated prey. Any ingested hydrocarbons can irritate the stomach and intestine and impacts to the liver and kidneys of exposed animals has been observed (Helm et al., 2014). Pinnipeds have been found to have enzyme systems which are able to convert hydrocarbons into polar metabolites, which can then be excreted in urine (Engelhardt, 1983) and studies suggest that a small phocid would have to ingest approximately one litre of oil to be at risk (Geraci and Aubin, 1988).

Fur seals, in particular juveniles, are more vulnerable to mortality due to the likelihood of the oil adhering to their fur. The fur acts as a thermal barrier, trapping in air to insulate the animal and repelling water. If any oil is covering the fur its insulative value is compromised due to a breakdown of the natural oils present in the fur. This increases the rate of heat transfer of the animal to potentially double the normal rate after contact with oil (Geraci and Aubin, 1988). This creates an energetic burden to the animal which can result in mortality; however, adult fur seals also rely on blubber for thermoregulation, which is not impacted by contact with oil (Kooyman et al., 1977). Oil sticking to fur can also result in a lack of mobility, with flippers of seal pups reported to stick to the animals' bodies, reducing their ability to swim (Davis and Anderson, 1976). In addition, mothers may not feed pups when they are oiled leading to starvation (Michel and Fingas, 2016).

Two pinniped species, the Australian fur seal (AUFS) and New Zealand fur seal (NZFS) are known to occur in the Gippsland region and have breeding colonies in proximity to the OWFA. Due to the difference in foraging behaviours and movements by each of these species (Appendix A), a detailed assessment of potential impacts to each species, as a result of an accidental hydrocarbon release, is provided below.

9.2.2.2.1 Australian fur seals

Results of the MESP indicate that AUFS from the Rag Island colony occur regularly throughout the OWFA and surrounding waters en route to foraging grounds in the north-east, with an estimated 5 per cent of the population predicted to be in the OWFA at any one time (Appendix A). Usage of the OWFA was highest during the mid / late-lactation stage (June to September). In comparison, it was estimated that 0.05 per cent of the population of AUFS at Kanowna Island would be in the OWFA at any one time (Appendix A).

The deep diving behaviour of foraging AUFS indicates that they are benthic foragers, with up to 95 per cent of dives to the sea floor (Speakman et al., 2020). Accidental hydrocarbon release modelling indicates that entrained oil (100 to greater than or equal to 500 ppb) does not reach below 20 metres water depth, and will not reach the seabed (Attachment II – Oil spill modelling summary; RPS, 2021). Therefore, AUFS are highly unlikely to be exposed to MGO through ingestion of contaminated prey while foraging. AUFS often return to land to rest rather than spending time at the sea surface in order to avoid predation, thereby reducing their exposure to surface oil.

Accidental hydrocarbon release modelling (Attachment II – Oil spill modelling summary) indicates a low probability of shoreline hydrocarbon contact at the Seal islands Wildlife Reserve, including Rag Island (22 to 25 per cent), and no contact at Kanowna Island. In the event of an accidental hydrocarbon release, it is unlikely fur seals would avoid colonies and waters within the OWFA as they rely on them for important behaviours (i.e. resting, breeding, foraging). Therefore, it is possible that AUFS, particularly from Rag Island, could be directly exposed to an MGO spill.

The risk of localised impacts (i.e. temporary skin irritation) to AUFS from an MGO spill from collision of a project vessel will be managed through vessel traffic management and the implementation of an OPEP. While the duration of construction may be up to four years and eleven months, any contact with MGO will be of extremely short duration and given the nature of MGO and the dilution and dispersion properties, any effects to individual AUFS are expected to be minimal and unlikely to have population level impacts.

9.2.2.2.2 New Zealand (long-nosed) fur seals

A small number of NZFS from the Kanowna Island colony may be present in the OWFA (Appendix A). NZFS predominantly dive to shallow depths of around 17 metres, indicating that they are epipelagic foragers (Arnould and Hindell, 2001; Hoskins et al., 2017), therefore, NZFS may be exposed to entrained oil while foraging or through ingestion of contaminated prey in the water column. Whilst NZFS could occur in the OWFA, the area including its surrounding waters does not represent important foraging habitat for animals from Kanowna Island (Appendix A). Accidental hydrocarbon release modelling indicates no shoreline hydrocarbon contact at Kanowna and Anser Islands (Attachment II – Oil spill modelling summary; RPS, 2021).

The risk of localised impacts (i.e. temporary skin irritation, consumption of contaminated prey) to NZFS from an MGO spill from collision of a project vessel will be managed through vessel traffic management and the implementation of an OPEP. While the duration of construction may be up to four years and eleven months, any contact with MGO will be of extremely short duration and given the nature of MGO and the dilution and dispersion properties, any effects to individual NZFS are expected to be minimal and unlikely to have population level impacts.

9.2.2.3 Marine turtles

There are no important habitats for marine turtles (i.e. nesting beaches, designated BIAs) in proximity to the OWFA, and their presence in the OWFA and surrounding waters is expected to be limited to highly occasional transient individuals. A single leatherback and a single loggerhead turtle were observed during the MESP and EIF baseline survey periods (Appendix A).

Marine turtles may be vulnerable to surface oiling from a MGO spill. However, modelling by French-McCay (2009) suggests adult turtles only spend 1 to 10 per cent of their time at the sea surface with each dive lasting between 30 to 70 minutes, and therefore exposure to surface oil is less likely. Impacts from large scale accidental hydrocarbon releases include severe metabolic and osmoregulatory abnormalities (Stacy et al., 2017) and mortality (Mitchellmore et al., 2017); however, there is limited information reported on the impacts to marine turtles from small scale or MGO spills. Other impacts to marine turtles may occur through oiling of sensitive tissues (eyes, respiratory) and through ingestion via contaminated food or absorption through skin causing dermal pathologies.

The presence of marine turtles is expected to be limited to highly occasional transient individuals spending only a small amount of time at the surface. The risk of localised impacts (i.e. temporary skin irritation) to marine turtles from an MGO spill from collision of a project vessel will be managed through vessel traffic management and the implementation of an OPEP. While the duration of construction may be up to four years and eleven months, any contact with MGO will be of extremely short duration and given the nature of MGO and the dilution and dispersion properties, any effects to individual marine turtles are expected to be minimal with no population level impacts.

9.2.3 Mitigation measures

The Spill Response Plan (initial mitigation SPL-M02; Table 7-3) will include measures for monitoring and assessment of ecological impacts. Monitoring of habitat and species affected by a spill release is important to determine the efficacy of spill response measures and any ongoing disruption to ecosystem functioning. Marine mammals and turtles could be impacted by a spill and this mitigation must therefore include recording of any marine mammals and turtles that encounter the discharge.

Following the implementation of initial mitigation measures, including a Spill Response Plan (SPL-M02) and compliance with maritime legislation relevant to the prevention of pollution in the marine environment (VES-M01), the initial risk rating of impacts to marine mammals and turtles from a hydrocarbon release is Low. Therefore, no further risk mitigation is required.

9.2.4 Residual risk

Table 9-4: Consequence, likelihood and residual risk ranking associated with an accidental hydrocarbon release from a collision of a project vessel during the construction phase

Potential Impact	Receptor	Receptor sensitivity	Initial risk rating	Mitigation	Residual risk rating
Oiling, toxicity	All marine mammals and turtles	Medium	Low	VES-M01 VES-M03 VES-M04 SNV-M07 SPL-M01 SPL-M02 SPL-M03	Low
			Consequence = Moderate (C) (Magnitude = Medium, Likelihood = Rare)		Consequence = Moderate (C) (Magnitude = Medium, Likelihood = Rare)

9.2.5 Evaluation of residual risk against assessment criteria

An evaluation of the residual impacts against the assessment performance criteria in Section 0 is provided in Table 9-5.

Table 9-5: Evaluation of residual risk against assessment criteria for accidental hydrocarbon release

Assessment criteria	Evaluation	Confidence / uncertainty
Principles of ESD AC1: Biological diversity and productivity of the environment is not compromised because of the project.	An accidental release of hydrocarbons resulting from a vessel collision may result in localised impacts to biological diversity and productivity of the environment. However, effects are expected to be short-term throughout the period of occupancy of animals (days to weeks) and limited to disruption to migration with no population level impacts. The risk of localised impacts from a release of hydrocarbons from collision of a project vessel will be managed through vessel traffic management and the implementation of an OPEP. The environmental outcome is not inconsistent with the Principles of ESD.	Medium confidence There is uncertainty in the prediction as variables such as the spill volume, season, location, response, number of animals encountered will determine the actual effects of the spill, however the likelihood of the event occurring remains very low.
Significant Impact Guidelines (threatened species) AC4: The project will not have a significant impact on Threatened (Endangered and Vulnerable) Species as defined in the MNES Significant Impact Guidelines 1.1	An accidental release of hydrocarbons resulting from a vessel collision may result in localised impacts to threatened species and their habitat. However, any contact with hydrocarbons or MGO spill from collision of a project vessel to threatened species will be of extremely short duration and given the nature of MGO and the dilution and dispersion properties, any effects to species are expected to be minimal and unlikely to impact breeding success or lead to a long-term decrease in the size of a population. The risk of localised impacts from a release of hydrocarbons from a collision of a project vessel will be managed through vessel traffic management and the implementation of an OPEP. The project is not	

Assessment criteria	Evaluation	Confidence / uncertainty
	inconsistent with the Significant Impact Guidelines for threatened species.	
EPBC Regulations (multiple) AC5: The project will be managed to prevent vessel strike (with marine fauna)	The project will implement a Vessel Management Plan and align with practices and approach distances outlined in the guidelines. The project is not inconsistent with the EPBC Regulations 2000 Part 8, Wildlife (Marine Mammal) Regulations 2019, and the Australian National Guidelines for Whale and Dolphin Watching. The project will implement measures described in the National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna.	
Pollution prevention AC6: The project will be managed to prevent pollution from routine and/or accidental discharges to the marine environment.	Accidental release of hydrocarbons is expected to be localised at the location of activity during construction. It is expected that potential impacts to pollution from routine and/or accidental discharges to the marine environment will be of extremely short duration and given the nature of MGO and the dilution and dispersion properties, any pollution impacts are expected to be minimal and/or localised to one area. The risks of localised impacts from a release of hydrocarbons from a collision of a project vessel will be managed through vessel traffic management and the implementation of an OPEP. The project is not inconsistent with the project assessment criteria.	
Significant Impact Guidelines (migratory species) AC7: The project will not have a significant impact on Migratory Species as defined in the MNES Significant Impact Guidelines 1.1	An accidental release of hydrocarbons resulting from a vessel collision may result in localised impacts to migratory species and their habitat. However, any contact with hydrocarbons or MGO spill from collision of a project vessel will be of extremely short duration and given the nature of MGO and the dilution and dispersion properties, and the species moving through the area rather than staying for long periods, any effects to species are expected to be minimal and unlikely to impact important behaviours, such as breeding, feeding, migration or resting. The risks of localised impacts from a release of hydrocarbons from a collision of a project vessel will be managed through vessel traffic management and the implementation of an OPEP. The project is not inconsistent with the Significant Impact Guidelines for migratory species.	
Significant Impact Guidelines (Commonwealth Marine Areas) AC8: The project will not have a significant impact on Commonwealth Marine Areas as defined in the MNES Significant Impact Guidelines 1.1.	Accidental release of hydrocarbons is expected to be localised at the location of activity during construction. It is expected that potential impacts to Commonwealth Marine Areas will be of extremely short duration and given the nature of MGO and the dilution and dispersion properties, any effects to Commonwealth Marine Areas are expected to be minimal. The risks of localised impacts from a release of hydrocarbons from a collision of a project vessel will be managed through vessel traffic management and the implementation of an OPEP. The project is not inconsistent with	

Assessment criteria	Evaluation	Confidence / uncertainty
	the Significant Impact Guidelines project for Commonwealth Marine Areas.	

9.3 Debris escape leading to entanglement or ingestion (MMT-R003)

9.3.1 Project activities

Marine debris in the ocean is usually assumed to be from land-based sources, although some studies have suggested that sea-based sources also play an important role. In coastal areas debris usually enter the ocean via direct littering that is moved offshore by the wind and / or tidal currents (Chassignet et al., 2021). The impacts of debris entanglement or ingestion have been observed in a broad range of marine fauna, including marine mammals and turtles (Kruse et al., 2023)

Entanglement and ingestion may occur either accidentally while feeding or scavenging, or deliberately if marine debris is mistaken for prey items (Laist, 1987, Roman et al., 2021). Sub-lethal effects of entanglement or ingestion of marine debris may reduce an individual's fitness and ability to successfully reproduce, catch prey and avoid predation (Pemberton et al., 1992). Additionally, habitat creation through artificial reef can adversely impact marine mammals and turtles through increased anthropogenic use of recreational fishing gear and thus an increased chance of entanglement / ingestion of lost gear (Revolution Wind, L. L. C, 2020).

9.3.2 Risk assessment

Marine debris is listed as a key threatening process under the EPBC Act. Marine sources of debris include commercial shipping and offshore installations and comprise solid, non-biodegradable floating materials disposed of or lost at sea (Commonwealth of Australia, 2018). Plastics are a major source of debris which have the potential to cause wide-ranging impacts to marine fauna (Commonwealth of Australia, 2018).

Several studies have investigated the impact of marine debris on seals in Australian waters. A study of the New Zealand Fur-seal, *Arctocephalus forsteri*, population on Kangaroo Island found 0.8 per cent of the population suffers entanglements each year (Page et al., 2003). In Tasmanian waters between 1989 and 1993, 136 Australian Fur-seals, *A. pusillus*, were observed with plastic neck collars (Pemberton et al., 1992). Observations of juvenile Australian Fur-seals on Montague Island found entanglement around the neck by rope, strap or portions of trawl net on seven occasions (Shaughnessy et al., 2001). There is also a relatively high incidence of entanglement in fishing equipment for the Australian Fur-seal. At haul-out sites in southern Tasmania, the incidence of entanglement was 1.9 per cent, and at Tenth Island in the Bass Strait, it was a minimum of 0.6 per cent (Pemberton et al., 1992). At Seal Rocks, Victoria, a high incidence of entanglement (up to 1.2 per cent) was also observed (Pemberton et al., 1992).

Several large baleen whales migrate past the Australian coast including the southern right whale *Eubalaena australis*, blue whale *Balaenoptera musculus*, and humpback whale *Megaptera novaeangliae*, while many species of dolphins are resident populations in coastal areas. There is currently an increasing trend in Australia with whales and dolphins becoming entangled in active commercial fishing gear (including lines, nets, traps and ropes), ghost nets (discarded fishing gear), and shark control nets and drumlines (Tulloch et al., 2020). The inshore distribution of common bottlenose dolphins and common dolphins makes them particularly susceptible to entanglement (Volep et al., 2017, Tulloch et al., 2020). While the near-shore migratory pathway of humpback whales and coastal distribution of reproducing southern right whales also make them vulnerable to the threat of entanglement (Lloyd and Ross, 2015, Tulloch et al., 2020). In one assessment of entanglements off the Western Australian coast humpback whales were the dominant species involved in greater than 90 per cent of entanglements (Groom and Coughran, 2012), with this pattern continuing over recent years (How et al., 2015). Southern right whales, while susceptible due to their coastal distribution, have had few reported entanglements in Australia (Groom and Coughran, 2012). However, the species has been slow to recovery from historical whaling, combined with low population estimates and a slow rate of reproduction, southern right whales may be particularly vulnerable to populations level impacts from entanglement (Tulloch et al., 2020). While there are limited sightings of blue whales within the OWFA and surrounding waters (Appendix A), as well as limited records of entanglement (Commonwealth of Australia, 2015), they have similar parameters to the endangered southern right whale,

with the lack of recovery from whaling, low populations estimates and slow rate of reproduction. Therefore, this receptor has been allocated a Medium sensitivity for this pathway.

Entanglement is recognised as one of the major sources of turtle mortality in areas of Australia where marine turtles frequent (Wilcox et al., 2015). A world-wide survey covering the major oceans where turtles live discovered that 91 per cent of entanglements are fatal (Duncan et al., 2017). While the magnitude of entanglement for marine turtles is Medium, there are limited observations in the OWFA and surrounding waters. The area is noted as a potential foraging hotspot for leatherback turtles, however only one observation of a leatherback was recorded during the 24-month MESP baseline survey. The OWFA and surrounding waters is not noted as an important habitat for any other species of turtle. Therefore, the receptor sensitivity has been assessed as Very Low.

9.3.3 Mitigation measures

To comply with the 'Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and ocean' (Commonwealth of Australia, 2018) standard industry vessel management practices will apply to prevent debris escape as provided in Table 7-3. No additional mitigations measures are required.

9.3.4 Residual risk

Table 9-6: Consequence, likelihood and residual risk ranking associated with entanglement or ingestion during the construction phase

Potential impact	Receptor	Receptor sensitivity	Initial risk rating	Mitigation measure	Residual Risk Rating
Entanglement or ingestion leading to injury or mortality	Humpback whale	Medium	Low Consequence = Negligible (E), (Magnitude = Low, Likelihood = Unlikely)	N/A	Low Consequence = Negligible (E), (Magnitude = Low, Likelihood = Unlikely)
Entanglement or ingestion leading to injury or mortality	Blue whale Southern right whale	Low	Very low Consequence = Negligible (E), (Magnitude = Low, Likelihood = Unlikely)	N/A	Very low Consequence = Negligible (E), (Magnitude = Low, Likelihood = Unlikely)
Entanglement or ingestion leading to injury or mortality	Other mysticetes Odontocetes - dolphins	Low	Very low Consequence = Negligible (E), (Magnitude = Low, Likelihood = Unlikely)	N/A	Very low Consequence = Negligible (E), (Magnitude = Low, Likelihood = Unlikely)
Entanglement or ingestion leading to injury or mortality	Marine turtles	Medium	Very low Consequence = Minor (D) (Magnitude = Low Likelihood = Rare)	N/A	Very low Consequence = Minor (D) (Magnitude = Low Likelihood = Rare)
Entanglement or ingestion leading to injury or mortality	Pinnipeds	Medium	Low Consequence = Minor (D) (Magnitude = Low, Likelihood = Unlikely)	N/A	Low Consequence = Minor (D) (Magnitude = Low, Likelihood = Unlikely)

9.3.5 Evaluation of residual risks against assessment criteria

An evaluation of the residual risk against the assessment criteria in Section 0 is provided in Table 9-7.

Table 9-7: Evaluation of residual risks against assessment criteria for entanglement or ingestion during the construction phase

Assessment criteria	Evaluation	Confidence / uncertainty
Principles of ESD AC1: Biological diversity and productivity of the environment is not compromised because of the project.	By limiting marine debris from offshore installations and shipping through compliance with the Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (2018), marine debris is unlikely to be so prevalent from the project activities that there is a population effect on any marine mammal or turtle species such that biological diversity or productivity is impacted. The project is not inconsistent with the Principles of ESD.	High confidence It is highly unlikely that marine debris will be lost during the project operations, and if it is, retrieval will be attempted so as to avoid impacts to marine fauna.
Significant Impact Guidelines (threatened species) AC4: The project will not have a significant impact on Threatened (Endangered and Vulnerable) Species as defined in the MNES Significant Impact Guidelines 1.1	By limiting marine debris from offshore installations and shipping through compliance with the Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (2018), the project is unlikely to significantly impact threatened species, with no impact on breeding success, the survival of individuals and, therefore, the recovery of a species. Standard industry vessel management practices will apply to prevent debris escape. The project is not inconsistent with the Significant Impact Guidelines for threatened species.	
Pollution prevention AC6: The project will be managed to prevent pollution from routine and/or accidental discharges to the marine environment.	By limiting marine debris from offshore installations and shipping through compliance with the Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (2018), the project is unlikely to significantly impact on pollution. Standard industry vessel management practices will apply to prevent debris escape. The project is not inconsistent with the project assessment criteria.	
Significant Impact Guidelines (migratory species) AC7: The project will not have a significant impact on for Migratory Species as defined in the MNES Significant Impact Guidelines 1.1	By limiting marine debris from offshore installations and shipping through compliance with the Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (2018), the project is unlikely to significantly impact threatened species, with no impact on breeding success, the survival of individuals or biologically important behaviours. Standard industry vessel management practices will apply to prevent debris escape. The project is not inconsistent with the Significant Impact Guidelines for migratory species.	
Significant Impact Guidelines (Commonwealth Marine Areas) AC8: The project will not have a significant impact on Commonwealth Marine Areas as defined in the MNES Significant Impact Guidelines 1.1.	By limiting marine debris from offshore installations and shipping through compliance with the Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (2018), marine debris is unlikely to be so prevalent from the project activities that there is a population effect on any marine mammal or turtle species such that biological productivity or ecological function/integrity are impacted. Standard industry	

Assessment criteria	Evaluation	Confidence / uncertainty
	vessel management practices will apply to prevent debris escape. The project is not inconsistent with the Significant Impact Guidelines for Commonwealth Marine Species.	

9.4 Accidental discharges (MMT-R004)

9.4.1 Project activities

Vessels will need to routinely discharge small volumes of liquid and solid waste into the marine environment during construction activities. Project activities that involve routine discharges are described in Section 8.2. Accidental discharges of these (including food waste, deck drainage, bilge waters, sewage and grey water, cooling waters and / or brine) may occur during the construction phase. The management and prevention of accidental discharges of liquid and solid waste are governed through the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and the *Navigation Act 2012*, to ensure compliance with international obligations (MARPOL).

9.4.2 Impact assessment

Marine mammals and turtles may be impacted by accidental discharges through similar ways as described in Section 8.2, including:

- A decline in water quality in the immediate vicinity of the discharge, including an increase in turbidity of surrounding waters.
- Introduction of marine pest species leading to a decline in health.
- Temporary toxicity to fauna through bilge water discharges.

Accidental discharges from large vessels may entail changes to water quality through contamination from hydrocarbons, detergents, solvents, and chemicals, or the introduction of marine pests species that can severely disrupt the marine ecosystem (Elçiçek et al., 2013). These are addressed in project technical reports on benthic habitats and fish (Technical Report B: Benthic Ecology and Technical Report C: Fish and Invertebrates). A range of mitigation measures (refer Table 7-3) will be implemented to decrease the risk of a reduction in water quality and the introduction of marine pests.

Accidental discharge of marine drilling fluids may occurring during marine drilling activities such as trenchless installation of the shore crossing and drilling monopiles in the event of pile refusal. Drilling fluids will be low toxicity, such as xanthan gum and bentonite, and consequently will limit potential environmental harm.

As soon as contaminants enter the marine environment, they will undergo weathering, dissolution and oxidation, which result in different impacts and depends on ocean conditions (Walker et al., 2019). Given the open area of the OWFA, small accidental discharges of hydrocarbons, detergents, solvents, and chemicals that affect water quality may disperse and dilute rapidly with little impact to the surrounding environment. However, large uncontrolled discharges may be more impactful and have the ability to negatively impact the surrounding environment and the marine mammal and turtle species in the area. Accidental discharge of bilge water can result in serious threat to the marine environment impacting the biodiversity, food / prey and ecosystem health (O'Brien, 2009). The accidental discharge of oily bilge water should be treated the same as an accidental hydrocarbon release discussed in Section 9.2.

The accidental discharge of sewage, grey water and garbage materials can reduce water quality of the surrounding environment, including increased turbidity and nutrient levels, and depleting oxygen (Mrčelić et al., 2021). This can lead to the promotion of harmful algal blooms resulting in the reduction of local biodiversity. Regulations regarding the release of sewage into the sea are contained in MARPOL Annex IV. Further risk assessment should be given to explain protocols in the event of an accidental discharge.

Ballast water not only carries the risk of introduction of invasive marine pest species (microbes, plants and animals), but also contains a variety of harmful substances, chemicals and bacteria (Čović et al., 2021; DAFF, 2023). The *International Convention for the Control and Management of Ships' Ballast Water and Sediments* requires the implementation of a ballast water management plan on all ships (IMO, 2004).

Receptor sensitivity to accidental discharges for marine mammals and turtles was assessed with a similar impact as Section 9.2 Accidental Hydrocarbon Release.

9.4.3 Mitigation measures

Standard industry vessel management practices will apply to vessel routine discharges as provided in Table 7-3.

The Spill Response Plan (initial mitigation SPL-M02; Table 7-3) will include measures for monitoring and assessment of ecological impacts. Monitoring of habitat and species affected by a spill release is important to determine the efficacy of spill response measures and any ongoing disruption to ecosystem functioning. Marine mammals and turtles could be impacted by a spill and this mitigation must therefore include recording of any marine mammals and turtles that encounter the discharge.

Following the implementation of initial mitigation measures, including a Spill Response Plan (SPL-M02) and compliance with maritime legislation relevant to the prevention of pollution in the marine environment (VES-M01), the initial risk rating of impacts to marine mammals and turtles from an accidental discharge is Very Low. Therefore, no further risk mitigation is required.

9.4.4 Residual risk

Residual impacts to the marine mammal and turtle receptors are described above. With existing protocols in place for managing routine discharges (i.e., MARPOL) residual impacts are not expected to occur therefore there would be no significant impacts on behaviour, migration, foraging and / or survival rates (Table 9-8)

Table 9-8: Consequence associated with accidental discharges during the construction phase

Potential Impact Receptor	Receptor sensitivity	Initial risk rating	Additional mitigation	Residual risk rating
Reduced water quality leading to changes in fauna behaviour / health	All marine mammals and turtles	Medium	Very low Consequence = Minor (D) (Magnitude = Low, Likelihood = Rare)	VES-M01 SPL-M02 Very low Consequence = Minor (D) (Magnitude = Low, Likelihood = Rare)

9.4.5 Evaluation of residual impacts against assessment criteria

Table 9-9: Evaluation of residual impacts against assessment criteria for accidental discharge during the construction phase

Assessment criteria	Evaluation	Confidence / uncertainty
Principles of ESD AC1: Biological diversity and productivity of the environment is not compromised because of the project.	Accidental discharges causing reduced water quality are unlikely to be so prevalent from project activities that there is a population effect on any marine mammal or turtle species such that biodiversity or productivity is affected. The risk of accidental discharges will be managed using standard industry protocols (i.e. MARPOL plus a Spill Response Plan. The project is not inconsistent with the Principles of ESD.	High confidence Australia's legislation safeguards the coastal and marine environments from the threat of pollution through regulation of vessels under the <i>Protection of the Sea (Prevention of Pollution from Ships) Act 1983</i> which invokes requirements of the MARPOL Convention relating to discharge of noxious liquid substances including oil, sewage, putrescible waste, garbage. These requirements are enacted through AMSA's
Significant Impact Guidelines (threatened species) AC4: The project will not have a significant impact on Threatened (Endangered and Vulnerable) Species	Changes in water quality affecting marine mammals and turtles are expected to be localised. Should an accidental discharge occur, discharges are predicted to be of low volume, rapidly diluted to	

Assessment criteria	Evaluation	Confidence / uncertainty
as defined in the MNES Significant Impact Guidelines 1.1	concentrations of negligible effect by mixing with the surrounding waters and recoverable with no long-term impacts to water quality. Accidental discharges could therefore result in minor habitat disturbance over the short-term. The project is unlikely to significantly impact breeding success, the survival of individuals and, therefore, the recovery of a species. Accidental discharges will be managed using standard industry protocols (i.e. MARPOL plus a Spill Response Plan). The project is not inconsistent with the Significant Impact Guidelines for threatened species.	Marine Orders which will apply to all vessels operating in Australian Commonwealth and State waters on the SOTS project.
Pollution prevention AC6: The project will be managed to prevent pollution from routine and/or accidental discharges to the marine environment.	Changes in water quality affecting marine mammals and turtles are expected to be localised. Should an accidental discharge occur, discharges are predicted to be of low volume, rapidly diluted to concentrations of negligible effect by mixing with the surrounding waters and recoverable with no long-term impacts to water quality. Accidental discharges will be managed using standard industry protocols (i.e. MARPOL) and the project will implement a Spill Response Plan.	
Significant Impact Guidelines (migratory species) AC7: The project will not have a significant impact on Migratory Species as defined in the MNES Significant Impact Guidelines 1.1	Changes in water quality affecting marine mammals and turtles are expected to be localised. Should an accidental discharge occur, discharges are predicted to be of low volume, rapidly diluted to concentrations of negligible effect by mixing with the surrounding waters and recoverable with no long-term impacts to water quality. Accidental discharges could therefore result in minor habitat disturbance over the short-term or, for migratory species, the period of occupancy. The project is unlikely to significantly impact breeding success, the survival of individuals or biologically important behaviours. Accidental discharges will be managed using standard industry protocols (i.e. MARPOL plus a Spill Response Plan). The project is not inconsistent with the Significant Impact Guidelines for migratory species.	
Significant Impact Guidelines (Commonwealth Marine Areas) AC8: The project will not have a significant impact on Commonwealth Marine Areas as defined in the MNES Significant Impact Guidelines 1.1	Changes in water quality affecting marine mammals and turtles are expected to be localised. Should an accidental discharge occur, discharges are predicted to be of low volume, rapidly diluted to concentrations of negligible effect by mixing with the surrounding waters and recoverable with no long-term impacts to water quality. Accidental discharges could therefore result in minor habitat disturbance over the short-term. The project is unlikely to significantly impact breeding success or the survival of individuals. Accordingly, accidental discharges are not considered as having the potential to result in a substantial change in water quality or the	

Assessment criteria	Evaluation	Confidence / uncertainty
	accumulation of harmful chemicals such that biodiversity or ecological function/integrity are affected. Accidental discharges will be managed using standard industry protocols (i.e. MARPOL plus a Spill Response Plan). The project is not inconsistent with the Significant Impact Guidelines for Commonwealth Marine Areas.	

10 OPERATIONS IMPACT ASSESSMENT

This section discusses the potential impacts of the project as a result of commissioning and operation of the project and the associated mitigation measures that aim to reduce impacts to as low a level as reasonably practicable.

Descriptions of routine discharges into the marine environment from vessels and any potential impacts to marine mammals and turtles have been assessed in Section 8.2. The number of vessels is expected to be substantially lower during the operational phase compared with the construction phase. Therefore, the assessment of impacts from routine discharges on marine mammals and turtles during the operation phase is conservatively based on that described in Section 8.2 for the construction phase and not further assessed here.

Vessel traffic and any potential impacts arising from vessel lighting on marine mammals and turtles during the operational phase have been assessed in Section 8.4. Given that the assessment did not identify any marine mammal or turtle receptors sensitive to artificial lighting emissions, and that lighting will be substantially lower in the operations phase compared to the construction phase, the potential impacts from operational lighting is not further assessed here.

10.1 Underwater noise (MMT-I001)

10.1.1 Operational activities

10.1.1.1 Project activities

Operation of the offshore project will produce underwater noise emitted above background levels from operating wind turbines and during project vessel activities for maintenance of turbines, and electrical infrastructure such as OSS and submarine cables. Both noise sources are continuous.

10.1.1.1.1 Operating wind turbines

Underwater noise from operating wind turbines originates from movement of air around turbine blades and mechanical noise of bearings and the generator converting kinetic energy to electricity. Sound generated by blades is produced in the air and is not likely to enter the water directly, while mechanical noise associated with the operating WTG is transmitted into the water as vibration through the foundation and subsea cable. Mechanical noise originates in the moving mechanical parts (gearbox, brake, control electronics) in the nacelle and is almost exclusively at frequencies below 1 kHz, in most cases below 750 Hz (Marmo et al., 2013; Tougaard et al., 2020). Noise is emitted into the water at frequencies in the range of 25 to 160 Hz, though in some cases harmonics may extend to up to a few hundred hertz (Bellman et al., 2023). There are no direct measurements to suggest that the source levels of noise emitted from an operating wind farm exceed a maximum of 145 dB re 1 $\mu\text{Pa}^2 \text{ m}^2$ (rms), which is below many the thresholds for TTS in both LF (177 dB re 1 $\mu\text{Pa}^2 \text{ m}^2$ (rms)) and HF (181 dB re 1 $\mu\text{Pa}^2 \text{ m}^2$ (rms)) cetaceans, and therefore also below PTS onset thresholds (Table 8-4). Furthermore, all measurements suggest that the received levels drop to less than 120 dB re 1 μPa (behavioural disturbance threshold for continuous noise) at 100 metres and that levels propagating in the water column beyond this point will be low irrespective of propagation conditions (Madsen et al., 2006; Tougaard et al., 2009; Bellman et al., 2023).

Noise measurements from operating offshore wind farms in the North and Baltic Seas found noise inputs into the water from large monopiles foundations (pile diameter up to 8.1 m) were lower (~3 dB) than other foundation structures, such as jackets (Bellman et al., 2023). Furthermore, larger turbines (8 MW) were slightly quieter than smaller turbines (2.3 MW), however this may be also attributed to a change from gearbox to direct drive (Bellman et al., 2023). A shift from using gear boxes to direct drive technology was shown to reduce the sound level by 2.5 dB (Bellman et al., 2023), substantially less than the predicted 10 dB reduction in Stöber and Thomsen (2021).

Studies that have created 'simple' models of entire OWFs show that the overall noise level from a wind farm extends out a few kilometres before it is masked by ambient noise. Tougaard et al. (2009) found that sound level from three different WTG types in European waters was only measurable above ambient sound levels at frequencies below 500 Hz. Thomsen et al. (2006) suggest that at approximately 500 metres from operating WTGs, sound levels are expected to approach ambient levels. However, noise levels differ

according to wind and rotor speed, with different ambient noise levels depending on distance of turbines to existing shipping traffic (Tougaard et al., 2009; Bellman et al., 2023; Yoon et al., 2023). A recent paper by Tougaard et al. (2020) used a linear model to fit sound levels as a function of turbine size, wind speed and distance. Their model suggested that sound from multiple WTGs would be detectable out to a few kilometres in areas with very low ambient noise levels but would be below ambient unless “very close” to individual WTGs in areas with high ambient noise from shipping or wind. However, this model is based on only a few smaller turbine types with gearboxes, and consequently predictions of the noise conditions were largely overestimated (up to 8 dB) above actually measured operational noise of turbines (Bellman et al., 2023; Holme et al., 2023) and therefore distances may be conservative.

Underwater noise levels emitted by operating wind turbines are generally below those from large vessels. Tougaard et al. (2020) report an estimated SPL from a single turbine measured at 100 metres from the source of 105 to 125 dB re 1 μ Pa and Bellman et al. (2023) report a mean SPL of 112 to 131 dB re 1 μ Pa. In contrast, McKenna et al. (2012) report an SPL of around 180 to 190 dB re 1 μ Pa for large commercial ships (e.g. container ship and chemical tanker). Consequently, the presence of large ships in an area with wind farms will mask the noise from turbines at considerable ranges (Madsen et al., 2006; Tougaard et al., 2020). Agreeing with this, Bergström et al. (2013) reported that a wind farm is less detectable in intense ship traffic areas, though it is acknowledged that as the size of turbines increase so too may the level of noise emitted (Tougaard et al., 2020; Stöber and Thomsen et al., 2021). In contrast to ships, wind turbines are static, and therefore their contribution to the local soundscape is much more persistent, although not constant (Tougaard et al., 2020). Furthermore, the cumulative impact of turbines (i.e. larger wind farms with many turbines) must be considered during spatial planning and environmental impact assessment as offshore wind farms increase in number and size (Tougaard et al., 2020).

10.1.1.1.2 Project vessels

During the operational phase of the project, operations and maintenance activities in the project area will be supported primarily by service operations vessels (SOVs) and crew transfer vessels (CTVs). Supply vessels and cable repair vessels will be used as required for specific maintenance activities. Larger installation vessels such as JUVs may be used occasionally for component replacement.

Up to 1,202 vessel trips (return to and from port) will occur per annum during the operation period. The majority of vessels trips will be by CTVs to transfer technicians. These are smaller vessels (average 2.5 metre draft), and do not use DP. The alternative is that the CTVs remain offshore and transfer technicians from an SOV to the WTG, resulting in fewer vessel trips to port. SOVs would typically use DP during transfer operations and approach to WTG.

Maintenance vessels and other service vessels would not typically use DP during operations. Some large-scale maintenance operations, such as replacement of WTG main components would require larger specialised vessels which may operate under DP, although these operations would be infrequent events. As such the sound field generated by maintenance vessels would be considerably less than vessel noise generated during construction phase.

10.1.2 Impact assessment

Operating wind turbines

Impacts at the anticipated noise levels emitted by an operational wind farm are limited to behavioural response and auditory masking (Bergström et al., 2014):

- Behavioural responses – impacts may include changes in foraging, socialisation, or movement, including avoidance or displacement from the area
- Auditory masking (i.e. reduction in communication space) – impacts may include changes to foraging, social interactions, and predator avoidance
- The potential for masking is highly dependent on the species in question, and those with low-frequency hearing range (e.g. mysticetes) will be more susceptible due to the overlap with the frequency range of WTG underwater noise.

Whilst the impact of wind farm construction, particularly pile driving, can have significant impacts on marine mammal abundance and distribution (Edrén et al., 2010; Brandt et al., 2011), operational wind turbines are unlikely to reach dangerous noise levels and are considered to have no significant negative effect (Scheidat

et al., 2011; McConnell et al., 2012; Marmo et al., 2013. These studies are mainly from European wind farms where marine mammal populations include seals, minke whales and harbour porpoises. The response of baleen whales to sound emitted from operating wind turbines is largely unknown and has not been adequately researched in the current literature, however, it is not anticipated to be of a greater magnitude and scale compared with oil and gas activities which are common in Gippsland. However, there are few peer-reviewed published studies monitoring noise from these activities available. In general, operational noise from wind farms and petroleum platforms is thought to be below background levels at distances of tens to hundreds of metres (Erbe et al. 2013, Jiminez-Arranz and Cook 2020, Amaral et al. 2023). Tagging studies on fins whales off the north-east coast of the United States are currently being undertaken by the US Department of Energy to try to determine baleen whale behaviour during the construction and operation of offshore wind farms.

It is recommended once a wind farm is constructed, studies and monitoring should continue through to the operations phase to better inform and understand if marine mammal and turtle populations are impacted, that is, to determine if they use the area more or less compared with prior to the construction of the wind farm and subsequently, if there could be any population effects that are inconsistent with the acceptance criteria.

Vessel operations

The assessment of impacts from vessel noise on marine mammals and turtles during the operation phase is conservatively based on that described in Section 8.1 for the construction phase.

10.1.2.1 Blue whale

Blue whale vocalisations may be masked by underwater noise emitted by operating wind turbines during the operational phase of the project, and consequently they may exhibit a behavioural response, for example avoidance of the OPA and / or deviation from their movement pathway as to avoid a reduction in communication space.

In response to vessel noise, blue whales were found to increase the amplitude of their calls, though also spend greater time at the surface thereby reducing time spent foraging when within 900 metres from a ship (McKenna, 2001).

The OWFA overlaps with a foraging BIA for blue whales, however the OWFA and surrounding waters have relatively low productivity with negligible influence from nearby upwelling waters (Huang et al., 2019) and all detections of blue whales during the MESP were for short periods only (Appendix A), and therefore it is not likely that blue whales would forage in the area. Instead, the presence of blue whales is expected to be limited to occasional transient individuals. Impacts from operating wind turbines are expected to be short-term and masking would only occur to whales while transiting through the ensonified area, which is expected to be limited to a few kilometres from the wind farm. The implementation of mitigation measures to reduce the risk of vessel strike for cetaceans (Section 11.1) will also help to reduce the risk of auditory impairment / disturbance from vessel noise.

10.1.2.2 Southern right whale

A review paper by Madsen et al. (2006) found that NARW may respond to wind turbine operational noise up to few kilometres away in a quiet habitat with no shipping. However, in a habitat near busy shipping routes, including the OWFA, the response range is expected to be much smaller (Estabrook et al., 2022). The significance of this response will depend on the proximity of wind farms to whale migration routes (Vella et al., 2001). Southern right whale vocalisations may be masked by underwater noise emitted by operating wind turbines during the operational phase of the project, resulting in a reduction in communication space, which may be particularly detrimental for female and calf pairs. Consequently, southern right whales may exhibit a behavioural response, for example avoidance of the OPA and / or deviation from their movement pathway as to avoid this.

Southern right whales are able to adapt their vocalisations in response to increasing ambient noise (Parks et al., 2015). While it is possible that southern right whales may habituate to vessel noise (Nowacek et al., 2004), it may also cause increased stress (Rolland et al., 2012).

The OWFA is within a southern right whale BIA for 'migration, approximately April to October', and offshore from a BIA / HCTS for 'reproduction – approximately May to September'. However, the OWFA and surrounding waters do not represent a recognised aggregation area for southern right whales, and it is

unlikely that whales will aggregate in the area in future due to a restricted memory of calving habitat and a lack of conspecifics (Pirzl, 2008). Instead, southern right whales may transit the OWFA and surrounding waters, particularly inshore, en-route to calving and aggregating sites in western Victorian waters and / or the New South Wales south coast. The OWFA is located ten kilometres from the coast, and masking of sound from wind turbines is unlikely to impact individuals resting in nearshore waters within two kilometres from the coastline, especially as research suggests southern right whale female and calf pairs may preferentially occupy noisy waters within the surf zone to reduce detectability by predators (Nielsen et al., 2019). Impacts from operating wind turbines are expected to be short-term and masking would only occur to whales while transiting through the ensonified area, which is expected to be limited to a few kilometres from the wind farm. The implementation of mitigation measures to reduce the risk of vessel strike for cetaceans (Section 11.1) will also help to reduce the risk of auditory impairment / disturbance from vessel noise.

10.1.2.3 Humpback whale

Humpback whale vocalisations may be masked by underwater noise emitted by operating wind turbines during the operational phase of the project, and consequently they may exhibit a behavioural response, for example avoidance of the OPA and / or deviation from their movement pathway as to avoid a reduction in communication space.

Humpback whales could display a behavioural change if in close proximity to vessels, or avoid the area around vessels (Dunlop et al., 2015; 2018).

Humpback whales are known to migrate through the OWFA and surrounding waters during seasonal migrations to and from feeding and breeding grounds, occurring in greater numbers while southbound. However, the OPA does not extend across the entire migratory pathway. While humpback whales were observed feeding in waters surrounding the OPA (Appendix A), the OWFA does not provide important foraging habitat for these species. Humpback whales may be present with calves during their southern migration (Appendix A). Impacts from operating wind turbines are expected to be short-term and masking would only occur to whales while transiting through the ensonified area, which is expected to be limited to a few kilometres from the wind farm. The implementation of mitigation measures to reduce the risk of vessel strike for cetaceans (Section 11.1) will also help to reduce the risk of auditory impairment / disturbance from vessel noise.

10.1.2.4 Other mysticetes

Marmo et al. (2013) predicted that minke whales could detect an operating wind farm at least 18 kilometres away. However, using the Southall et al. (2007) M-weighted function ten per cent of animals were expected to move away within 3.7 kilometres when wind speed was 15 metres per second, reducing to 1.7 kilometres when wind speed was ten metres per second (Marmo et al., 2013). Though it is noted that these conclusions were made for a relatively small wind farm (16 turbines).

Other mysticetes may alter the amplitude of their calls in response to increasing ambient noise (Helbe et al. 2013), or possibly reduce calling rate (Cholewiak et al., 2018).

Dwarf minke whales are known to migrate through the OWFA and surrounding waters during seasonal migrations to and from feeding and breeding grounds, and were occasionally observed feeding, though the OWFA does not provide important foraging habitat for this species (Appendix A). Dwarf minke whales may be present with calves during their southern migration (Appendix A). The movement patterns of other species including Antarctic minke whales and Bryde's whales are unknown; however, it is expected that the presence of these whales will be limited to transient individuals or small pods. Impacts from operating wind turbines are expected to be short-term and masking would only occur to whales while transiting through the ensonified area, which is expected to be limited to a few kilometres from the wind farm. The implementation of mitigation measures to reduce the risk of vessel strike for cetaceans (Section 11.1) will also help to reduce the risk of auditory impairment / disturbance from vessel noise.

10.1.2.5 Odontocetes – dolphins

Few studies have investigated the response of porpoises and dolphins to noise from an operating wind farm. Tielmann and Carstensen (2012) reported avoidance of the wind farm area by harbor porpoises during initial operation of the wind farm, though numbers slowly increased again during continued operation, demonstrating potential long-term habituation. Koschinski et al. (2013) found that harbor porpoises exhibited

a behavioural response at ranges of 200 to 300 metres to playback of simulated offshore wind turbine sounds. The response of bottlenose dolphins to wind farms is expected to be minor due to their poor low frequency hearing capabilities, and there is no reason to believe they would hear even the noisiest of operating wind farms at a range of more than a few hundred metres (Madsen et al., 2006). However, responses may change as the size of wind farms and therefore the noise levels emitted increase. Due to the higher frequency range that odontocetes vocalise within (greater than 1 kHz), the risk of masking from operating turbines is likely to be negligible (Madsen et al., 2006).

Odontocetes, including dolphins and killer whales, were shown to alter their vocalisations and change behaviour (i.e. increased time spent travelling) in response to vessel noise.

Bottlenose dolphins and common dolphins were present in the OWFA and surrounding waters year-round, and two 'like striped dolphins' were sighted in September (Appendix A). The predominant behaviour for dolphins was travelling, followed by feeding and resting. Five bottlenose dolphin calves and one common dolphin calf were sighted over March, April and August, respectively (Appendix A). Two killer whales were sighted during visual aerial surveys in July, with a possible third 'like-killer whale' sighted in April (Appendix A). Killer whales may be present in the OWFA; however, their presence is expected to be limited to occasional transient individuals or small groups.

It is unlikely that odontocete vocalisations (whistles and echolocation clicks) would be masked by noise from operating wind turbines, or that they would display a behavioural response to noise. Any possible impacts to individuals would be short-term and masking would only occur to animals while in the potentially ensounded area, which is expected to be limited to a few hundred metres from the wind farm. While dolphins may be present in the OWFA year-round, other species are transient, and it is extremely unlikely that a killer whale would remain within distances to PTS and TTS for vessel noise for a full 24-hour period, and therefore any impacts are expected to be limited to a behavioural response. The implementation of mitigation measures to reduce the risk of vessel strike for cetaceans (Section 11.1) will also help to the risk of PTS and TTS to dolphins from vessel noise.

10.1.2.6 Pinnipeds

Tougaard et al. (2009) estimated the maximum distance that seals could perceive the noise from different wind farms to be between 2.5 and 10 kilometres; however, this may vary depending on type and size of wind turbine as well as other environmental conditions. Harbour seals displayed avoidance behaviours when exposed to simulated sound from operating WTGs; however, this response was limited to distances of less than 500 metres from the source (Hastie et al., 2018). In contrast, Russell et al. (2016) found harbour seals did not avoid an operational wind farm and were tracked making directed movements between turbine locations, suggesting they were foraging around the foundations. It is possible that seals would display initial avoidance to wind farms, followed by habituation and possible attraction to wind farms as feeding grounds (Vella et al., 2001) (see Section 10.6). The potential for masking of seal calls by operational wind turbines was considered low compared to impulsive sound (Lucke et al., 2008).

In response to vessel noise fur seals may alter their behaviour, for example a change in dive behaviour or ceasing resting.

Fur seals were present in all months of the year during the MESP and in five of the six months of the EIF program (Appendix A). Tracking data indicate that AUFS from the Rag Island colony occur regularly throughout the OWFA and surrounding waters en-route to foraging grounds in the north-east, while the OWFA and surrounding waters do not represent important foraging habitat for AUFS or NZFS from Kanowna Island (Appendix A).

Fur seals may display a localised adverse behavioural response to noise from operating wind turbines (i.e. avoidance). However, it is also possible that turbine foundations offer a foraging opportunity as fish and shellfish colonised the hard substrates thus the attraction of increased prey ability may override the avoidance response. Impacts are expected to be short-term and localised to areas near the wind turbines. Given the proximity of fur seal colonies, and in particular Kanowna Island, to shipping lanes, it is likely that fur seals are accustomed to vessel noise. The implementation of mitigation to reduce vessel strike for pinnipeds (Section 11.1) further reduces the risk of PTS and TTS to fur seals from vessel noise.

10.1.2.7 Marine turtles

The response of marine turtles to sound emitted from operating wind turbines is unknown. However, the most sensitive hearing range of marine turtles is within the frequency range of operating wind turbines (Ridgeway et al., 1969; Barlow, 1999), and marine turtles have shown behavioural avoidance in response to low frequency sound (Dow Piniak et al., 2012). It is unlikely that marine turtles would detect sound at large distances from the wind farm (less than one kilometre) (McPherson et al., 2022).

In response to vessel noise marine turtles may display a short-term behavioural response, for example a change in swimming direction or diving behaviour.

There are no important habitats for marine turtles (i.e. nesting beaches, designated BIAs) in proximity to the OWFA, though the OWFA is in the 'known / likely species range in the Commonwealth marine area' for leatherback, loggerhead and green turtles (Commonwealth of Australia, 2017a). Only a single leatherback turtle and a single loggerhead turtle were observed during the MESP and EIF survey program (Appendix A). Therefore, the presence of marine turtles in the OWFA and surrounding waters is expected to be limited to highly occasional transient individuals.

Marine turtles may exhibit a behavioural change i.e. avoidance in response to noise from operating wind turbines; however, the numbers of turtles in the OWFA is extremely limited. The implementation of mitigation measures to reduce the risk of vessel strike for marine turtles (Section 11.1) further reduces the risk of auditory impairment from vessel noise.

10.1.3 Mitigation measures

No additional mitigation measures required.

10.1.4 Residual Impacts

Residual effects to marine mammals and turtles from underwater noise from operating wind turbines and project vessels are the same as those described above.

Table 10-1: Consequence associated with underwater noise during the operations phase

Potential Impact	Receptor	Receptor sensitivity	Initial consequence	Additional mitigation	Residual Consequence
Hearing impairment (PTS and TTS onset), change in fauna behaviour including displacement, communication masking	Blue whale Southern right whale Humpback whale Other mysticetes	Medium	Minor (D) (Magnitude = Low)	N/A	Minor (D) (Magnitude = Low)
Hearing impairment (PTS and TTS onset), change in fauna behaviour including displacement, communication masking	Odontocetes – dolphins Pinnipeds Marine turtles	Low	Negligible (E) (Magnitude = Low)	N/A	Negligible (E) (Magnitude = Low)

10.1.5 Evaluation of residual risk against assessment criteria

An evaluation of residual impacts against the assessment criteria as stated in Section 0 is provided in Table 10-2.

Table 10-2: Evaluation of residual impacts against assessment criteria

Assessment criteria	Evaluation	Confidence/uncertainty
Principles of ESD • AC1: Health, productivity, biological diversity and ecological integrity of the environment is not compromised as a result of the project.	Underwater noise from operational activities may result in behavioural response to marine mammals and turtles and/or masking of marine mammal vocalisations. However, effects are expected to be short-term throughout the period of occupancy of animals (days to weeks) and limited to disruption to migration with no impact on breeding success or the survival of individuals. The project is not inconsistent with the Principles of ESD.	High confidence • Sound source verification study to validate UWNM results • Precautionary approach for SRW reproduction BIA / HCTS by adoption of conservative behavioural disturbance thresholds for vessel activities
Conservation Management Plan for the Blue Whale • AC2: The project will be managed such that residual impacts and/or risks will not be inconsistent with the objectives of the Conservation Management Plan for the blue whale, including application of the “Guidance on key terms” and the requirements of Action Area A2 – assessing anthropogenic noise	Underwater noise from operational activities may result in a behavioural response and/or masking of blue whale vocalisations. However, effects are expected to be short-term throughout the period of blue whale occupancy (few hours to days), and whales are expected to recover once outside of impact ranges. The presence of blue whales in the OWFA and surrounding waters is expected to be limited to occasional transient individuals, with no evidence of feeding. Therefore, blue whales will continue to utilise the without injury and will not be displaced from a foraging area. The project is not inconsistent with the Conservation Management Plan for the Blue Whale.	
Recovery Plan for the Southern Right Whale • AC3: The project will be managed such that residual impacts and/or risks will not be inconsistent with the objectives of the objectives of the National Recovery Plan for the Southern Right Whale including the requirement Action Area A5 – assessing, managing and mitigating impacts to southern right whales from anthropogenic underwater noise	Underwater noise from operating wind turbines may result in a localised behavioural response and / or masking of southern right whale vocalisations. However, effects are expected to be short-term throughout the period of southern right whale occupancy (days to weeks), and whales are expected to recover once outside of impact ranges. The presence of southern right whales in the OWFA and surrounding waters is expected to be limited to occasional migratory and/or resting individuals. The project is not inconsistent with the National Recovery Plan for the Southern Right Whale.	
Significant Impact Guidelines (threatened species) • AC4: The project will not have a significant impact on the environment as defined in the MNES Significant Impact Guidelines 1.1 for Threatened (Endangered and Vulnerable) Species.	Underwater noise from operational activities may result in a behavioural response to marine mammals and turtles and/or masking of marine mammal vocalisations. However, effects are expected to be short-term throughout the period of occupancy of animals (days to weeks) and limited to disruption to migration with no impact on breeding success or the survival of individuals. The project is not inconsistent with the Significant Impact Guidelines for threatened species.	
Significant Impact Guidelines (migratory species) • AC7: The project will not have a significant impact on Migratory Species as defined in the MNES Significant Impact Guidelines 1.1.	Underwater noise from operational activities may result in a behavioural response to marine mammals and turtles and/or masking of marine mammal vocalisations. However, effects are expected to be short-term throughout the period of occupancy of animals (days to weeks) and limited to disruption to migration with no impact on	

Assessment criteria	Evaluation	Confidence/ uncertainty
Significant Impact Guidelines (Commonwealth Marine Areas) • AC8: The project will not have a significant impact on Commonwealth Marine Areas as defined in the MNES Significant Impact Guidelines 1.1	breeding success or the survival of individuals. The project is not inconsistent with the Significant Impact Guidelines for migratory species. Underwater noise from operational activities may result in a behavioural response to marine mammals and turtles and / or masking of marine mammal vocalisations. However, effects are expected to be short-term throughout the period of occupancy of animals (days to weeks) and limited to disruption to migration with no impact on breeding success or the survival of individuals. The project is not inconsistent with the Significant Impact Guidelines for Commonwealth Marine Areas.	

10.2 Physical presence of turbines – attraction, barrier effects or displacement (MMT-I005)

10.2.1 Project activities

Installation of project infrastructure including foundations, scour protection and cable protection (rock armour or concrete mattresses) would decrease the amount of sediment-based habitat, whilst increasing hard substrate in the project area. Of greater significance would be the introduction into the existing open-water habitat of up to 147 WTGs and 5 substations (each with up to six legs) extending from seafloor to sea surface. Across the OPA, foundation scour protection and cable protection would add a footprint of approximately 0.58 km² of artificial substrate (Technical Report B: Benthic Ecology).

10.2.2 Impact assessment

The degree to which the physical presence of artificial structures in the marine environment may provide a beneficial or detrimental ecological effect is complex and challenging to quantify; the potential impacts include:

- Attraction to infrastructure – leading to an increase in species abundance within the OWFA
- Barrier effects – disruption to migration and breeding events within the OWFA
- Displacement – leading to a decline in abundance and species diversity within the OWFA.

Provided below is an assessment of the potential impacts from the physical presence of artificial structures on receptor groups.

10.2.2.1 Attraction

The introduction into the existing open ocean ecosystem of a large amount of hard substrate, both across the seabed and vertically to the surface may result in significant change to the existing fish assemblage and broader food web through creation of artificial reefs (Degraer et al., 2020, Langhamer, 2012). For many species, in particular generalist feeders and higher trophic level species, the change in habitat may be beneficial (Raoux et al., 2017), with likely increases in abundance of benthic and pelagic fish species. This potential positive change in habitat surrounding the structures may have an attraction effect to apex predator species, to utilise these artificial reefs for foraging (Arnould et al., 2015, Russell et al., 2014, Scheidat et al., 2011).

Investigations in the northern hemisphere have identified that some seal species have been attracted to offshore wind farms as a result of increased food resources provided by the structures (Russell et al., 2014, Todd et al., 2020). A tagging study of harbour seals in the North Sea reported the animals utilising offshore wind structures, including cable routes, to forage. The animals were evidenced to specifically target, and concentrate their foraging activity at individual turbine structures, with the animals able to freely move and

navigate between structures (Russell et al., 2014). In Australian waters, a potential beneficial outcome has been observed between Australian fur seals and anthropogenic infrastructure: Arnould et al. (2015) reported 72 per cent of tracked individuals were spending time within the vicinity of structures whilst on their foraging trips, with 96 per cent visiting cable routes.

No published information is available on the sensitivity of other marine mammal and turtle species to attraction from OWF structures.

10.2.2.2 Barrier effects and displacement

Many marine mammals undertake annual migrations during which they could encounter OWF structures (Kraus et al., 2019, Secor et al., 2024). As OWF structures can act as barriers, individuals may be forced to avoid the area resulting in the potential of course alteration and lengthening of their migratory route (Buenau et al., 2022, Hemery et al., 2024). Any resident animals, or those animals utilising key habitat areas (e.g. foraging BIAs) may be displaced if a loss of habitat occurs due to the installation and operation of OWF structures. Sparling et al. (2020) defines displacement as “the movement of animals away from the area within or immediately adjacent to an area in which an anthropogenic activity is occurring or has occurred”. Displacement, as an effect, may occur both in the area of the disturbance or development and to some distance beyond it, known as a ‘buffer’ (Mendel et al., 2014). While the area may continue to support resources for a particular species, it is no longer available as habitat, or its habitat value is reduced. The degree of displacement, both in terms of length of time and proportion of the original source population affected, may vary seasonally and among species (Joint SNBC, 2022). There is currently limited data on the overall impact and response of marine mammal and turtle displacement due to the relative infancy of the industry, particularly in the southern hemisphere. Therefore, array design, including the size and placement of arrays, that would create biologically significant displacement effects is currently not known (Buenau et al., 2022). However, the placing arrays at a significant distance from migratory routes and BIAs may mitigate the risk of displacement.

10.2.2.2.1 Blue whale

There are very few historical sightings of blue whales in the Gippsland. A single blue whale was observed during the MESP baseline survey, on April 4, 2023. Despite only a single visual sighting throughout the whole baseline survey period, NZ pygmy blue whale and EIO pygmy blue whale vocalisations were detected sporadically in acoustic recordings (Appendix A). All detections of pygmy blue whale song (both sub-species) in underwater noise recordings collected during the MESP were for short periods only, a few hours to days, and there was no evidence that either sub-species persisted in the area and were engaged in feeding (Appendix A). Pygmy blue whales may transit the OWFA to areas of greater productivity to the north-east (e.g. Upwelling East of Eden KEF), or while migrating to possible breeding grounds off Tonga (Möller et al., 2020). The presence of blue whales in the OWFA and surrounding waters is expected to be limited to occasional individuals during the winter to spring months.

The Conservation Management Plan for the Blue Whale identifies potential displacement of blue whales from offshore wind as a threat to the species (Commonwealth of Australia, 2015a). Whilst there are currently no operational wind farms in Australia, the management plan outlines the future threat of displacement from infrastructure and coastal development (e.g. offshore wind farms) as a likely occurrence with a minor consequence. Due to the limited presence of blue whales in the OWFA and surrounding waters, any effects to individual blue whales from displacement is expected to be minimal and unlikely to have population level impacts.

10.2.2.2.2 Southern right whale

The OWFA and surrounding waters do not represent a recognised aggregation area for southern right whales, and it is unlikely that whales will aggregate in the area in future due to a restricted memory of calving habitat and a lack of conspecifics (Pirzl, 2008). Instead, southern right whales may transit the OWFA and surrounding waters en-route to calving and aggregating sites in western Victorian waters and / or the New South Wales south coast (e.g. Eden, Jervis Bay). Seven southern right whales were sighted during the MESP; two cow calf pairs and an unaccompanied adult in shallow inshore waters north-east of the OWFA, and a third cow calf pair sighted in offshore waters seaward of the OWFA (Appendix A). Sightings occurred inshore in June and July and offshore in September, agreeing with the known time of arrival and departure at aggregation sites (Charlton et al., 2019a).

The National Recovery Plan for the Southern Right Whale identifies displacement due to presence of offshore infrastructure as a threat to the species (DCCEEW, 2024b). With few sightings of southern right whales detected during the 24-month MESP baseline survey, any effects to individual southern right whales from displacement is expected to be minimal, and unlikely to have population level impacts. Due to the OWFA located within the migration BIA for southern right whales, and near the coastal reproduction BIA, a post construction monitoring mitigation is recommended to understand if habitat use of marine fauna has changed due to the OWF.

10.2.2.2.3 Humpback whale

There are no BIAs for humpback whales in proximity to the OWFA; however, they were the most dominant mysticete species recorded during the MESP baseline survey period (Appendix A). Humpback whale sightings typically occurred in offshore waters during April to July / August and closer to shore on the shallower edge of the OWFA in September to December (Appendix A). This is consistent with the literature which suggests humpback whales travel further offshore during their northward migration and closer inshore during their southern migration while travelling with calves (Noad et al., 2011). Almost half of all humpback whale sightings observed were individuals travelling, with an increased number of individuals observed within the survey area on their southbound migration. Humpback whales were also observed feeding and displaying surface-active social behaviours. Given the foraging behaviour recorded and migratory pathway within and near the OWFA, humpback whales may be susceptible to displacement from OWF structures.

Humpback whale density was greatest outside the OWFA during the MESP baseline survey, with concentrations highest offshore of the OWFA during the northern migration, and to the northeast of the OWFA during the southern migration (Appendix A). In addition, the majority of the satellite tracking data recorded individuals using waters offshore of the OWFA (Figure 6-7) migrating past the Furneaux Group on the eastern side. With such a wide spatial use of the waters offshore of the Gippsland area during both migration direction, and the ability to utilise other migratory routes, any effects to individual animals are expected to be minimal, and unlikely to have population level impacts.

10.2.2.2.4 Other mysticetes

Six other mysticetes may occur in the OWFA and surrounding waters (refer to Section 6.2.4), three of which were recorded during the MESP: Bryde's whale, dwarf minke whale, and Antarctic minke whale (Antarctic minke whale) (Appendix A). The seasonal presence of other mysticetes such as the fin whale and pygmy right whale is uncertain; however, it is expected that they may only occur for short periods.

The OWFA and surrounding waters do not represent any known important breeding, resting or foraging habitat for any other mysticete species, and it is assumed that any presence in the area would be sporadic and primarily in deep water. The risk of impacts to other mysticetes from displacement is expected to be minimal and unlikely to have population impacts.

10.2.2.2.5 Odontocetes (dolphins)

Dolphins, smaller in size compared to mysticetes, are less likely to be displaced from areas containing offshore wind farm structures, as the animals are able to easily travel between the individual turbines (Hemery et al., 2024). A study by Vallejo et al. (2017) investigated changes in harbour porpoise abundance and distribution during the construction and operation phases of a northern hemisphere offshore wind farm. Whilst harbour porpoises were reportedly displaced during the construction phase of OWF, no difference in animal abundance was observed during the operation phase (Vallejo et al., 2017), suggesting that once construction was complete, the animals were no longer displaced.

During the MESP baseline survey dolphins were present in the OWFA year-round. Common dolphin peak presence was recorded in September and November, while bottlenose dolphin presence peaked in June and September. Two 'like striped dolphins' were sighted in September. The predominant behaviour for dolphins was travelling, followed by feeding and resting. Five bottlenose dolphin calves were sighted over March and April and one common dolphin calf was sighted in August (Appendix A). During the MESP common dolphin sightings were distributed mostly in offshore waters outside of the OWFA, while bottlenose dolphins were more commonly sighted in inshore waters (Appendix A). Two killer whales were sighted during visual aerial surveys in July, with a possible third 'like-killer whale' sighted in April. Killer whales may be present in the OWFA; however, their presence is expected to be limited to occasional transient individuals or small groups.

The seasonal presence of Risso's dolphin is uncertain; however, it is expected that they may only occur for short periods of time.

10.2.2.2.6 Pinnipeds

The AUFS and NZFS have breeding colonies in proximity to the OWFA. Tracking data indicate that AUFS from the Rag Island colony occur regularly throughout the OWFA and surrounding waters en-route to foraging grounds in the north-east, with up to five percent of the population estimated to be in the OWFA at any one time (Appendix A). In contrast, the OWFA and surrounding waters do not represent important foraging habitat for AUFS or NZFS from Kanowna Island and are therefore expected to occur much more infrequently (Appendix A).

Russel et al. (2016) reported that harbour seals were attracted to infrastructure, as evident by an increase in seal abundance, with any displacement effects limited to the construction period. Therefore, the risk of impacts to pinnipeds from displacement due to offshore wind farm structures is expected to be minimal and unlikely to have population impacts, with any impacts likely to be limited to AUFS from the Rag Island colony.

10.2.2.2.7 Marine turtles

There is limited information available on the sensitivity of marine turtles to displacement from OWF structures, however, due to the low occurrence of marine turtles in the OWFA and surrounds it is unlikely that significant population level impacts would be a result.

While the south-eastern waters of Australia are considered a potential hotspot for foraging leatherback turtles (Hays et al., 2023), there are no listed BIAs for marine turtles (i.e. nesting beaches, designated foraging BIAs) in proximity to the OWFA. Marine turtle presence in the OWFA and surrounding waters is expected to be limited to highly occasional transient individuals. A single leatherback and a single loggerhead turtle were observed during the MESP baseline survey periods (Appendix A).

Any effects to individual marine turtles from displacement is expected to be minimal, and unlikely to have population level impacts for species.

10.2.3 Mitigation measures

The MDS involves a total of up to 147 turbines, compared to a design with a total of 400 turbines that was under earlier consideration (EIS Chapter 3 – Project Development). The reduced complement of turbines will have greater distances between them (approximately one km minimum and therefore reduce displacement effects. It is likely that any potential displacement effects will be reduced by the lower number of turbines and the greater spacing between them providing more space for marine mammals to travel between the turbines.

As the residual consequence for all species is assessed as Negligible or Minor, no further mitigation is required.

There remains uncertainty about how some species, such as the humpback, southern right and blue whale, will respond to OWF installations, as there are limited global examples and research studies to draw definitive conclusions from. It is not expected that any barrier effects will be observed by wind turbines, due to the scale of whale movement and distance between turbines. The OWF is not blocking an entire migratory route, and in fact migration of SRW may be alongshore. An animation created by [BOEM](#) for floating OWF attempts to visual the scale of whales compared to turbines to demonstrate that there is not anticipated to be any barriers to access even for floating wind farms, which have greater physical presence footprint due to their mooring lines.

Post-construction (operations) monitoring that will be undertaken during maintenance activities (described in section 15.2) will be needed to understand the extent to which these species adapt to the introduction of the wind farm or may be impacted by displacement (i.e., a loss of habitat). Monitoring during maintenance activities will provide a unique long-term data set i.e., over the lifetime of the OWF which will be unique for the Gippsland region, even though other offshore infrastructure has been present in the region for decades. This monitoring will include recording details on the date, time, location, species, direction of travel and behaviour of marine mammals and turtles observed within the OPA from project vessels or infrastructure. This will add to the knowledge base of marine mammal use of the areas within and around OWF and will contribute to considerations related to decommissioning of the SOTS OWF and to EIA for OWF in Australia generally.

There also remains uncertainty about ecosystem benefits from offshore structures, and therefore any flow on effects this may have to apex predators such as pinnipeds. The response of these animals and other marine mammal and turtle species is unknown. Post-construction monitoring will be needed to understand the extent of the effects on the ecosystem and the impact this may have on foraging behaviour of marine mammals and turtles (refer to Section 15.3).

10.2.4 Residual impacts

Table 10-3: Consequence associated with physical presence of operational turbines during the operations phase

Potential Impact	Receptor	Receptor sensitivity	Initial consequence	Additional mitigation	Residual consequence
Attraction of fauna	Pinnipeds	Low	Negligible (E) (Magnitude = Low)	N/A	Negligible (Magnitude = Low)
Displacement and barrier effects for fauna	All marine mammals and turtles	Low	Negligible (E) (Magnitude = Low)	N/A	Negligible (Magnitude = Low)
Creation of artificial habitat	Pinnipeds	Low	Negligible (E) (Magnitude = Low)	N/A	Negligible (Magnitude = Low)

10.2.5 Evaluation of residual impacts against assessment criteria

An evaluation of the residual risk against the assessment criteria in Section 0 is provided in Table 10-4.

Table 10-4: Evaluation of residual impacts against assessment criteria

Assessment criteria	Evaluation	Confidence / uncertainty
Principles of ESD AC1: Biological diversity and productivity of the environment is not compromised because of the project.	There were no species for which the OWFA is likely to cause significant displacement through migratory corridors or impact access to a critical habitat to the degree that it would result in a significant decrease in foraging or reproductive success of the population. However, it is likely that pinnipeds will be attracted to the structures. As the OWFA makes up only a minor portion of these marine mammal species' overall potential foraging ranges, it is highly unlikely that any possible displacement will result in significant impacts at a population level, such that biodiversity or productivity would be affected. The project is not inconsistent with the principles of ESD.	Medium confidence - Offshore wind farms internationally have not been observed as creating barriers to marine mammal movements, however, monitoring during the operational phase of the project will enable verification of these predictions. - Investigations in the northern hemisphere have identified that some seal species are attracted to OWFA as a result of increased food resources provided by the structures.
Significant Impact Guidelines (Threatened Species) AC4: The project will not have a significant impact on Threatened (Endangered and Vulnerable) Species as defined in the MNES Significant Impact Guidelines 1.1	For many species, the change in habitat with OWF structures may be beneficial with likely increases in abundance of benthic and pelagic fish species. This positive change may have an attraction effect to apex predator species such as pinnipeds. Any resident threatened species may be displaced if a loss of habitat occurs due to OWF structures. However, for most species the future threat of displacement from infrastructure has only a minor consequence. Due to the OWFA making up only a minor portion of marine mammal and	

Assessment criteria	Evaluation	Confidence / uncertainty
	turtles' species' overall potential foraging and habitat ranges, any effects to individual threatened species are expected to be minimal and unlikely to impact on breeding success or the survival of individuals. The project is not inconsistent with the Significant Impact Guidelines for threatened species.	
Significant Impact Guidelines (Migratory Species) • AC7: The project will not have a significant impact on Migratory Species as defined in the MNES Significant Impact Guidelines 1.1.	There were no species for which the OWFA is likely to cause significant displacement through migratory corridors or impact access to a critical habitat to the degree that it would result in a significant decrease in foraging or reproductive success of the population. For many species, the change in habitat may be beneficial with likely increases in abundance of benthic and pelagic fish species. However, this positive change may have an attraction effect to apex predator species. Should displacement occur, any effects to individual migratory species are expected to be minimal and unlikely to have population level impacts for species. The project is not inconsistent with the Significant Impact Guidelines for migratory species.	
Significant Impact Guidelines (Commonwealth Marine Areas) • AC8: The project will not have a significant impact on Commonwealth Marine Areas as defined in the MNES Significant Impact Guidelines 1.1.	Though some individuals may be displaced from the OWFA, this area makes up only a minor portion of these marine mammal and turtle species' overall potential foraging ranges and migratory routes, therefore, any impacts to habitat availability are expected to be negligible. There were no species for which the OWFA is likely to cause significant displacement through migratory corridors or impact access to a critical habitat to the degree that it would result in a significant decrease in foraging or reproductive success of the population, meaning it's unlikely any impacts to ecosystem function or integrity will occur. The project is not inconsistent with the Significant Impact Guidelines for Commonwealth Marine Areas.	

10.3 Electromagnetic interference (MMT-I006)

10.3.1 Project activities

Electromagnetic fields (EMF) are generated by the flow of current passing through power cables from both electric fields, measured in volts per metre (V m⁻¹) and magnetic fields, measured in microtesla (μT). The level of electromagnetic interference (EMI) (i.e. the interference arising from emitted electromagnetic fields) produced from the cable depends on a variety of design and installation factors including current flow, type of current (AC vs DC), distance between cables, cable insulation, number of conductors, configuration of cable and burial depth (Taormina et al., 2018).

The flow of electricity in an AC cable changes direction, and therefore creates an electric field that is constantly changing, whereas electricity in a direct current (DC) cable flows in the same direction creating a static electric and magnetic field (Panofsky and Phillips, 2005). Research has shown that DC cables produce electromagnetic fields higher than those produced from AC cables with similar voltages, and marine animals are more likely to respond to EMI produced by DC cables, particularly those that can magnetosense (Panofsky et al., 2005, Hutchison et al., 2018).

Further, in an evaluation of potential EMFs from a wind farm, Snyder et al. (2019) noted that whilst the cable size and voltage of AC inter-array cables are smaller than export cables, the magnetic fields from each are similar, as the export cables operate at a higher voltage and hence require less current to supply power, and less current means lower magnetic fields. Ultimately, EMFs produced by undersea power cables associated with offshore wind energy projects are similar to, or less than, common household items such as a television, hair dryer or electric drill, and the electrical frequencies of power cables (generally 50 to 60 Hz), and are typically well above the detection range of fish, which are among the species most likely to be impacted by EMI (Snyder et al., 2019, Nyqvist et al., 2020).

EMI will be generated from the installation and operation of a maximum of 418 kilometres of 66 kilovolt inter-array cables to carry electrical current produced from WTGs to OSS, and up to 326 kilometres (up to eight export cables totalling 286 kilometres and 40 kilometres of inter-link cables) of high voltage (HV) (275 kilovolt) AC export cables and inter-link cables. Subsea cables will have a minimum depth of lowering (MDoL) of 1.0 metres for offshore export cable and 0.6 metres for inter-array cables (max depth two metres) or otherwise protected by rock armour or concrete mattresses (see Table 7-2).

During operations, the high voltage alternating current (HVAC) export and Inter-link cables will likely generate a static magnetic field that will be higher than the ambient background of the Earth's magnetic field. The strength of both the magnetic and induced electric fields increases with current flow and rapidly decreases horizontally and vertically with distance from the cable (Taormina et al., 2018). Normandeau et al. (2011) found that the range of the field was approximately 10 metres each side of the cable (assuming one metre burial), using a model with average magnetic fields generated for typical 132 Kilovolt AC and DC export cables. EMF reached background levels at 15 to 20 metre vertical distance above the seabed (Sherwood et al., 2016). At five metres above the cable (0 metre horizontal distance), there was a variation of less than 1 per cent from background EMF levels (Sherwood et al., 2016).

Burial of cables is an important way of reducing the effects of EMI on biota because of the physical barrier it creates. As such, most power cables installed in wind farms are buried to target depths between 0.9 and 1.8 metres, with Snyder et al. (2019) noting that an increase in burial depth from one to two metres reduces the magnetic field at the seafloor about four-fold. Where seafloor conditions do not permit burial, the concrete mattresses or rock armour would aim to achieve the same level of EMI reduction as burial, and beyond approximately three metres from the cable the field levels for buried and mattress-covered cables are similar (Snyder et al., 2019).

10.3.2 Impact assessment

In the marine environment, there are natural magnetic and electric fields associated with both physical and biological sources, and there are anthropogenic EMFs that permeate it (Gill et al., 2014). Many marine animals, such as those that undertake large-scale movements, can detect electric and magnetic fields and utilise them in important life processes such as movement, orientation and foraging (Gill et al., 2014; Normandeau et al., 2011). The ability to sense either electric or magnetic fields has been identified or theorized for a range of marine wildlife including some fish species, elasmobranchs (i.e., sharks, skates, and rays), cetaceans (i.e., whales and dolphins), some sea turtles, and invertebrates (i.e., some snails, lobsters, and crabs) (SEER, 2022).

The physical interactions between cable-induced EMFs and naturally occurring EMFs are not well understood, and EMFs from subsea cables may disguise or distort natural EMF cues that animals use for important life functions (SEER, 2022). However, for electrosensitive and magnetosensitive species to detect particular intensities and frequencies of EMFs, an animal's range of detection must overlap with the intensity and frequency of the EMF emitted (SEER, 2022).

Magnetosensitive species can use small deviations in the geomagnetic field over relatively long periods of time and distances for orientation and navigation and are responsive to very small changes in the magnetic field (SEER, 2022). This geomagnetic orientation has been suggested for some cetacean and sea turtle species, which enables long migrations or repeated movements to specific areas (Mynett, 2022). Although some studies indicate the use of magnetic "maps" for some of these species (e.g. fin whales, sperm whales, loggerhead turtles), understanding of the implications of anthropogenic disruptions to these magnetic fields remains limited (Walker et al., 1992; Lohmann et al., 2012; Vanselow, 2020; Goforth et al., 2025).

Electrosensitive species (e.g. sharks, skates, rays, invertebrates and some fish) have receptors capable of detecting electric fields from low-frequency, low-voltage AC signals where the need for detection is immediate and the range of detection is limited to less than one meter (three feet) (SEER, 2022). For these species, the greatest sensitivity to electric fields less than 25 hertz (SEER, 2022). The frequencies of AC

power cables proposed to be deployed within the project area are generally between 50 to 60 hertz. Some species of cetacean have also been identified to be capable of electroreception, with bottlenose dolphins and Guiana dolphins both exhibiting behavioural responses to electric stimuli (Hüttner, et al., 2022; Czech-Damal et al., 2012). These relatively recent studies may indicate that electroreception may be more widespread within cetaceans, particularly benthic feeders, however further studies are necessary to better understand this and the implications for EMI (Hüttner et al., 2021).

Little is known about the response of marine mammals and turtles to EMI, with much of the existing literature focussed on ex-situ studies on fish, sharks and rays, and invertebrates (Klimley et al., 2021; OWET, 2010). The marine mammals and turtles that are magnetosensitive (i.e. use the earth's magnetic field to navigate), may be more sensitive to EMI, especially from DC cables (Normandeau et al., 2011; Hutchison et al., 2018). In particular, species that occupy shallow waters or feed in waters near the seabed will spend more time in proximity to subsea cables, and consequently have a greater likelihood of exposure to EMI (Normandeau et al., 2011). A case study on bottlenose dolphins determined that an animal would have to be within a few metres of the cable to detect EMI from wind turbine export cables (Normandeau et al., 2011).

There is potential for marine mammals and turtles to react to local variations of the geomagnetic field caused by power cable EMI. Impacts will be dependent on the magnitude and persistence of the confounding magnetic field, and the animals' proximity to the cables, and may include a temporary change in swim direction or a longer detour during the animal's migration (Gill et al., 2005; Normandeau et al., 2011). However, due to their high mobility limiting the duration of exposure, marine mammal and turtle species have a low likelihood of being affected by power cable EMI (Normandeau et al., 2011).

Indirectly, prey species, such as bony or cartilaginous fish, are also unlikely to come close to buried power cables during normal migratory or foraging activities and as such they are unlikely to detect weak electric fields emanating from them (Snyder et al., 2019; Hutchison et al., 2021). Further to this, the high frequency EMF from AC cables are not easily detected by magnetosensitive migratory fish species (for full assessment, see Technical Report C: Fish and Invertebrates) (Armstrong et al., 2015; Orpwood et al., 2015). Copping et al. (2020) explain that while there are significant gaps in understanding how pelagic species (e.g. sharks, marine mammals and fin fish) may react to EMFs emitted by cables, "the evidence to date suggests that the levels are unlikely to keep animals away from their preferred habitats or affect migration patterns." Thus, EMI is unlikely to impact marine mammals or turtles indirectly through changes in prey distribution and abundance.

10.3.2.1 Blue whales

There are few historical sightings of blue whales in the Gippsland region when compared to more productive waters of the Bonney Upwelling approximately 500 kilometres west. One blue whale was visually sighted during the MESP baseline survey, approximately 30 kilometres from the coastline in 50 to 60 metre water depths, just outside the offshore project area on the eastern side of Wilsons Promontory. Despite only a single visual sighting throughout the survey, both NZ and EIO pygmy blue whale vocalisations were acoustically detected (Appendix A). There was no evidence that either population persisted in the area or were engaged in feeding (Appendix A). Blue whales may transit the OWFA to areas of greater productivity to the north-east (e.g. Upwelling East of Eden KEF), or while migrating to possible breeding grounds off Tonga (Balcazar et al., 2015, 2017).

There are significant gaps in the current literature surrounding the impact of EMI on pelagic species, including marine mammals (Gill and Desender, 2020). There is currently no evidence that EMI created by subsea cables affect migration or behaviour of cetaceans (Gill et al., 2014). As the presence of blue whales within the OWFA is expected to be occasional individuals travelling through the area in deeper waters, it is unlikely that they will be impacted by EMI. In addition, the foraging ecology of blue whales (i.e. feed within the water column) preclude them from being at risk of EMI and are therefore scoped out of this impact pathway.

10.3.2.2 Southern right whales

The OWFA is within the coastal distribution range for southern right whales including BIAs for migration (April to October) and for reproduction (May to September) (DCCEE, 2024b). However, the OWFA and surrounding waters do not represent a habitat critical for survival for southern right whales, and it is unlikely that whales will aggregate in the area in future due to a restricted memory of calving habitat and a lack of conspecifics (Pirzl, 2008). Instead, southern right whales may transit the OWFA and surrounding waters en-route to calving and aggregating sites in western Victorian waters and / or the New South Wales south coast

(e.g. Eden, Jervis Bay). Seven southern right whales were sighted during the MESP; two cow calf pairs and an unaccompanied adult in shallow inshore waters north-east of the OWFA, and a third cow calf pair sighted in offshore waters seaward of the OWFA (Appendix A). Sightings occurred inshore in June and July and offshore in September, supporting the known time of arrival and departure at aggregation sites (Charlton et al., 2019a).

There is no current evidence that EMI created by subsea cables affects the migration or behaviour of southern right whales, however there is potential for localised variations to EMI to elicit short-term behavioural responses or larger impacts on migration (DCCEEW, 2022). Southern right whales are likely to be present in the OWFA while transiting through the area, and as such, impacts to individuals are expected to be minimal and are unlikely to have population level impacts. Like blue whales, the foraging ecology of southern right whales decreases their risk of EMI. Therefore, southern right whales have been scoped out of this impact pathway.

10.3.2.3 Humpback whales

There are no BIAs for humpback whales in proximity to the OWFA; however, humpback whale population numbers are high, predicted to reach at least 40,000 individuals between 2021 to 2026 (Noad et al., 2019), and they were the most dominant mysticete species recorded during the MESP and EIF baseline survey periods (Appendix A). Humpback whale sightings typically occurred in offshore waters during April to July / August and closer to shore on the shallower edge of the OWFA in September to December (Appendix A), consistent with the literature which suggests humpback whales travel further offshore during their northward migration and closer inshore during their southern migration while travelling with calves (Noad et al., 2011). Almost half of all humpback whale sightings observed individuals travelling, with an increased number of individuals observed within the survey area on their southbound migration. Humpback whales were also observed feeding and displaying surface-active social behaviours.

The cables associated with the OWF will be installed within the OWFA and the OECA further inshore. There is no current evidence that EMI created by subsea cables affect migration or behaviour of cetaceans (Gill et al., 2014), although there is limited research in the area. Humpback whales are likely to be present in the OWFA for short durations during their migration, and as such, impacts to individuals are expected to be minimal and are unlikely to have population level impacts. In addition, humpback whales feed within the water column and are not considered benthic foragers. Therefore, humpback whales have been scoped out of this impact pathway.

10.3.2.4 Other mysticetes

Seven other mysticetes may occur in the OWFA and surrounding waters (refer to Section 6.2.4), three of which were recorded during the MESP: Bryde's whale, dwarf minke whale, and Antarctic minke whale (Antarctic minke whale) (Appendix A). The seasonal presence of other mysticetes such as the fin whale and pygmy right whale is uncertain; however, it is expected that they may only occur for a period of months.

The cables associated with the OWF will be installed within the OWFA and the OECA further inshore. There is no evidence that EMI created by subsea cables affect migration or behaviour of cetaceans (Gill et al., 2014). The OWFA and surrounding waters do not represent any known important breeding, resting or foraging habitat for any other mysticete species, and it is assumed that any presence in the area would be sporadic and primarily in deep water. Although some species (e.g. fin whale; Walker et al., 1992) may use geomagnetic sensing to navigate during migrations, and may therefore be more susceptible to potential EMI from subsea cables, impacts to individuals are expected to be minimal and are unlikely to have population level impacts. Mysticetes are not considered benthic foragers and therefore will unlikely spend considerable time within the range of EMI and / or critical behaviours are unlikely to be impacted. All other mysticete species have been scoped out of this impact pathway.

10.3.2.5 Odontocetes dolphins

Species that occupy shallow waters or feed in waters near the seabed will spend more time in proximity to subsea cables and consequently have a greater likelihood of exposure to EMI (Normandeau et al., 2011). While several dolphin species may feed in the OWFA, it is not thought that they are bottom feeders, but rather primarily feed on fish and invertebrates from the water column. Bottlenose dolphins were found to occupy inshore waters, while common dolphins were present in waters offshore of the OWFA (Appendix A). Although bottlenose dolphins (and potentially other odontocetes species) may be capable of

electroreception, a case study of bottlenose dolphins determined that a dolphin would have to be within a few metres of the cable to detect EMI from wind turbine export cables (Hüttner, et al., 2021; Normandeau et al., 2011).

Some inshore dolphin species that occupy shallow waters may be affected by EMI from inter-array and export cables; however, due to the mobility of the animals and expected small distances to effect, potential impacts to individuals would be minimal (i.e. small changes in swim direction), and there are unlikely to have population level impacts. No species of odontocete (dolphin) are considered benthic foragers and therefore will likely not be impacted by EMI. All species of odontocete dolphins considered during this assessment have been scoped out of this impact pathway.

10.3.2.6 Pinnipeds

No evidence of magnetosensitivity has been reported for fur seals or sea lions (Gill et al., 2005; Normandeau et al., 2011), and no scientific literature exists on the effects of EMI on pinnipeds. Extensive monitoring (pre- and post-construction) of the Horns Rev 2 OWF, which transmits power from AC inter-array cables (33 kV) and export cables (132 kV) found no effects of the OWF or cables on the behaviour of seals (Hoffmann et al., 2000).

AUFS from Kanowna Island were shown to utilise anthropogenic seafloor structures for foraging, in particular pipelines and cables routes including the Basslink DC electricity cable (Arnould et al., 2015). Results from the MESP study found that distance from anthropogenic seafloor structures influenced the at-sea location of tagged AUFS at both Rag Island and Kanowna Island, and NZFS at Kanowna Island (Appendix A).

Given that fur seals are known to forage around subsea cables, it seems unlikely that they experience negative effects from EMI. Therefore, it is unlikely that fur seals would be affected by EMI from inter-array and export cables. AUFS are primarily benthic foragers diving almost exclusively in a benthic manner, while NZFS use a variety of areas to forage, including shallow waters, the continental slope and pelagic regions beyond the shelf. Due to the differences in foraging strategy, only AUFS have been scoped into this impact pathway.

10.3.2.7 Marine turtles

Studies have shown that juvenile and adult marine turtles rely on the earth's magnetic field long range navigation and migration between foraging grounds and natal nesting beaches, and orientation (Lohmann et al., 2008), though it is likely that navigation is based on experience as well (Normandeau et al., 2011).

It is suggested that marine turtles are capable of sensing magnetic fields from undersea cables (Normandeau et al., 2011). Hatchlings and juveniles that occupy relatively shallow, nearshore waters, and bottom foraging adults may not be able to avoid EMI emitted from power cables and are therefore more vulnerable to possible disorientation (Normandeau et al., 2011).

There are no nesting beaches for marine turtles in proximity to the OWFA. While the Bass Strait is considered a foraging hotspot for leatherback turtles (Bone, 1998), the OWFA and surrounding waters have relatively low productivity (Huang and Wang, 2019). A single leatherback and single loggerhead turtle were sighted during the MESP program (Appendix A).

The presence of all marine turtles in the OWFA and surrounding waters is expected to be limited to highly occasional transient adult individuals. It is unlikely the OWFA and surrounding waters provide important migratory routes for any marine turtle species due to the absence of nesting habitat. Few individuals, if any, may be affected by EMI from inter-array and export cables; however, potential impacts are expected to be minimal (i.e. change in orientation).

10.3.3 Mitigation measures

Power cables will be buried or covered reducing the potential for EMI in the water column (EMF-M01). The initial risk to marine mammals and turtles from EMI are Negligible. No further mitigation measures are required.

10.3.4 Residual Impacts

Residual effects to marine mammals and turtles from EMI are the same as those described above.

Table 10-5: Consequence associated with electromagnetic interference during the operations phase

Potential Impact	Receptor	Receptor sensitivity	Initial consequence	Additional mitigation	Residual Consequence
Change in fauna behaviour	AUFS (benthic foragers)	Low	Negligible (E) (Magnitude = Low)	EMI-M01 SNV-M04	Negligible (E) (Magnitude = Low)
Change in fauna behaviour	Marine turtles	Low	Negligible (E) (Magnitude = Low)	EMI-M01 SNV-M04	Negligible (E) (Magnitude = Low)

10.3.5 Evaluation of residual risk against assessment criteria

An evaluation of residual impacts against the performance outcomes as stated in Section 0 is provided in Table 10-6.

Table 10-6: Evaluation of residual impacts against performance outcomes for electromagnetic interference

Assessment criteria	Evaluation	Confidence / uncertainty
Principles of ESD • AC1: Biological diversity and productivity of the environment is not compromised because of the project.	If buried, it is anticipated that there will be no impact of EMI to individuals or populations. The environmental outcome is not inconsistent with the project assessment criteria.	Medium confidence • Research in the field of EMI is still evolving and will be monitored to ensure that predictions in the EIS are correct.
Significant Impact Guidelines (Threatened Species) • AC4: The project will not have a significant impact on Threatened (Endangered and Vulnerable) Species as defined in the MNES Significant Impact Guidelines 1.1.	There is no current evidence that EMI created by subsea cables affects the migration or behaviour of marine mammal and turtle threatened species. If buried, it is anticipated that there will be no impact of EMI to threatened species. Due to threatened species' high mobility limiting the duration of exposure, marine mammal and turtle threatened species have a low likelihood of being affected by power cable EMI. Therefore, as threatened species travel through the area, it is unlikely they will be impacted by EMI and population impacts are unlikely. The environmental outcome is not inconsistent with the project assessment criteria.	• Due to marine mammal and turtles' high mobility limiting the duration of exposure, marine mammal and turtle species have a low likelihood of being affected by power cable EMI
Significant Impact Guidelines (migratory species) • AC7: The project will not have a significant impact on Migratory Species as defined in the MNES Significant Impact Guidelines 1.1.	There is no current evidence that EMI created by subsea cables affects the migration or behaviour of marine mammal and turtle migratory species. If buried, it is anticipated that there will be no impact of EMI to migratory species. Due to migratory species' high mobility limiting the duration of exposure, these species have a low likelihood of being affected by power cable EMI. Migratory species are likely only transiting through the OWFA and as such it is unlikely they will be impacted by EMI and therefore population impacts are unlikely. The environmental outcome is not inconsistent with the project assessment criteria.	
Significant Impact Guidelines (Commonwealth Marine Areas) • AC8: The project will not have a significant impact on Commonwealth Marine Areas as defined in the MNES Significant Impact Guidelines 1.1.	If buried, it is anticipated that there will be no impact of EMI to Commonwealth Marine Areas. The environmental outcome is not inconsistent with the project assessment criteria.	

10.4 Changes in prey abundance and distribution (MMT-I007)

10.4.1 Project activities

While studies relating to the impacts on marine mammal and turtle prey species during the construction phase of wind farms are numerous, there is a scarcity of literature on studies relating to the operational phase.

Marine mammal and turtle prey species include krill and other invertebrates (including benthic invertebrates) and pelagic fish species (e.g. baitfish). Potential impacts to prey species during operation of the project range from short-term behavioural change to direct or indirect mortality. Impacts are dependent on a range of factors including the source of impact, location and life history stage of individual prey species at the time of impact, and species specific biological and ecological characteristics.

As per Technical Report C: Fish and Invertebrates, impacts to prey species may result from the following identified hazards during the operational phase:

- Underwater noise emissions
- Habitat change
- Release of trace metals
- Increased fishing activity
- Light emissions and routine discharges from project vessels
- Accidental hydrocarbon release from collision of a project vessel or during operations on substations.

10.4.2 Impact assessment

10.4.2.1 Potential impacts to prey species

10.4.2.1.1 Underwater noise emissions

The predominant source of underwater noise during the operations phase are noise emitted from the WTG turbines themselves, and vessel noise during maintenance activities. These noise sources are described in Section 10.1. Evidence from established wind farms indicates that noise emissions from activities during the operation phase would not cause significant physical injury or mortality to fish. For example, Mooney et al., (2020) state that operational wind farm noise tends to be lower amplitude and extend over shorter ranges than noise from construction and decommissioning activities. However, it is possible that major maintenance campaigns requiring larger vessels operating on DP may cause displacement and scattering of pelagic fish (Peña, 2019).

Potential impacts to fish as a result of noise emissions during the operational phase include disturbance leading to behavioural changes or displacement from important areas, and masking or interfering with other biologically important sounds (Technical Report C: Fish and Invertebrates). Studies have shown that bony fish, a prey species of fur seals, living within the noise exposure zones surrounding wind turbines habituate to this continuous noise (Thomsen et al., 2006). This is further supported by a growing body of literature documenting the high fish and invertebrate species diversity and abundance on new habitats created by operating WTG foundations (Bergström et al., 2013; Copping et al., 2021; Degraer et al., 2021; Hutchison et al., 2020; NYSERDA, 2017).

Pelagic and mobile fish species are expected to avoid areas where noise emissions may cause disturbance, though international studies have shown that pelagic fish continue to utilise offshore wind farm areas during the operational phase (Kok et al., 2021; Ray et al., 2022).

Based on the low received noise levels, low level of planktonic biomass exposed to noise emissions and capacity for replenishment, the consequence of noise emissions to plankton are expected to be localised and short-term, with negligible population level effects (Technical Report C: Fish and Invertebrates).

10.4.2.1.2 Electromagnetic interference

EMI will be emitted by inter-array and export cables. A full understanding of the effects of EMI on fish and the potential role habituation may play in negating these effects is uncertain, though it is possible that site-attached fish may be unable to recolonise areas previously disturbed or lost during installation of the cable in the construction phase. However, as cables are buried it is likely that very little habitat would be affected, and ecological surveys of the operating Basslink cable recorded individuals of several species of bony fish, including those that are known or likely to occur in the OWFA (Technical Report C: Fish and Invertebrates), in close proximity to the cable and within the area of measurable EMF (Sherwood et al., 2016).

Benthic fish species are more likely to experience the effects of EMF from power cables due to their seabed proximity, particularly for skates and rays which are known to have sensitivity to electric fields (CSA, 2019). The response of benthic invertebrates to EMI may impact individuals through reduced fitness, including changes in development and growth and physiological effects (Copping et al., 2021). However, given the broad distributions of these species population consequences are expected to be negligible. Benthic fish may habituate to EMI over time (Bergstrom et al., 2013; Kilfoyle et al., 2018), and the drive for prey is likely to override possible minor behavioural responses, and therefore potential behavioural effects of EMI are not expected (Technical Report C: Fish and Invertebrates).

Pelagic fish are unlikely to come close to buried power cables and are therefore not expected to be adversely affected by EMI. Exposure of plankton to EMI would be very short and infrequent due to their distribution throughout the water column (particularly in surface waters) and transportation by ocean currents, therefore population level consequences are expected to be negligible (Technical Report C: Fish and Invertebrates).

10.4.2.1.3 Habitat change

Installation of project infrastructure including WTG and OSS foundations, scour protection and cable protection (rock armour or concrete mattresses) would decrease the amount of sediment-based habitat (fine sand to sandy gravel) whilst increasing hard substrate in the OWFA. Across the OPA, foundation scour protection and cable protection would add a footprint of approximately 0.58 km² of artificial substrate (Technical Report B: Benthic Ecology).

The introduction into the existing open ocean ecosystem of a large amount of hard substrate, both across the seabed and vertically to the surface, may result in significant change to the existing fish assemblage and broader food web (Raoux et al., 2016). Field studies into the effects of artificial structures show that the increase in species diversity and broad ecological use of them by species, particularly fish species of lower trophic levels, including for spawning, nursery and shelter purposes is likely to provide ecological benefits to the local ecosystem (Herbert et al., 2017; Hutchison et al., 2020; Knorrn et al., 2024). Studies within established wind farms indicate that these changes will generally be localised to the vicinity of the wind farm although the effects of hydrodynamic changes may be broader (Methratta et al., 2020).

While it is possible that impacts to certain species such as those that inhabit soft-sediment habitats may be negative, a decrease in the abundance of fish and decline in species diversity within the OWFA is not expected (Technical Report C: Fish and Invertebrates). However, it is unclear how an increase in biomass of lower trophic levels may affect the abundance and interaction between higher-level predators including fish species and carnivorous marine mammals such as dolphins and fur seals.

10.4.2.1.4 Release of trace metals

During the operation phase of the project, one or more forms of corrosion protection will be used to protect WTG and OSS foundations and other offshore infrastructure from corrosion, thereby extending the longevity of the infrastructure and reducing maintenance requirements. The continuous degradation of zinc or aluminium based anodes during operation of the wind farm releases metals into the seawater. Whilst high concentrations may occur in the vicinity of each anode, any biological impacts would largely be limited to site-attached individuals located near the anodes and have no population-level effects.

10.4.2.1.5 Increased fishing activity

A potential increase in the abundance of fish species targeted by recreational and commercial fishers could lead to increased catches of fish within the OWFA, particularly in areas where they are more abundant such as in the vicinity of WTG and OSS foundations and rock protection of cables (Technical Report C: Fish and

Invertebrates). Therefore, despite a potential increase in the abundance of such species as a result of habitat change, increased fishing activity and pressure could negatively impact them as a consequence of overfishing (Brink, 2018).

Target species for recreational and commercial fisheries, including kingfish and gummy sharks, are not expected to provide food sources for marine mammal and turtle species. Moreover, these species are wide ranging and increased fishing activity would have minimal impact across the population (Technical Report C: Fish and Invertebrates).

10.4.2.1.6 Light emissions and routine discharges from project vessels

Fish in the immediate vicinity of project vessels may experience behavioural or physiological changes such as temporary avoidance or attraction and temporary stress, depending on the species. The most sensitive receptors would therefore be surface dwelling pelagic species, in particular those attracted to light such as small mackerel and squid, and plankton. However, given the limited spatial extent of light emissions and small volumes of discharges and their rapid dispersion and localised effects, impacts on these and all receptor groups are expected to be negligible.

10.4.2.1.7 Accidental hydrocarbon release from collision of a project vessel or during operations on substations

In the event of an accidental hydrocarbon release, most of the spilled oil is buoyant and therefore fish living in the water column or on the seabed will typically only have limited exposure to hydrocarbons and are able to move away from the area to avoid direct contact. However, if the spill enters shallow or confined waters the impacts to fish, particularly shellfish and other immobile species, can be considerable. Phytoplankton and zooplankton, which make up different trophic levels for higher predators like cetaceans, are generally resilient to the impacts of an accidental hydrocarbon release at the community-level despite being highly vulnerable at the individual level, thus also enabling replenishment of populations (Murawski et al., 2021; Technical Report C: Fish and Invertebrates). Due to the size of a spill from operations on substations and rapid dispersion by offshore currents, the impact to fish and invertebrate species would be localised and temporary (Technical Report C: Fish and Invertebrates).

10.4.2.2 Potential impacts on marine mammals and turtles

10.4.2.2.1 Mysticetes

The OWFA and surrounding waters may provide opportunistic foraging habitat for humpback whales, dwarf minke whales and Bryde's whales (Appendix A). Despite the OWFA sitting within a 'foraging' BIA for blue whales, no evidence of animals persisting in the area to feed was found during the MESP baseline survey (Appendix A). The distribution of prey species (plankton and baitfish) may be affected during operation of the project due to underwater noise emissions, habitat change, light emissions and routine discharges, and possibly EMF. It is possible baitfish may increase in abundance due to project infrastructure (e.g. WTG and OSS foundations) leading to aggregation of prey species. Changes in prey distribution and abundance may affect opportunistic feeding mysticetes, particularly humpback whales. However, given the broad distribution of these species, any change in their distribution and abundance in the OWFA is likely to have negligible impact on mysticetes that may feed in the area that may feed in the area.

10.4.2.2.2 Odontocetes

The OWFA and surrounding waters may provide foraging habitat for bottlenose and common dolphins (Appendix A). The distribution of prey species (plankton and baitfish) may be affected during operation of the project due to underwater noise emissions, habitat change, light emissions and routine discharges, and possibly EMF. It is possible baitfish may increase in abundance due to project infrastructure (e.g. WTG foundations) leading to aggregation of prey species. Changes in prey distribution and abundance may affect feeding dolphins, however, given the broad distribution of these species, any change in their distribution and abundance in the OWFA is likely to have negligible impact on delphinid species that may feed in the area. (Appendix A).

The presence of project infrastructure including WTG and OSS foundations and transmission cables will modify habitat in the OWFA and may provide positive impacts for delphinid species by creating an artificial

reef effect and attracting prey species to the area, therefore increasing foraging opportunity. Wind turbines act as fish aggregation devices, increasing biomass of fish species within the OWFA (Methratta and Dardick, 2019; Technical Report C: Fish and Invertebrates). This in turn may attract dolphins due to an increase in food availability. A study in the Netherlands found more harbour porpoise clicks were recorded in the area of an operating OWF (i.e. greater presence) than in the reference areas outside the OWF, most likely linked to an increase in food availability and the exclusion of fisheries and reduced vessel traffic (Lindeboom et al., 2011).

10.4.2.2.3 Pinnipeds

AUFS from the Rag Island colony occur regularly throughout the OWFA and surrounding waters en-route to foraging grounds in the north-east, while the OWFA and surrounding waters do not represent important foraging habitat for AUFS or NZFS from Kanowna Island (Appendix A).

The presence of project infrastructure including WTG and OSS foundations and transmission cables will modify habitat in the OWFA and may provide positive impacts for fur seals by creating an artificial reef effect and attracting prey species to the area, therefore increasing foraging opportunity.

AUFS are benthic foragers, with up to 95 per cent of dives to the sea floor (Speakman et al., 2020). Arnould et al. (2015) assessed the foraging patterns of 36 female AUFS from Kanowna Island and found that 72 per cent of individuals spent time foraging in the vicinity of anthropogenic seafloor structures. Most of these visits were to pipelines and cable routes (96 per cent), although foraging occurred at oil and gas wells and shipwrecks also. Results from the MESP study found that distance from anthropogenic sea floor structures influenced the at-sea location of tagged AUFS at both Rag Island and Kanowna Island, and NZFS at Kanowna Island (Appendix A). The location of oil and gas infrastructure north-east of the OWFA is an important foraging area for Rag Island AUFS (Appendix A). Research indicates that benthic foragers rapidly make use of seafloor structures (Arnould et al., 2015; Russell et al., 2014) such that increased foraging opportunities may begin throughout the construction phase as turbines and sea floor cables are installed (Russell et al., 2014).

10.4.2.2.4 Marine turtles

Marine turtles predominantly feed on jellyfish, cephalopods (octopus and squid) and benthic invertebrates, as well as seagrass and algae (Limpus et al., 2005; Commonwealth of Australia, 2017a). The Bass Strait is reportedly a foraging hotspot for leatherback turtles; however, just a single 'likely' leatherback turtle and a single loggerhead turtle were observed during the MESP baseline survey (Appendix A). The OWFA and surrounding waters are not likely to provide important foraging habitat for other marine turtle species and consequently changes in prey distribution and abundance are not considered to impact for these species.

10.4.3 Mitigation measures

No additional mitigation measures required.

10.4.4 Residual impacts

Residual effects to marine mammals and turtles from changes in prey distribution and abundance are the same as those described above.

Table 10-7 Consequence associated with changes in prey distribution and abundance during the operations phase

Potential Impact	Receptor	Receptor sensitivity	Initial consequence	Additional mitigation	Consequence
Reduced habitat and water quality leading to change in prey distribution and	Blue whale Humpback whale Odontocetes - dolphins Marine turtles - leatherback	Medium	Minor (D) (Magnitude = Low)	N/A	Minor (D) (Magnitude = Low)

abundance (indirect impact)

Indirect impact: Changes in prey distribution and abundance	Other mysticetes Pinnipeds	Low	Negligible (E) (Magnitude = Low)	N/A	Negligible (E) (Magnitude = Low)

10.4.5 Evaluation of residual risk against assessment criteria

An evaluation of residual impacts against the performance outcomes as stated in Section 0 is provided in Table 10-8.

Table 10-8 Evaluation of residual impacts against performance outcomes for changes in prey distribution and abundance

Assessment criteria	Evaluation	Confidence / uncertainty
Principles of ESD AC1: Biological diversity and productivity of the environment is not compromised because of the project.	Changes in prey distribution and abundance may result in localised impacts to marine mammals and turtles. However, it is more likely that the presence of foundations will result in an increase in prey aggregation. Monitoring of marine mammals and turtles through the operational phase of the project will determine whether any changes are observed. It is not anticipated that changes in prey abundance and distribution will compromise productivity or reduce biological diversity, alternatively it may enhance both. Monitoring during the operational phase will be undertaken as a precautionary measure. The project is not inconsistent with the Principles for ESD.	Medium confidence Monitoring is proposed to validate predictions
Significant Impact Guidelines (threatened species) AC4: The project will not have a significant impact on Threatened (Endangered and Vulnerable) Species as defined in the MNES Significant Impact Guidelines 1.1	Changes in prey distribution and abundance may result in localised impacts to marine mammals and turtles. However, it is more likely that the presence of foundations will result in an increase in prey aggregation. Monitoring of marine mammals and turtles through the operational phase of the project will determine whether any changes are observed, however, given the broad distribution key prey species coupled with the large foraging ranges of marine mammals and turtles, any change in the availability of their prey within the OWFA is likely to have a negligible impact. It is not anticipated that changes in prey abundance and distribution will compromise habitat availability, breeding success or the survival of individuals, alternatively it may enhance both, and will not interfere with the recovery of a species. The project is not inconsistent with the Significant Impact Guidelines for threatened species.	
Significant Impact Guidelines (migratory species) AC7: The project will not have a significant impact on for Migratory Species as defined in the MNES Significant Impact Guidelines 1.1	Changes in prey distribution and abundance may result in localised impacts to marine mammals and turtles. However, it is more likely that the presence of foundations will result in an increase in prey aggregation. Monitoring of marine mammals and turtles through the operational phase of the project will determine whether any changes are observed, however, given the broad	

Assessment criteria	Evaluation	Confidence / uncertainty
	distribution key prey species coupled with the large foraging ranges of marine mammals and turtles, any change in the availability of their prey within the OWFA is likely to have negligible impact. It is not anticipated that changes in prey abundance and distribution will compromise breeding success or the survival of individuals, alternatively it may enhance both. The project is not inconsistent with the Significant Impact Guidelines for migratory species.	
Significant Impact Guidelines (Commonwealth Marine Areas) • AC8: The project will not have a significant impact on Commonwealth Marine Areas as defined in the MNES Significant Impact Guidelines 1.1	Changes in prey distribution and abundance may result in localised impacts to marine mammals and turtles. However, it is more likely that the presence of foundations will result in an increase in prey aggregation. Monitoring of marine mammals and turtles through the operational phase of the project will determine whether any changes are observed, however, given the broad distribution of migratory species, any change in the availability of their prey within the OWFA is likely to have negligible impact. It is not anticipated that changes in prey abundance and distribution will be such that biodiversity or ecological function/integrity are adversely affected, alternatively it may enhance both. The project is not inconsistent with the Significant Impact Guidelines for Commonwealth Marine Areas.	-

11 OPERATIONS RISK ASSESSMENT – ACCIDENTS

11.1 Vessel strike (MMT-R001)

11.1.1 Project activities

Vessel strike, or collisions between vessels and marine mammals and turtles, could occur whenever vessels are active at sea during operation of the offshore wind farm. Wind turbines are expected to operate for 30 years, and it is anticipated that up to 1,202 vessel round trips per year could occur during the operation phase, of which the majority would be by smaller-sized CTVs (average 2.5 metre draft) transferring technicians to turbines. The alternative is that the CTVs remain offshore and transfer technicians from an SOV to the WTG. This would result in fewer vessel trips and is therefore not the maximum design scenario considered for this assessment.

Other service vessels will undertake regular maintenance and servicing, however heavy maintenance and infrastructure surveys will require campaigns by larger vessels. Heavy maintenance vessels and survey vessels will have the same characteristics as vessels with the same function used during construction phase (Section 9.1).

Vessel movements during operations and maintenance are compared to existing and projected 'no project' levels. Overall, the change to existing vessel traffic levels is small (compared to pre-construction background levels), except in the case of:

- CTVs, which will go from 7,520 vessel round trips over the four years and eleven months construction period to 1,202 vessels round trips per year for the 30-year operations phase.

A number of initial mitigation measures will be adopted as part of the project design to reduce any potential impacts to marine mammals and turtles as described in Table 7-3. This includes the use of vessel movement corridors between ports and OWFA to reduce spatial extent of vessel movement, speed restrictions in BIAs for southern right whale reproduction during the months of May to September to minimise risk of vessel collision, particularly for cow / calf pairs that are at an increased vulnerability. Additional measures for protected species also include maintaining safe distances at all time, actively reducing speed and avoiding abrupt movements. For delphinid species that are bow- or wake-riding, vessel should maintain course and speed as long as it is safe to do so or until the animal(s) leave the vicinity of the vessel.

11.1.2 Risk assessment

Risks of vessel strike for each receptor group are discussed in detail in Section 9.1. Potential impacts to marine mammal and turtles from vessel strike during the operation phase are similar as described in Section 9.1 for the construction phase. However, as both the size of the vessels and the annual number of vessel movements will be less than during construction, the potential risk for vessel strike will be reduced during construction, albeit greater than baseline levels.

It is plausible to consider an increased risk of vessel strike to marine mammal and turtle species in areas where vessel traffic from multiple projects (existing and deemed likely to occur) overlaps with the presence of marine mammals and turtles. Large vessels typically travel at slow speeds, and support vessels will be deployed to prevent interactions with marine mammals and turtles. In general, the addition of vessels from non-wind farm projects is considered a negligible change to existing and projected levels. However, the addition of project vessels from proposed wind farms may enhance cumulative risk. Accordingly, it will be important for liaison between project proponents to develop simultaneous operations plans in the event of more than one project in operation in the Gippsland declared area in order to mitigate any potential cumulative risk of vessel strike.

11.1.3 Mitigation measures

Final mitigation measures for the operations and maintenance phase are the same as those for the construction phase (Section 9.1), noting that:

- Legislation, regulation, guidance and community expectations as they relate to vessel strike risks may change over the 30-year life of the project

- The mitigation measures implemented during the commissioning and operations phase must use data and experience gained during the construction phase to ensure:
- Vessel crew and project staff receive updated awareness training on an annual basis
- Mitigations must consider different vessel operating characteristics (which may change over time), species population status, distribution and seasonality.
- A simultaneous operations plan (SIMOPS) to minimise the risk of vessel strike in the event of multiple large offshore projects operating in the Gippsland region but maximising the distances between areas of activity (see cumulative impacts assessment section 14.4).

11.1.4 Residual risk

Residual effects to marine mammals and turtles from increased risk of vessel strike from project vessels are the same as those described in Section 9.1.

Table 11-1: Consequence associated with the increased risk of vessel strike from project vessels during the operations phase

Event (ID no.)	Receptor	Receptor sensitivity	Initial risk rating	Additional mitigation	Residual Risk Rating
Vessel strike leading to direct injury / mortality	Blue whale Southern right whale	High	Low Consequence = Moderate (C) (Magnitude = Low, Likelihood = Unlikely)	VES-M09 VES-M10 VES-M11	Low Consequence = Moderate (C) (Magnitude = Low, Likelihood = Rare)
Vessel strike leading to direct injury / mortality	Humpback whale Other mysticetes	Medium	Low Consequence = Minor (D) (Magnitude = Low, Likelihood = Unlikely)	VES-M09	Very low Consequence = Minor (D) (Magnitude = Low, Likelihood = Rare)
Vessel strike leading to direct injury / mortality	Odontocetes - dolphins Pinnipeds Marine turtles	Low	Very low Consequence = Negligible (E) (Magnitude = Low, Likelihood = Rare)	VES-M09	Very low Consequence = Negligible (E) (Magnitude = Low, Likelihood = Rare)

11.1.5 Evaluation of residual risk against assessment criteria

An evaluation of the residual impacts against the assessment criteria in Table 3-5 is provided in Table 11-2.

Table 11-2: Evaluation of residual risk against assessment criteria for increased risk of vessel strike from project vessels

Assessment criteria	Evaluation	Confidence / uncertainty
Principles of ESD • AC1: Biological diversity and productivity of the environment is not compromised because of the project	Vessel strike is highly unlikely to be so prevalent from project activities that there is a population effect on any marine mammal or turtle species such	High confidence • Vessel strike is very unlikely, and if it occurs, restricted speeds and

Assessment criteria	Evaluation	Confidence / uncertainty
	that biological diversity or productivity is affected because it is more likely to affect individuals. The exceptions to this include species with low abundance estimates, such as the eastern subpopulation of southern right whales and possibly blue whales, where the loss of an individual could have a significant population level effect. Notwithstanding, the precautionary approach is applied and the risk of injury / mortality from vessel strike will be minimised through the implementation of vessel speed restrictions and best practice measures for monitoring marine fauna (e.g. MFOs). Likewise, specific measures will apply to manage the risk of injury/mortality for southern right whales and blue whales such that vessel strike to any marine mammal or turtle is not expected to occur. The project is not inconsistent with the Principles of ESD.	precaution zones when encountering marine fauna as per the mitigations mean that in the unlikely event of vessel strike, injuries will be minimised. If strike occurs, only individuals may be affected, not populations, and therefore the assessment criteria will be met.
Conservation Management Plan for the Blue Whale AC2: The project will be managed such that residual impacts and/or risks will not be inconsistent with the objectives of the Conservation Management Plan for the Blue Whale, including application of the “Guidance on key terms” and the requirement of Action Area A4 – minimising vessel collisions	Vessel strike due to the project activities was assessed as having a low risk to blue whales. Vessel strike is considered a threat to the recovery of blue whales, if sufficient number of individuals in the population lose reproductive fitness or are killed, though the uncertainty in population estimates is acknowledged. Vessel strike is unlikely given the low likelihood of occurrence of blue whales within the OWFA, which is expected to be limited to occasional migratory individuals. Notwithstanding, the risk of injury / mortality from vessel strike will be minimised through the implementation of vessel speed restrictions and best practice measures for monitoring marine fauna (e.g. MFOs) such that vessel strike is not expected to occur. The project is not inconsistent with the Conservation Management Plan for the blue whale.	
National Recovery Plan for the Southern Right Whale AC3: The project will be managed such that residual impacts and/or risks will not be inconsistent with the objectives of the National Recovery Plan for the Southern Right Whale including the requirement of Action Area A6 – manage, minimise and mitigate the threat of vessel strike	Vessel strike due to the project activities was assessed as having a low risk to southern right whales. Vessel strike is considered a threat to the recovery of southern right whales, particularly the smaller eastern population, if sufficient number of individuals in the population lose reproductive fitness or are killed. Vessel strike is unlikely given the low number of individuals recorded within the OWFA during the aerial surveys of the MESP, though they are considered likely to occur and are known to be difficult to (visually) detect due to their inconspicuous profile. On this basis, and in accordance with the southern right whale recovery plan, the risk of injury/mortality will be managed through	

Assessment criteria	Evaluation	Confidence / uncertainty
	the implementation of vessel speed restrictions, including slow speeds in the 'reproduction' BIA during peak calving months of May to September, and best practice measures for monitoring marine fauna (e.g. MFOs). Additional measures will also apply in the event that a southern right whale is sighted, in which case the caution zone will be increased to 500 metres and the vessel speed reduced to five knots within this caution zone where safe to do so, such that vessel strike is not expected to occur. The project is not inconsistent with the National recovery plan for the southern right whale.	
Significant Impact Guidelines (threatened species) • AC4: The project will not have a significant impact on Threatened (Endangered and Vulnerable) Species as defined in the MNES Significant Impact Guidelines 1.1.	Vessel strike is not considered a threat to population viability for species that have larger populations, however it could have a significant population level effect for species with low abundance estimates such as the eastern subpopulation of southern right whales, and possibly blue whales. No impacts to the recovery of species are predicted. Vessel strike is unlikely given the low likelihood of occurrence of threatened species of marine mammals and turtles and the risk of injury / mortality from vessel strike will be managed through the implementation of vessel speed restrictions and best practice measures for monitoring marine fauna (e.g. MFOs) such that vessel strike is not expected to occur. No significant impacts are predicted to threatened species.	
EPBC Regulations (multiple) • AC5: The project will be managed to prevent vessel strike with marine fauna.	The project will implement a Vessel Management Plan and align with practices and approach distances outlined in the guidelines. The project is not inconsistent with the EPBC Regulations 2000 Part 8, Wildlife (Marine Mammal) Regulations 2019, and the Australian National Guidelines for Whale and Dolphin Watching. The project will implement measures described in the National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna.	
Significant Impact Guidelines (migratory species) • AC7: The project will not have a significant impact on Migratory Species as defined in the MNES Significant Impact Guidelines 1.1.	Vessel strike is not considered a threat to population viability for species that have larger populations, however it could have a significant population level effect for species with low abundance estimates such as the eastern subpopulation of southern right whales, and possibly blue whales. Vessel strike is unlikely given the low likelihood of occurrence of migratory species of marine mammals and turtles and the occasional and mostly transient nature of their presence. The risk of injury / mortality from vessel strike will be managed through the implementation of	

Assessment criteria	Evaluation	Confidence / uncertainty
	vessel speed restrictions and best practice measures for monitoring marine fauna (e.g. MFOs) such that vessel strike is not expected to occur, with no impact on breeding success or individuals. The project is not inconsistent with the Significant Impact Guidelines for migratory species.	
Significant Impact Guidelines (Commonwealth Marine Areas) • AC8: The project will not have a significant impact on Commonwealth Marine Areas as defined in the MNES Significant Impact Guidelines 1.1.	Vessel strike is highly unlikely to be so prevalent from project activities that there is a population effect on any marine mammal and turtle species such that biological diversity or productivity is affected because it is more likely to affect individuals. The exceptions to this include species with low abundance estimates, such as the eastern subpopulation of southern right whales and possibly blue whales, where the loss of an individual could have a significant population level effect. The risk of injury/mortality to all marine mammals and turtles will be managed through the implementation of vessel speed restrictions, including slow speeds in the southern right whale 'reproduction' BIA during peak calving months of May to September, and best practice measures for monitoring marine fauna (e.g. MFOs). Additional measures will also apply in the event that a southern right whale is sighted, in which case the caution zone will be increased to 500 metres and the vessel speed reduced to five knots within this caution zone where safe to do so, such that vessel strike is not expected to occur, with no long term impacts on habitat or populations. The project is not inconsistent with the Significant Impact Guidelines for Commonwealth Marine Areas.	

11.2 Accidental hydrocarbon release (MMT-R002)

11.2.1 Project activities

This assessment of impacts due to an accidental hydrocarbon release from collision of a project vessel during the operations phase uses the same spill scenario and modelling as that for the construction phase (Section 9.2). However, while the duration of the operations phase would be much longer than the construction phase, maintenance vessels used during the operations phase would typically be smaller, fewer in number and more manoeuvrable than those used during construction. They are also expected to have smaller fuel carrying capacity. As outlined in Section 9.2, it is very unlikely that a vessel collision would occur given the high skill level of crew onboard vessels in the offshore construction industry (ATSB, 2018).

Changes in the size and number of vessels, and reduced fuel capacity have considerable influence on the likelihood and consequences of an accidental hydrocarbon release, and for much of the operations phase the risk profile is likely to be considerably less than assessed in Section 9.2 for the construction phase. Nevertheless, in the event of a breakdown of project infrastructure requiring major component replacement, it is likely that a large construction vessel along with support vessels would be required to complete the work, potentially for an extended period incorporating other heavy maintenance activities. In this case, the risk profile is expected to be similar to that for the construction phase.

The project also presents a risk in the form of an accidental hydrocarbon release during operations on substations. The OSSs would collect, transform and export power generated by the WTGs and provide other power system, control and support functions. Transformers used in wind turbines are subject to more severe stresses than is typically the case because the erratic nature of wind causes output energy of a wind turbine to vary. This can result in component failure which, if occurring in the lubrication system could lead to loss of transformer oil into the marine environment. The assessment was based on a maximum realistic spill scenario involving the release of 40 cubic metres of naphthenic oil to sea and utilised an accidental hydrocarbon release trajectory and fates model (Attachment II – Oil Spill Modelling). The modelling is based on mineral naphthenic oil, considered more toxic to marine life and slower to biodegrade than silicone fluids or synthetic esters. The spill location considered is on the nearshore border of the OWFA, which presents a worst-case scenario in terms of the extent and impact of a spill.

11.2.2 Risk assessment

Potential impacts to marine mammals and turtles from a marine gas oil (MGO) spill due to collision of a project vessel during the operations phase are the same as described in Section 9.2 for the construction phase.

Impact pathways include:

- Surface oil which affects animals when surfacing
- Entrained oil which affects animals swimming / foraging usually down to approximately ten metres below sea surface
- Shoreline accumulation which affects animals which utilise these areas (e.g. pinnipeds)

Through these pathways the following impacts can occur:

- Direct physical injury (e.g. skin irritation or damage to sensitive areas such as eyes or mouth)
- Direct toxicity through ingestion of oil and/or contaminated prey
- Indirect impacts through effects on prey species e.g. changes in distribution (see Section 10.4).

Limited research has been conducted the effects of small-scale spill or MGO spills to marine mammals and turtles. The severity of impacts to marine mammals and turtles may vary depending on the location and source of spill, volume of spill, and spill characteristics (e.g. composition, trajectory, intensity, timing (season) and duration. Given the nature of MGO, and the dilution and dispersion from natural weathering processes such as ocean currents, the extent of exposure will be limited in area (less than 50 kilometres) and duration and impacts to marine mammals and turtles are expected to be minimal. Due to smaller fuel carrying capacity for vessels utilised during operational activities, impacts are also likely to be lower than those described in Section 9.2.

Naphthenic mineral oil is manufactured from crude oil, is insoluble, and contains no aromatic hydrocarbons. It has relatively low viscosity and is predicted to readily entrain into the water column and be transported along the shore in a northeast – southwest trajectory by prevailing currents (Attachment II – Oil Spill Modelling). The oil plume would have a low probability of contacting benthic habitats in the area and a two per cent probability of contacting nearby McLoughlins and Woodside Beaches at a high concentration of greater than 100 parts per billion (Attachment II – Oil Spill Modelling; an exposure level of 100 ppb is considered appropriate for informing risk evaluation specific to the particular oil characteristics (NOPSEMA, 2019). The trajectory of a spill and associated impacts to habitat and fish would also vary significantly depending on the weather and oceanographical conditions at the time of the spill.

Naphthenic compounds can be toxic to marine organisms and in the event of a spill, surface slicks and plumes of entrained hydrocarbons may cause localised reduction in water quality of surface waters, which at specific thresholds and exposure hours may have behavioural consequences to individuals including avoidance of affected areas, as well as a range of sub-lethal to lethal effects depending on the spatial and temporal extent of the exposure and level of toxicity (Attachment II – Oil Spill Modelling). Therefore, impacts of an accidental hydrocarbon release on defined receptor groups that are relevant to population-level assessment are:

- Disruption to migration and breeding events within the area affected by the accidental hydrocarbon release
- Decline in the abundance of individuals within the area affected by the accidental hydrocarbon release.

- A potential spill of MGO from a vessel collision during operational activities would likely drift relatively small distances (less than 50 kilometres), with surface oil expected to become fully entrained within 14 days. Given that the discharges will disperse rapidly close to the discharge point and that any contact with the discharge will be of extremely short duration, impacts are expected to be minimal.

11.2.2.1 Cetaceans

In the event of an MGO spill, cetaceans may come into contact with hydrocarbons entrained in the water column and at the surface. Southern right whales are more vulnerable to contact with surface slicks as they spend a large amount of time in shallow waters (less than 20 metres depth) 'logging' at the surface, often moving slowly. Physical contact with localised areas MGO may result in the potential for temporary skin irritation; however, given that the MGO will disperse rapidly close to the discharge point and that any contact with the discharge will be of extremely short duration, it is not considered credible that any long-term toxic effects to any cetaceans would occur. Humpback whales, dwarf minke whales and dolphin species were observed feeding in the OWFA and surrounding waters (Appendix A), and therefore feeding individuals may consume contaminated prey (e.g. krill, baitfish). However, cetaceans are not expected to ingest quantities of contaminated prey large enough to induce toxicity effects. As dolphin species were present year-round in the OWFA, and the gravity of impacts from an MGO spill are far greater for resident populations (Wells et al., 2017), dolphin species are considered to be at greater risk from an MGO spill. Therefore, odontocetes (dolphins) were assessed as medium, and all other cetaceans were assessed as low.

Given the nature of MGO and the dilution and dispersion properties, few individuals could be directly exposed to a MGO spill; however, long-term impacts are unlikely.

11.2.2.2 Pinnipeds

Pinnipeds are at an increased risk of potential impacts from an MGO spill as they utilise all three risk pathways including time spent at the surface, time spent below surface swimming and foraging, and time spent on the shore during hauling out. However, fur seals are likely to haul out rather than spend large periods of time at the surface. Accidental hydrocarbon release modelling (Attachment II – Oil spill modelling summary) indicates a low probability of shoreline contact at Rag Island (up to 25 per cent), and no shoreline contact at Kanowna Island. AUFS from the Rag Island colony occur regularly throughout the OWFA and surrounding waters, with an estimated 5 per cent of the population predicted to be in the OWFA at any one time, while much fewer AUFS and NZFS from the Kanowna Island colony would be in the OWFA (Appendix A). AUFS are benthic foragers; however, accidental hydrocarbon release modelling indicates that oil does not reach below 20 metres water depth, and therefore foraging AUFS will not be exposed to MGO through the ingestion of prey. While NZFS may consume contaminated prey while foraging in the water column, the OWFA and surrounding waters do not represent important foraging habitat for this species. Given the nature of MGO and the dilution and dispersion properties, some individuals could be directly exposed to a MGO spill; however, it is unlikely to affect a significant proportion of a population.

11.2.2.3 Marine turtles

Marine turtles may be vulnerable to hydrocarbons entrained in the water column and at the surface in the event of an MGO spill. There are no important habitats for marine turtles (i.e. nesting beaches, designated BIAs) in proximity to the OWFA, and their presence in the OWFA and surrounding waters is expected to be limited to highly occasional transient individuals. Marine turtles spend little time at the surface and are unlikely to ingest quantities of contaminated food large enough to induce toxicity effects.

Given the nature of MGO and the dilution and dispersion properties, highly occasional transient individuals could be directly exposed to a MGO spill. However, the spill would affect only individuals and not populations of turtles.

11.2.3 Mitigation measures

No additional mitigation measures to standard described in Table 7-3.

11.2.4 Residual risk

Table 11-3: Consequence, likelihood and residual risk ranking associated with an accidental hydrocarbon release from a collision of a project vessel during the construction phase

Potential Impact Receptor	Receptor sensitivity	Initial risk rating	Mitigation	Residual risk rating
Oiling, toxicity All marine mammals and turtles	Medium	Low Consequence = Moderate (C) (Magnitude = Medium, Likelihood = Rare)	N/A	Low Consequence = Moderate (C) (Magnitude = Medium, Likelihood = Rare)

11.2.5 Evaluation of residual risk against assessment criteria

An evaluation of the residual impacts against the assessment criteria is provided in Table 9-5.

Table 11-4: Evaluation of residual risk against assessment criteria for accidental hydrocarbon release from collision of a project vessel

Assessment criteria	Evaluation	Confidence / uncertainty
Principles of ESD AC1: Biological diversity and productivity of the environment is not compromised because of the project	An accidental release of hydrocarbons resulting from a vessel collision may result in impacts to biological diversity and productivity of the environment. However, with appropriate control measures in place, effects are expected to be short-term throughout the period of occupancy of animals (days to weeks) with no population level impacts. The risk of localised impacts from a release of hydrocarbons from collision of a project vessel will be managed through vessel traffic management and the implementation of an OPEP. The environmental outcome is not inconsistent with the Principles of ESD.	Medium confidence The likelihood of a spill occurring is very low, however due to the uncertainty in variables such as the spill volume, season, location, response, number of animals encountered, which will determine the actual effects of the spill, the evaluation is of medium confidence.
Significant Impact Guidelines (threatened species) AC4: The project will not have a significant impact on Threatened (Endangered and Vulnerable) Species as defined in the MNES Significant Impact Guidelines 1.1.	An accidental release of hydrocarbons resulting from a vessel collision may result in localised impacts to threatened species and their habitat. However, any contact with hydrocarbons or MGO spill from collision of a project vessel to threatened species will be of extremely short duration and given the nature of MGO and the dilution and dispersion properties, any effects to species are expected to be minimal and unlikely to impact breeding success or lead to a long-term decrease in the size of a population. The risk of localised impacts from a release of hydrocarbons from a collision of a project vessel will be managed through vessel traffic management and the implementation of an OPEP. The project is not inconsistent with the Significant Impact Guidelines for threatened species.	
EPBC Regulations (multiple) AC5: The project will be managed to prevent vessel strike with marine fauna.	The project will implement a Vessel Management Plan and align with practices and approach distances outlined in the guidelines. The project is not inconsistent with the EPBC Regulations 2000 Part 8, Wildlife (Marine Mammal) Regulations 2019, and the Australian National Guidelines for Whale and	

Assessment criteria	Evaluation	Confidence / uncertainty
	Dolphin Watching. The project will implement measures described in the National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna.	
Pollution prevention AC6: The project will be managed to prevent pollution from routine and/or accidental discharges to the marine environment.	Accidental release of hydrocarbons is expected to be localised at the location of activity during construction. It is expected that potential impacts to pollution from routine and/or accidental discharges to the marine environment will be of extremely short duration and given the nature of MGO and the dilution and dispersion properties, any pollution impacts are expected to be minimal and/or localised to one area. The risks of localised impacts from a release of hydrocarbons from a collision of a project vessel will be managed through vessel traffic management and the implementation of an OPEP. The project is not inconsistent with the project assessment criteria.	
Significant Impact Guidelines (migratory species) AC8: The project will not have a significant impact on Migratory Species as defined in the MNES Significant Impact Guidelines 1.1.	An accidental release of hydrocarbons resulting from a vessel collision may result in localised impacts to migratory species and their habitat. However, any contact with hydrocarbons or MGO spill from collision of a project vessel will be of extremely short duration and given the nature of MGO and the dilution and dispersion properties, and the species moving through the area rather than staying for long periods, any effects to species are expected to be minimal and unlikely to impact important behaviours, such as breeding, feeding, migration or resting. The risks of localised impacts from a release of hydrocarbons from a collision of a project vessel will be managed through vessel traffic management and the implementation of an OPEP. The project is not inconsistent with the Significant Impact Guidelines for migratory species.	
Significant Impact Guidelines (Commonwealth Marine Areas) AC9: The project will not have a significant impact on Commonwealth Marine Areas as defined in the MNES Significant Impact Guidelines 1.1.	Accidental release of hydrocarbons is expected to be localised at the location of activity during construction. It is expected that potential impacts to Commonwealth Marine Areas will be of extremely short duration and given the nature of MGO and the dilution and dispersion properties, any effects to Commonwealth Marine Areas are expected to be minimal. The risks of localised impacts from a release of hydrocarbons from a collision of a project vessel will be managed through vessel traffic management and the implementation of an OPEP. The project is not inconsistent with the Significant Impact Guidelines project for Commonwealth Marine Areas.	

11.3 Debris leading to entanglement or ingestion (MMT-R003)

11.3.1 Project activities

Marine activities, including fishing, shipping and offshore developments, are significant contributors to the growing problem of marine debris, with various sources impacting ocean health (Pawar et al., 2016).

Commercial and recreational fishing activities are a major source of discarded, lost, or abandoned gear, including nets, lines, and traps, that have the potential to entangle marine life and damage ecosystems (Watson et al., 2022). Shipping and maritime transport also contribute to marine debris through accidental spills, waste disposal, and littering from vessels. Offshore developments, such as oil and gas extraction and renewable energy projects like wind farms, can accidentally introduce debris during maintenance activities, including discarded equipment, cables and maintenance materials (Katsanevakis, 2008). Additionally, habitat creation through artificial reef can adversely impact marine mammals and turtles through increased anthropogenic use of recreational fishing gear in the general area of the offshore wind farm due to spillover effects, and thus an increased risk of entanglement / ingestion of lost gear (Revolution Wind, L. L. C, 2020).

11.3.2 Risk assessment

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) serves as a key framework for protecting biodiversity, including the habitats of threatened species such as marine mammals and turtles. Additionally, the Threat Abatement Plan for Marine Debris, established under the EPBC Act, specifically targets the impacts of marine debris on vulnerable species, outlining actions to mitigate risks such as entanglement and ingestion.

Entanglement and ingestion may occur either accidentally while feeding or scavenging, or deliberately if marine debris is mistaken for prey items (Laist, 1987, Roman et al., 2021). Sub-lethal effects of entanglement or ingestion of marine debris may reduce an individual's fitness and ability to successfully reproduce, catch prey and avoid predation (Pemberton et al., 1992).

Potential entanglement or ingestion of marine debris to marine mammals and turtles during the operations phase are the same as described in Section 9.3 for the construction phase. Refer to Section 9.3 for further details regarding differences in receptor sensitivity.

11.3.3 Mitigation measures

Standard industry vessel management practices will apply to prevent debris escape as provided in Table 7-3. No additional mitigation measures required.

11.3.4 Residual Risk

Table 11-5: Consequence, likelihood and residual risk ranking associated with entanglement or ingestion during the operations phase

Potential impact	Receptor	Receptor sensitivity	Initial risk rating	Mitigation measure	Residual Risk Rating
Entanglement or ingestion leading to injury or mortality	Humpback whale	Medium	Low Consequence = Negligible (E), (Magnitude = Low, Likelihood = Unlikely)	N/A	Low Consequence = Negligible (E), (Magnitude = Low, Likelihood = Unlikely)
Entanglement or ingestion leading to injury or mortality	Blue whale Southern right whale	Low	Very low Consequence = Negligible (E), (Magnitude = Low, Likelihood = Unlikely)	N/A	Very low Consequence = Negligible (E), (Magnitude = Low, Likelihood = Unlikely)
Entanglement or ingestion leading to injury or mortality	Other mysticetes Odontocetes - dolphins	Low	Very low Consequence = Negligible (E), (Magnitude = Low, Likelihood = Unlikely)	N/A	Very low Consequence = Negligible (E), (Magnitude = Low, Likelihood = Unlikely)

Potential impact	Receptor	Receptor sensitivity	Initial risk rating	Mitigation measure	Residual Risk Rating
Entanglement or ingestion leading to injury or mortality	Marine turtles	Medium	Very low Consequence = Negligible (E), (Magnitude = Low Likelihood = Rare)	N/A	Very low Consequence = Negligible (E), (Magnitude = Low Likelihood = Rare)
Entanglement or ingestion leading to injury or mortality	Pinnipeds	Medium	Low Consequence = Minor (D) (Magnitude = Low, Likelihood = Unlikely)	N/A	Low Consequence = Minor (D) (Magnitude = Low, Likelihood = Unlikely)

11.3.5 Evaluation of residual risks against assessment criteria

An evaluation of the residual risk against the assessment criteria is provided in Table 11-6.

Table 11-6: Evaluation of residual risks against assessment criteria for entanglement or ingestion during the operations phase

Assessment criteria	Evaluation	Confidence / uncertainty
Principles of ESD AC1: Biological diversity and productivity of the environment is not compromised because of the project	By limiting marine debris from offshore installations and shipping in accordance with the Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (2018), marine debris is unlikely to be so prevalent from the project activities that there is a population effect on any marine mammal or turtle species to the point that biological diversity or productivity is impacted. The project is not inconsistent with the Principles of ESD.	High confidence It is highly unlikely that marine debris will be lost during the project operations, and if it is, retrieval occur where feasible to avoid impacts to marine fauna.
Significant Impact Guidelines (threatened species) AC4: The project will not have a significant impact on Threatened (Endangered and Vulnerable) Species as defined in the MNES Significant Impact Guidelines 1.1.	By limiting marine debris from offshore installations and shipping in accordance with the Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (2018), the project is unlikely to significantly impact threatened species, with no impact on breeding success, the survival of individuals and, therefore, the recovery of a species. Standard industry vessel management practices will apply to prevent debris escape. The project is not inconsistent with the Significant Impact Guidelines for threatened species.	

Assessment criteria	Evaluation	Confidence / uncertainty
Pollution prevention AC6: The project will be managed to prevent pollution from routine and/or accidental discharges to the marine environment.	By limiting marine debris from offshore installations and shipping in accordance with the Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (2018), the project is unlikely to significantly impact on pollution. Standard industry vessel management practices will apply to prevent debris escape. The project is not inconsistent with the project assessment criteria.	
Significant Impact Guidelines (Migratory Species) AC7: The project will not have a significant impact on Migratory Species as defined in the MNES Significant Impact Guidelines 1.1.	By limiting marine debris from offshore installations and shipping in accordance with the Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (2018), the project is unlikely to significantly impact threatened species, with no impact on breeding success, the survival of individuals or biologically important behaviours. Standard industry vessel management practices will apply to prevent debris escape. The project is not inconsistent with the Significant Impact Guidelines for migratory species.	
Significant Impact Guidelines (Commonwealth Marine Areas) AC8: The project will not have a significant impact on Commonwealth Marine Areas the environment as defined in the MNES Significant Impact Guidelines 1.1.	By limiting marine debris from offshore installations and shipping in accordance with the Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (2018), marine debris is unlikely to be so prevalent from the project activities that there is a population effect on any marine mammal or turtle species such that biological productivity or ecological function/integrity are impacted. Standard industry vessel management practices will apply to prevent debris escape. The project is not inconsistent with the Significant Impact Guidelines for Commonwealth Marine Species.	

11.4 Accidental discharges (MMT-R004)

11.4.1 Project activities

Vessels will need to routinely discharge small volumes of liquid and solid waste into the marine environment during operations activities. Project activities that involve routine discharges are described in Section 8.2. Accidental discharges of these (including food waste, deck drainage, bilge waters, sewage and grey water, cooling waters and / or brine) may occur during the construction phase. The management and prevention of accidental discharges of liquid and solid waste are governed through the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and the *Navigation Act 2012*, to ensure compliance with international obligations (MARPOL).

11.4.2 Risk assessment

Marine mammals and turtles may be impacted by accidental discharges through similar ways as described in Section 9.4, including:

- A decline in water quality in the immediate vicinity of the discharge, including an increase in turbidity of surrounding waters
- Introduction of marine pest species leading to a decline in health
- Temporary toxicity to fauna through bilge water discharges.

Accidental discharges from large vessels may entail changes to water quality through contamination from hydrocarbons, detergents, solvents, and chemicals, or the introduction of marine pest species that can severely disrupt the marine ecosystem (Elçiçek et al., 2013). These are addressed in project technical reports on benthic habitats and fish (Technical Report B: Benthic Ecology and Technical Report C: Fish and Invertebrates). A range of mitigation measures (refer to Table 7-3) will be implemented to decrease the risk of a reduction in water quality and the introduction of marine pests.

Given the open area of the OWFA, small accidental discharges of hydrocarbons, detergents, solvents, and chemicals that affect water quality may disperse and dilute rapidly with little impact to the surrounding environment. However, large uncontrolled discharges may be more impactful and have the ability to negatively impact the surrounding environment, and the marine mammal and turtle species in the area. Accidental discharge of bilge water can result in serious threat to the marine environment impacting the biodiversity, food / prey, and ecosystem health (O'Brien, 2009). The accidental discharge of oily bilge water should be treated the same as an accidental hydrocarbon release discussed in Section 9.2.

The accidental discharge of sewage, grey water, and garbage materials can reduce water quality of the surrounding environment, including increased turbidity and nutrient levels, and depleting oxygen (Mrčelić et al., 2021). This can lead to the promotion of harmful algal blooms resulting in the reduction of local biodiversity. Regulations regarding the release of sewage into the sea are contained in MARPOL Annex IV. Further risk assessment should be given to explain protocols in the event of an accidental discharge.

Ballast water not only carries the risk of introduction of invasive marine pest species (microbes, plants and animals), but also contains a variety of harmful substances, chemicals and bacteria (Mrčelić et al., 2021; DAFF, 2023). The *International Convention for the Control and Management of Ships' Ballast Water and Sediments* requires the implementation of a ballast water management plan on all ships (IMO, 2004).

Receptor sensitivity to accidental discharges for marine mammals and turtles was assessed with a similar impact as Section 9.2 Accidental Hydrocarbon Release.

11.4.3 Mitigation measures

The Spill Response Plan (initial mitigation SPL-M02; Table 7-3) will include measures for monitoring and assessment of ecological impacts. Monitoring of habitat and species affected by a spill release is important to determine the efficacy of spill response measures and any ongoing disruption to ecosystem functioning. Marine mammals and turtles could be impacted by a spill and this mitigation must therefore include recording of any marine mammals and turtles that encounter the discharge.

Following the implementation of initial mitigation measures, including a Spill Response Plan (SPL-M02) and compliance with maritime legislation relevant to the prevention of pollution in the marine environment (VES-M01), the initial risk rating of impacts to marine mammals and turtles from an accidental discharge is Low. Therefore, no further risk mitigation is required.

11.4.4 Residual risk

Residual impacts to the marine mammal and turtle receptors are described above. With existing protocols in place for managing routine discharges (i.e., MARPOL), residual impacts are not expected to occur therefore there would be no significant impacts on behaviour, migration, foraging and or survival rates.

Table 11-7: Consequence associated with accidental discharges during the operations phase

Potential Impact Receptor	Receptor sensitivity	Initial risk rating	Mitigation	Residual risk rating
Reduced water quality leading to changes in fauna behaviour / health	All marine mammals and turtles	Medium	Low Consequence = Minor (D) (Magnitude = Low, Likelihood = Rare)	VES-M01 SPL-M02 Low Consequence = Minor (D) (Magnitude = Low, Likelihood = Rare)

11.4.5 Evaluation of residual risk against assessment criteria

Table 11-8: Evaluation of residual impacts against assessment criteria

Assessment criteria	Evaluation	Confidence / uncertainty
Principles of ESD AC1: Biological diversity and productivity of the environment is not compromised because of the project	Accidental discharges causing reduced water quality were assessed as posing low risk to marine mammals and turtles. This is not considered as having the potential to result in serious or irreversible impacts to biological diversity or productivity. The risk of accidental discharges will be managed using standard industry protocols (i.e. MARPOL) plus a Spill Response Plan. The project is not inconsistent with the Principles of ESD.	High confidence Considering that discharges are managed to concentrations of negligible effect, it is unlikely that even if spilled, there would be significant consequences on marine fauna to the effect that biodiversity or productivity are affected.
Significant Impact Guidelines (Threatened Species) AC4: The project will not have a significant impact on Threatened (Endangered and Vulnerable) Species as defined in the MNES Significant Impact Guidelines 1.1.	Changes in water quality affecting marine mammals and turtles from an accidental discharge are expected to be localised. Should an accidental discharge occur, discharges are predicted to be of low volume, rapidly diluted to concentrations of negligible effect by mixing with the surrounding waters and recoverable with no long-term impacts to water quality. Accidental discharges could result in minor habitat disturbance over the short-term, however, the project is unlikely to significantly impact breeding success, the survival of individuals and, therefore, the recovery of a species. Accidental discharges will be managed using standard industry protocols (i.e. MARPOL plus a Spill Response Plan). The project is not inconsistent with the Significant Impact Guidelines for threatened species.	
Pollution prevention AC6: The project will be managed to prevent pollution from routine and/or accidental discharges to the marine environment.	Changes in water quality affecting marine mammals and turtles from an accidental discharge are expected to be localised. Should an accidental discharge occur, discharges are predicted to be of low volume, rapidly diluted to concentrations of negligible effect by mixing with the surrounding waters and recoverable with no long-term impacts to water quality. Accidental discharges will be managed using standard industry protocols (i.e. MARPOL) and the project will implement a Spill Response Plan.	
Significant Impact Guidelines (Migratory Species) AC7: The project will not have a significant impact on Migratory Species as defined in the MNES Significant Impact Guidelines 1.1.	Changes in water quality affecting marine mammals and turtles from an accidental discharge are expected to be localised. Should an accidental discharge occur, discharges are predicted to be of low volume, rapidly diluted to concentrations of negligible effect by mixing with the surrounding waters and recoverable with no long-term impacts to water quality. Accidental discharges may result in minor habitat disturbance over the short-term or, for migratory species, the period of occupancy. However, they are unlikely to significantly impact breeding success, the survival of individuals or species distribution. Accidental	

Assessment criteria	Evaluation	Confidence / uncertainty
	discharges will be managed using standard industry protocols (i.e. MARPOL plus a Spill Response Plan). The project is not inconsistent with the Significant Impact Guidelines for migratory species.	
Significant Impact Guidelines (Commonwealth Marine Areas) • AC8: The project will not have a significant impact on Commonwealth Marine Areas as defined in the MNES Significant Impact Guidelines 1.1.	Changes in water quality affecting marine mammals and turtles from accidental discharges are expected to be localised. Should an accidental discharge occur, discharges are predicted to be of low volume, rapidly diluted to concentrations of negligible effect by mixing with the surrounding waters and recoverable with no long-term impacts to water quality. Accidental discharges could result in minor habitat disturbance over the short-term, however, they are unlikely to significantly impact breeding success or the survival of populations or species. Accordingly, accidental discharges are not considered as having the potential to result in a substantial change in water quality or the accumulation of harmful chemicals such that biodiversity or ecological function/integrity are affected. Accidental discharges will be managed using standard industry protocols (i.e. MARPOL plus a Spill Response Plan). The project is not inconsistent with the Significant Impact Guidelines for Commonwealth Marine Areas.	

12 DECOMMISSIONING ASSESSMENT

Few offshore wind farms have been decommissioned, and given their long lifecycles there are uncertainties regarding the decommissioning process, particularly for large projects. These uncertainties include (Bennun et al., 2021):

- The regulatory environment (in many jurisdictions, regulations regarding offshore wind farm decommissioning are at present limited)
- Strategies for recycling components
- The economic case for recycling and reuse of infrastructure at the time of decommissioning
- The consequences of removal of habitats that has developed on project infrastructure.

Consistent with the requirements outlined in the OEI Act 2021 (section 116(2)), at the end of the operation phase of the Star of the South project it is envisaged that all offshore infrastructure above the seabed would be removed. The exact decommissioning activities to take place would be in accordance with requirements of relevant legislation in place at the time and the approved management plan. This section discusses the potential impacts of the project as a result of decommissioning activities and the associated mitigation measures that aim to reduce impacts to as low as reasonably practicable. The level of detail that can be provided in this section is commensurate with the level of detail available now about activities that may occur in 30+ years' time. Mitigation measures and management referred to are summarised in Section 15.

Innovation in decommissioning techniques is likely to progress significantly over the period of time before it is required for this project. The offshore decommissioning activities are conservatively assumed to impact the same receptors at the same or lesser magnitude and scale as construction operations. The anticipated duration is up to two to three years within the Commercial Licence period (noting options for re-powering post 30 years). While details of these activities will not be resolved for a number of years, indicative activities may include:

- Removal of OSS topsides and foundations to just below the seabed
- Removal of WTG, transition pieces and monopiles to just below seabed
- Removal of scour protection where reasonably practicable and appropriate to do so
- Retention of subsea cables *in situ*
- Seabed will be returned to baseline conditions as far as reasonably practicable.

A Marine Decommissioning Management Plan (DEC-M01) will be developed prior to commencement of decommissioning activities. The plan will detail the final agreed infrastructure proposed to be removed or left in situ, an assessment of potential impacts of decommissioning activities for the removal or retention of infrastructure on protected matters and specify how activities associated with decommissioning will be carried out in accordance with the project approval conditions.

12.1 Potential impacts and risks

Potential impacts from these activities are listed below and predicted residual impacts are summarised in Section 8:

- Underwater noise from vessels and decommissioning activities
- Routine discharges
- Seabed disturbance and sediment plumes
- Artificial light emissions
- Changes in prey distribution and abundance
- Risk of vessel strike
- Accidental hydrocarbon release
- Debris escape leading to entanglement or ingestion

- Accidental discharges.

In the period of time leading up to decommissioning of the OWF, however, noting the potential for re-powering the wind farm to extend life beyond 30 years, it is likely that technology innovations and advances in mitigations will result in further reduction in potential risk to marine mammals and turtles when compared to the construction phase. As a conservative measure, in the absence of detailed information about decommissioning activities that may occur in 30+ years' time, the residual impact and risk assessment outcomes for construction has been adopted here.

12.2 Mitigation measures

Mitigation measures implemented during the decommissioning phase are expected to be the same as those described in Section 8 and 9 for the construction phase, subject to provision of information enabling more focussed assessment. As indicated in Section 115 of the *OEI Act 2021* and subject to the final requirements of the subordinate regulations a decommissioning management plan (DEC-M01; Table 12-1) will be developed during the operation phase of the project that includes more informed assessment of the impacts of decommissioning activities on marine mammal and turtle receptor groups. A summary of consequence / risk ratings and mitigation measures for relevant impact and risk pathways during the decommissioning phase is provided in Table 12-2.

Table 12-1 Mitigation measures (Decommissioning phase)

ID	Mitigation measure	Mitigation measure and description
DEC-M01	Marine Decommissioning Management Plan	A Marine Decommissioning Management Plan will be developed prior to decommissioning activities commencing to assess the impacts on the final agreed methodologies of removing offshore infrastructure. The plan will include: Details on marine infrastructure proposed to be removed or left in situ Assess potential impacts of decommissioning activities for the removal or retention of infrastructure on protected matters Specify how activities associated with decommissioning will be carried out in accordance with the project approval conditions Describe measures to be implemented to avoid or reduce impacts arising from the removal of infrastructure (if required) Consider management measures adopted in construction and apply where similar impacts could occur.

12.3 Summary residual impacts and risks

The magnitude of activities during the decommissioning phase (e.g. underwater noise, risk of vessel strike, seabed disturbance and routine discharges) are expected to be no greater than those during the construction phase, and likely will be less due to technology innovation over the period of OWF operation.

Assuming that decommissioning activities would principally be the same or lower magnitude as the construction activities and the same mitigation measures are used, the impact to marine mammals and turtle receptor groups from decommissioning activities ranges from Negligible to Minor (Table 12-2). Similarly, if the activities and mitigation measures are assumed to be the same as the construction phase the residual risk to marine mammal and turtle receptors ranges from Very Low to Low (Table 12-3).

Table 12-2: Summary of decommissioning activities, residual impacts and mitigations

Potential Impact	Receptor	Receptor sensitivity	Residual magnitude	Residual consequence
Underwater noise emissions (MMT-I001)	Blue whale Southern right whale Humpback whale Other mysticetes	High	Negligible	Minor (D)

Potential Impact	Receptor	Receptor sensitivity	Residual magnitude	Residual consequence
	Odontocete – dolphins Pinnipeds Marine turtles	Low	Negligible	Negligible (E)
Routine discharges (MMT-I002)	All marine mammals and turtles	Low	Negligible	Negligible (E)
Seabed disturbance and sediment plumes (MMT-I003)	Odontocetes – dolphins Pinnipeds – Australian fur seal Marine turtles	Low	Negligible	Negligible (E)
Artificial light emissions (MMT-I004)	Marine turtles	Low	Negligible	Negligible (E)
Changes in prey distribution and abundance (MMT-I007)	Blue whale Humpback whale Odontocetes – dolphins Marine turtle - leatherback	Medium	Low	Minor (D)
	Other mysticetes Pinnipeds	Low	Low	Negligible (E)

Table 12-3: Summary of decommissioning activities, residual risks and mitigations

Potential Risk	Receptor	Receptor sensitivity	Residual magnitude	Residual consequence	Residual likelihood	Residual risk rating
Vessel strike from project vessels (MMT-R001)	Blue whale Southern right whale	High	Low	Moderate (C)	Rare	Low
	Humpback whale Other mysticetes	Medium	Low	Minor (D)	Rare	Very low
	Odontocetes – dolphins Pinnipeds Marine turtles	Low	Low	Negligible (E)	Rare	Very low
Accidental hydrocarbon release (MMT-R002)	All marine mammals and turtles	Medium	Medium	Moderate (C)	Rare	Low
Debris escape leading to entanglement or ingestion (MMT-R003)	Humpback whale	Medium	Low	Negligible (E)	Unlikely	Low
	Blue whale Southern right whale	Low	Low	Negligible (E)	Unlikely	Very low
	Other mysticetes Odontocetes - dolphins	Low	Low	Negligible (E)	Unlikely	Very low
	Marine turtles	Medium	Low	Minor (D)	Rare	Very low
	Pinnipeds	Medium	Low	Minor (D)	Unlikely	Low
Accidental discharges (MMT-R004)	All marine mammals and turtles	Medium	Low	Minor (D)	Rare	Very low

13 INTER-RELATED IMPACTS

Due to the spatial and temporal overlap of project activities, there is potential for interaction of different impacts and risks, as assessed separately in Sections 8 to 12, to result in inter-related impact(s) on marine mammals and turtles that are greater than the sum of their separate impacts (cumulative, additive, synergistic or antagonistic impacts). While individual impacts from a single source may not be significant, when combined with a second or additional sources of impact from the project spatially or temporally separated from the first, the impact may become significant.

Two types of inter-related effects have been assessed (Table 13-1):

- Project lifetime effects – individual effects on each of the key receptor groups that interact or combine across the construction, operation and maintenance, and decommissioning phases of the project.
- Receptor-led effects – multiple effects on the same receptor (within the same phase of the Star of the South Offshore Wind Farm).

Where additive or synergistic effects can be identified, it is possible that these may be mutually exclusive and therefore will not interact to produce impacts of greater significance. For example, impact pile driving could result in the avoidance of or displacement of species that do not have recovery plan requirements to the contrary (for those that do, mitigations measures would prevent this), which in turn would mean that marine mammals and turtles would not be exposed to increased risk of vessel strike within the avoidance ranges. Therefore, it is predicted that some inter-related impacts identified may, to some extent, counter the potential combined effects and consequently impacts are not predicted to be of greater significance than the individual impacts considered in isolation.

13.1 Screening for inter-related effects

To focus the assessment of inter-related effects on appreciable interactions, an initial screening has been undertaken (Table 13-1) to identify where potential interactions could occur. All impacts identified for the project alone assessment (i.e. in Sections 8 to 12) have been considered for potential interactions. Where potential inter-related effects are identified, these are taken forward for further consideration ('Table 13-2 and 'receptor-led effects' in Table 13-3). For these effects, a conclusion has been made as to whether the inter-related effect could result in an effect that is greater in significance than the individual impacts when considered in isolation.

Where a potential effect alone was assessed as Negligible as a final consequence and/or there is very low spatial or temporal potential for interactions, these effects were generally not carried forward for further consideration within the inter-related effects assessment. This is on the basis there is no meaningful potential for appreciable interactions, even if both effects were to occur at the same time, or consecutively.

Following this screening, two impacts were identified as potential contributors to 'project lifetime effects':

- Underwater noise (various sources, all phases) and;
- Changes in prey distribution and abundance (all phases).

These potential 'project lifetime effects' are considered for two receptor groups: 'blue whale, southern right whale, humpback whale and other mysticetes' and 'pinnipeds and marine turtles' (that experience underwater noise impacts differently).

Three impacts were identified as potential contributors to 'receptor lifetime effects':

- Underwater noise (various sources, all phases)
- Changes in prey distribution and abundance (all phases) and
- Physical presence of Infrastructure (operation and maintenance)

Other impacts considered were discounted either through the application of mitigation which reduced impacts to Negligible (e.g. accidental discharges), low receptor-specific sensitivities (e.g. lower sensitivity of odontocetes to underwater noise or marine mammals generally to sediment plumes) or the large time spans between potential effects. The outcomes of the screening for inter-related effects are explained in Table 13-1.

REPORT

The inter-related effects assessment in this section addresses interactions between impacts but not risks from accidental events. The consequences of exposure to multiple project risks are considered extremely unlikely events.

REPORT

Table 13-1: Potential inter-related impacts for marine mammal and turtle receptors. Bold face denotes impact or and risks carried forward for consideration of inter-related impacts (C = Construction, O = Operations and Maintenance, D= Decommissioning)

Impact	Potential Sources	Project phase	Receptor or receptor group	Project lifetime effects Y/N	Project Receptor-led effects Y/N	Rationale
Underwater noise	Piling and drilling of foundations, project vessel activities, turbine operations	C, O, D	Blue whale Southern right whale Humpback whale Other mysticetes	Y	Y	Hearing impairment and disturbance from activities that generate underwater noise could accumulate across project phases or within one phase (for example, from exposure to different types of noise (i.e. impulsive and non-impulsive).
Underwater noise	Piling and drilling of foundations, project vessel activities and operating turbines	C, O, D	Pinnipeds Marine Turtles	N	Y	Impacts of Negligible final consequence during construction are predicted based on low-species sensitivity and low impact ranges. The consequences of such impacts not predicted to persist into subsequent phases and the potential for project-lifetime impacts is discounted. Hearing impairment, masking and behavioural disturbance could have Minor consequences during the operation and maintenance phase. Assessment to consider the additive effects of underwater noise together with impacts from changes in prey distribution and abundance.
Underwater noise	Piling and drilling of foundations, project vessel activities and operating turbines	C, O, D	Odontocetes - Dolphins	N	N	Impacts of Negligible final consequence in all phases are not predicted to accumulate across project phases or within one phase.
Routine discharges	Project vessel activities, drilling of foundations, shore crossing installation	C, O, D	All marine mammals and turtles	N	N	Impacts of Negligible final consequence are predicted for all phases based on compliance with MARPOL to mitigate adverse impacts. An inter-related effect of greater significance is not predicted to result over the project's lifetime, or within an isolated phase.
Seabed disturbance /sediment plumes	Construction piling and drilling of foundations, project vessel activities	C	Odontocetes - dolphins Pinnipeds - Australian fur seal Marine turtles	N	N	Impacts of Negligible final consequence are predicted for this effect (i.e. impacts will not affect reproduction and/or survival rates). Given this and considering the localised and intermittent nature of the effect and high potential for reversibility of impacts following exposure, no inter-related synergies can be conceptualised across, or within phases.

REPORT

Impact	Potential Sources	Project phase	Receptor or receptor group	Project lifetime effects Y/N	Project Receptor-led effects Y/N	Rationale
Artificial light emissions	Project vessel activities, partially installed infrastructure, includes turbines during operation and maintenance.	C, O	Marine turtles	N	N	Impacts of Negligible final consequence are predicted in all phases because there are no important habitats for marine turtles in the region (i.e. nesting beaches). Such impacts are not expected to result in additive impacts across phases, or significant synergies with other impacts.
Changes in prey distribution and abundance	Project vessel activities, drilling of foundations, shore crossing installation and partially installed infrastructure, operational turbines, presence of offshore export, inter-array and interlink cables	C, O, D	Blue whale Humpback whale Odontocete - dolphins Marine turtle - leatherback	Y	Y	Prey species may be affected through all phases of the Star of the South Offshore Wind Farm. Assessment to consider the additive effects of underwater noise together with impacts from changes in prey distribution and abundance.
Changes in prey distribution and abundance	Project vessel activities, drilling of foundations, shore crossing installation and partially installed infrastructure	C, O, D	Other mysticetes Pinnipeds	N	N	Impacts of Negligible final consequence are predicted for this impact because the study area does not represent an important foraging habitat for these species. Such impacts are not expected to result in additive impacts across phases, or significant synergies with other impacts.
Physical presence of Infrastructure	Physical presence operational turbines,	O	All marine mammals and turtles	N	N	Impacts of Negligible final consequence are predicted for displacement and barrier effects for all marine mammal and turtle receptors. These consequences are not predicted to persist into subsequent phases or result in inter-phase synergies.

REPORT

Impact	Potential Sources	Project phase	Receptor or receptor group	Project lifetime effects Y/N	Project Receptor-led effects Y/N	Rationale
	subsea export and inter-array cables					
Physical presence of Infrastructure	Physical presence operational turbines, other project infrastructure	O	Pinnipeds	N	Y	Impacts of Negligible final consequence are predicted. These consequences are so small they would not persist into subsequent phases, negating the potential for project-lifetime effects. The attraction of fauna due to prey attraction to infrastructure could be countered (and accounted for) by underwater noise impacts, which are considered separately.
Electromagnetic interference	Presence of offshore export, inter-array and interlink cables	O	AUFS - benthic foragers Blue whale Southern right whale Humpback whale Other mysticetes Odontocetes - Dolphins Pinnipeds Marine Turtles	N	N	Impacts of Negligible final consequence are not expected to persist outside the operations and maintenance phase, which negates the potential for project-lifetime effects. No appreciable potential for accumulation, or synergy within single project phases.

REPORT

Table 13-2: Summary of inter-related impacts from project lifetime effects on marine mammals and turtles (C = Construction, O = Operations and Maintenance, D= Decommissioning)

Potential impact pathway	Receptor group	Phase of project C, O, D		Potential likely significant inter-related effects	Additional mitigations and management
Project lifetime effects (i.e. across the construction, operation and maintenance, and decommissioning phases)					
Underwater noise	Blue whale Southern right whale Humpback whale Other mysticetes	✓	✓	The consequences from auditory impairment and disturbance from activities that generate underwater noise could accumulate across project phases. For example, noise during operation and maintenance, and decommissioning would occur subsequent to noise during piling (construction phase only) and vessels will be used throughout all phases. Additive effects across phases are possible as the overall duration of disturbance is extended, and more animals may be affected, or the same animals affected over a greater duration. This project-lifetime effect is not predicted to result in an inter-related effect of greater significance (than the assessments presented for each individual phase) in view of the high reversibility of impacts between phases and the short-term and localised impacts predicted for non-piling activities (i.e. of Minor or Negligible significance). For impacts that continue for extended durations e.g. across multiple breeding seasons over a period of years e.g. noise, mitigations are in place so that impacts are reduced to the extent that recovery plan requirements are met, resulting in no meaningful impact being carried forward.	No mitigation additional to that set out in Section 15 is required or proposed.
Changes in prey distribution and abundance	Blue whale Humpback whale Odontocete - dolphins Marine turtle - leatherback	✓	✓	Fish (prey) communities may be affected through all phases of the Star of the South Offshore Wind Farm. In all cases, the final consequence of individual events is expected to be Negligible to Minor (for both fish receptors and this receptor group). The species under assessment are broadly distributed and/or seasonally present. Therefore, changes in prey distribution are likely to have negligible impacts over on wide-ranging foraging areas. As there are no significant negative impacts to changes in prey distribution predicted for each project phase, the longer-term effect on marine mammals and turtles through changes/reductions to prey availability across phases is not likely to be additive in a negative way, or result in an inter-related effect of greater significance over the project's lifetime.	No mitigation additional to that set out in Section 15 is required or proposed.

Table 13-3: Summary of inter-related impacts receptor-lead effects for marine mammals and turtles (i.e. multiple effects on the same receptor, with the same phase) (C = Construction, O = Operations and Maintenance, D= Decommissioning)

Receptor group	Project phase	Individual impact (and final consequence level)	Potential inter-related interactions	Final consequence level	Additional mitigations and management
Blue whale Southern right whale Humpback whale Other mysticetes	C	Underwater noise: hearing impairment and disturbance	Impulsive noise sources e.g. pile driving (Minor) + Continuous noise sources e.g. vessels (Minor) + Changes in prey distribution and abundance (Minor)	Minor	No mitigation additional to that set out in Section 15 is required or proposed as mitigations are in place to manage impacts to the lowest level possible.
Blue whale Southern right whale Humpback whale Other mysticetes Pinnipeds Marine Turtles	O	Underwater noise: change in behaviour (e.g. displacement, communication masking) (Minor)	Underwater noise from turbines (Minor) + Underwater noise from project vessel activities (Minor) + Changes in prey distribution and abundance (Minor)	Minor	No mitigation additional to that set out in Section 15 is required or proposed as mitigations are in place to manage impacts to the lowest level possible.

14 CUMULATIVE IMPACT ASSESSMENT

14.1 Cumulative impact from other projects

As required by the EIS guidelines (EIS Attachment V) and EES scoping requirements (EES Attachment IV) the impact assessment must include a review and analysis of residual impacts of the proposed development and of other known proposals where there may be a spatial or temporal overlap (in other words, cumulative impact).

Cumulative impacts are those that arise when the effects of a single project on a single receptor are considered alongside the effect of other projects on the same receptor. The method to consider cumulative impacts has been described in Section 5.7 and Chapter 6 – Assessment Framework within both the EIS and EES.

Temporally, the CIA assessment will extend from the proposed start of construction, i.e. no earlier than 2030, for a period of 59 months (i.e. to December 2034) to the likely end of decommissioning works in 2068 (based on an operational life of 30 years and five years each for construction and decommissioning). Impacts are not expected to continue beyond the life and decommissioning of the project. Where the likelihood of impact or risk increases due to the presence of additional projects, these are included in the CIA. Where the likelihood of a risk increases due to the presence of additional projects, these are also included in the CIA (e.g. collision risk). The initial long list of projects that fall within the potential CIA assessment zone are presented in Table 14-2.

The CIA has been based on information available on each relevant project as of early August 2025, to allow sufficient time to assess the effects and incorporate into technical assessments and chapters ahead of EES/Draft EIS submission, which coincides with the CIA methodology described in Chapter 6 - Assessment Framework within both the EIS and EES.

14.2 Defining the zone of influence

To evaluate cumulative impacts for marine mammals and turtle receptors, this assessment has identified other projects that are located within the zone of influence (Zol) of this study, which form the topic-specific 'long list'. The Zol for this study has been defined as the geographical range of interest for sensitive species (i.e. cumulative study area) and whether they could occur within the zones of influences from other projects.

For this assessment, the Zol is restricted to species ranges within Australian territorial waters. It is acknowledged that cumulative impacts may occur outside of this region, with some offshore wind farms and other projects/actions within the potential Zol for receptors such as migratory cetaceans. However, compatible data for projects outside Australia is not unavailable (for example, underwater noise modelling assessments for external projects) and the granularity of migratory species routes is also unknown, so it is not possible to undertake a meaningful assessment. The CIA is therefore focused on projects within Australian waters.

The cumulative study area for marine mammals and turtle receptors is based on the geographical range of the following species, which are present within the Star of the South OPA and have the potential to be present in the Zol of other projects:

- **Blue whale:** The geographical range of blue whales on the east coast of Australia as determined by observational data and satellite tracking studies indicate it is inclusive of the Bonney Upwelling region to Sydney, New South Wales (DoE, 2015c; Möller et al., 2020; Pirota and Harcourt, 2021).
- **Humpback whale:** Humpback whales occupy all oceans globally. Two populations of humpback whales are found in Australian waters; the western population, known as Breeding Stock D, and the eastern population, known as Breeding Stock E1 (Schmitt et al. 2014). Individuals in the western population are not expected to occur in the east coast waters of Gippsland. Humpback whales from the eastern population migrate annually along the east coast of Australia to calving grounds off northern Queensland (QLD) in the Great Barrier Reef Marine Park (Andrews-Goff et al. 2018).
- **Southern right whale:** The geographical range of the eastern subpopulation of SRWs is from Ceduna, SA to Hervey Bay, QLD including Tasmania. However, SRW photo-ID images collected during the MESP identified a breeding female belonging to the western subpopulation, sighted at Fowlers Bay, SA in the same year (Appendix A - MESP baseline report). Therefore, the geographical range of SRWs is

conservatively inclusive of waters of the Great Australian Bight to Hervey Bay, Queensland (DSEWPAC, 2012).

- Dwarf minke whale: Minke whales may occur broadly from Victoria to northern Queensland between March and October (Minke Whale Project, 2018). Both the VBA and ALA list a single dwarf minke whale sighting in the Bass Strait from 1974 (DELWP 2019). A solitary dwarf minke whale was reported at the head of the Great Australian Bight in late July 2017 (Ward, pers. obs.), indicating dwarf minke whales may occupy waters along the southern Australian coastline during the winter period.
- Other mysticetes: The geographical range of other mysticetes on the east coast of Australia is largely unknown. However, as these species are migratory it is conservatively estimated between the Bonney Upwelling region to the Great Barrier Reef.
- Common dolphin: Geographical range of the 'east of Wilsons Promontory' common dolphin population, Wilsons Promontory to Ninety Mile Beach, Victoria, including Kent Group Islands (Bilgmann et al., 2014).
- Bottlenose dolphin: It is not known whether bottlenose dolphins occupying the OPA are resident. The home range of bottlenose dolphins in coastal waters is estimated at less than 190 square kilometres (H. Smith, 2012; Sprogis et al., 2016). Therefore, the geographical range of bottlenose dolphins is conservatively estimated between Wilsons Promontory and Lakes Entrance, Victoria.
- Other odontocetes: The geographical range of other odontocetes on the east coast of Australia is largely unknown. It is estimated conservatively along the South Coast of Australia.
- Australian fur seals: Data collected during the MESP indicates that AUFS are distributed from Cape Liptrap to the Skerries, Victoria, including Bass Strait and northern Tasmania (Appendix A - MESP baseline report).
- New Zealand fur seals: Data collected during the MESP indicates that NZFS are distributed from Cape Otway to the Skerries, Victoria, including Bass Strait and Tasmania (Appendix A - MESP baseline report).
- Marine turtles: In southeast Australia (South Australia, Victoria, and Tasmania), five out of the six marine turtle species listed under the EPBC have been documented. These include the leatherback, loggerhead, green, hawksbill, and olive ridley turtles, compiled from various databases as part of the Southern Australian Sea Turtle Project (SWIFFT, 2014; DoE 2015b). The leatherback turtle, although infrequently observed, has the highest recorded presence, particularly more during the Summer and Autumn than at other times of the year (Appendix A – MESP baseline report).

14.3 Project screening

14.3.1 Potential cumulative impacts

It is the objective of the CIA to identify where potential interactions could occur that lead to appreciable cumulative effects on a receptor. Potential impact pathways arising from the Star of the South Offshore Wind Farm were screened for their potential to have a cumulative impact for marine mammal and turtle receptors (Table 14-1). Where, based on the experience and knowledge of technical specialists undertaking the assessment, impacts were identified as having the potential to result in a cumulative impact on an identified receptor or receptor group, these are taken forward and considered in relation to projects on the initial long list. Where there is no conceptual overlap in the spatial, temporal, the impact-receptor pathway is excluded from further consideration. Where a potential effect for the project alone was assessed as negligible and/or there is low spatial incidence with external projects, these were generally not considered within the CIA assessment, due to the potential for cumulative effects being of a very small magnitude.

The CIA evaluates credible and modelled impacts of the project on the receiving environment, specifically impacts that are expected or probable to happen (e.g., underwater noise impacts from construction). The cumulative impacts section addresses new threats, while existing threats such as oil and gas facilities in operation are considered as part of the baseline environmental conditions (Section 6). Events deemed unlikely to occur based on a risk assessment and that have effective mitigation measures are excluded from the CIA (e.g., accidental hydrocarbon releases). Noting that potentially relevant receptors vary between projects, the findings from the Star of the South Offshore Wind Farm alone assessment have been carried forward in terms of receptor sensitivities, groupings and residual impacts (after mitigation). Potential impact pathways arising from the Star of the South Offshore Wind Farm were considered for their potential to result

in a cumulative impact due to those impact pathways also occurring due to other projects in the region are considered in Table 14-1.

REPORT

Table 14-1: Potential cumulative impacts for marine mammal and turtle receptors. Bold face denotes projects or actions carried forward for CIA

Impact	Project phase	Receptor or receptor group	Potential for cumulative impact?	Rationale
Hearing impairment/disturbance from elevated underwater noise during piling and drilling and vessel activities.	Construction and decommissioning	Blue whale Southern right whale Humpback whale Other mysticetes	Yes	The final consequence level for underwater noise emissions from the Star of the South Offshore Wind Farm is Minor. There is potential for a cumulative effect with other projects with temporal and spatial co-incidence and an assessment of this potential is required. Temporal co-incidence is defined as a direct temporal overlap with the Star of the South Offshore Wind Farm's construction phase, or where activities conclude up to three years preceding it.
Hearing impairment/disturbance to marine mammals and turtles from elevated underwater noise during piling and drilling activities.	Construction and decommissioning	Odontocetes - Dolphins Pinnipeds Marine turtles	No	The final consequence level for underwater noise emissions from Star of the South Offshore Wind Farm on these species is Negligible. A low potential for cumulative impact has been identified, based on the lower sensitivity of this group to underwater noise, which limits impact ranges to hundreds of meters and therefore, the potential for a spatial co-incidence of effects. Noting that the initial contribution from the Star of the South Offshore Wind Farm to impacts on this receptor group is very small, no cumulative impact can be conceptualised.
All impacts associated with increased underwater noise from operating turbines and project vessels.	Operation	Blue whale Southern right whale Humpback whale Other mysticetes Odontocetes - dolphins Pinnipeds Marine turtles	No	The final consequence levels for underwater noise emissions from the Star of the South project during operation are Negligible or Minor. The potential for a cumulative impact is very low; effects from other projects would be unlikely to combine or accumulate being small scale, localised, temporary and subject to adequate conditions to avoid adverse effects. Noting that the initial contribution from the Star of the South Offshore Wind Farm to impacts on this receptor group is very small, no cumulative impact can be conceptualised. Operational monitoring results will be reviewed to determine whether this prediction is accurate, and if not, additional assessment will be completed.
Changes in behaviour/health from reduced water quality from discharges and sediment changes from project vessel activities, piling, drilling and shore crossing installations.	Construction and decommissioning	All marine mammals and turtles	No	The final consequence level for water quality changes from the Star of the South project is Negligible. The potential for a cumulative impact is very low. Other projects are expected to be subject to adequate conditions to avoid adverse effects. Impact contributions would be small scale, localised, temporary and unlikely to combine or accumulate. Noting that the initial contribution from the Star of the South Offshore Wind Farm to impacts on this receptor group is very small, and the low potential for spatial or temporal coincidence of effects, no cumulative impact can be conceptualised.
Changes in behaviour/health from reduced water quality from project vessels.	Operation	All marine mammals and turtle receptors	No	The final consequence level for water quality changes from the Star of the South Offshore Wind Farm during operation is Negligible. As above, impact contributions from other projects would be small scale, localised, temporary and unlikely to combine or accumulate. Noting that the initial

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Impact	Project phase	Receptor or receptor group	Potential for cumulative impact?	Rationale
				contribution from the Star of the South Offshore Wind Farm to impacts on this receptor group is very small, and the low potential for spatial or temporal coincidence of effects, no cumulative impact can be conceptualised.
Changes in behaviour from artificial light emissions from turbines, project vessels and infrastructure.	Construction, operation and decommissioning	All marine mammals and turtles	No	The final consequence level for artificial light emissions from the Star of the South Offshore Wind Farm is Negligible. There is very low potential for an appreciable cumulative effect based on the small impact contribution from the Star of the South Offshore Wind Farm that is dependent on an unlikely temporal and spatial co-incidence of multiple projects. Even if these effects did occur at the same time, this would not constitute an appreciable impact.
Changes in fauna behaviour/health from changes in prey distribution and abundance from project vessel activities, drilling and infrastructure.	Construction, operation and decommissioning	Blue whale Humpback whale Odontocete - dolphins Pinnipeds Marine turtles Other mysticetes	No	The final consequence level for changes in prey distribution and abundance from the Star of the South Offshore Wind Farm is Negligible or Minor. The potential for a cumulative impact is very low. Marine mammals and turtles are wide ranging and would be able to adapt (i.e. still access a range of prey species) should impacts from other projects (which are expected to be similarly localised and short-term) occur at the same time. Long term monitoring carried out in the operational phase of the project will inform whether this prediction is correct, and if changes are detected additional assessment will be completed.
Changes in fauna behaviour/health or that of their prey, from the creation of artificial habitat by project infrastructure.	Operation	All marine mammals and turtles	No	The final consequence level for changes in prey distribution and abundance from the Star of the South Offshore Wind Farm is Negligible. The potential for a cumulative impact is very low. As above, impacts from other projects are expected to be highly localised, and the receptors able to adapt to the impacts over scale, lending to a low potential for a spatial co-incidence of effects. Even if these effects did occur at the same time, this would not constitute an appreciable impact. Long term monitoring carried out in the operational phase of the project will inform whether this prediction is correct, and if changes are detected additional assessment will be completed.
Change in fauna behaviour due to electromagnetic interference from the presence of cables	Operation	Blue whale Southern right whale Humpback whale Other mysticetes Odontocetes - dolphins Pinnipeds Marine Turtles	No	The final consequence level for impacts from electromagnetic interference from the Star of the South Offshore Wind Farm is Negligible. Given the highly localised nature of the effect, the high recoverability and the low spatial co-incidence of sources of electromagnetic fields from other project infrastructure, no appreciable cumulative impact can be conceptualised.

14.3.2 Projects within zone of influence

The initial long list of projects that fall within the potential CIA assessment zone for marine mammals and turtles is presented in Appendix D. This list considers relevant offshore wind farm projects, oil and gas projects and other projects with the potential to impact common receptors.

To assess the potential cumulative impacts for the Star of the South Offshore Wind Farm it is important to consider that some developments, predominately those 'proposed' (referred) or identified in development plans, may not actually be taken forward. There is, therefore, a need to build in some certainty (or uncertainty) with respect to the potential impacts that may arise from such proposals, which is done by allocating projects into 'tiers' to allow appropriate weight to be given to each project.

The screening process described in Section 5.7 will be applied to determine the short list of projects taken forward within the CIA. Each of the projects in (Appendix D) have been evaluated against the cumulative performance criteria to determine whether there is the potential for cumulative impacts with the Star of the South and sufficient information available to undertake a meaningful assessment (Table 14-1). The CIA will consider how marine mammals and turtle receptors are vulnerable to the combined effect of impacts. The consequence of cumulative exposure to risks is addressed only for vessel strike risk in Section 14.4.

Fifty-one projects (excluding projects already in the operations phase) were identified within the Zol of the Star of the South Offshore Wind Farm. This includes 18 projects assessed as tier three (Low certainty) projects that were screened out of the CIA due to insufficient information (refer Section 5.9). It is acknowledged that tier three offshore wind projects within the same region or species range have the potential to lead to cumulative impacts. However, it is highly unlikely that all projects will progress to construction and, as publicly available information on these projects does not provide design details, timing of project phases or the extent of infrastructure, making assumptions about these elements may overestimate impacts and provides no meaningful assessment for accurate decision making.

A further 22 projects are expected to be complete before the offshore construction commences for the Star of the South Offshore Wind Farm were screened out due to no temporal overlap of impacts (Table 14-2). Six operational projects, such as oil and gas and existing vessel operations, undertaking approved activities within the Gippsland Region are considered as an inherent part of the existing environment in the baseline impact and risk assessment.

Onshore projects, or remote projects with very minimal offshore activities (such as the Longford Gas Conditioning plant, East Australia Carbon Capture and Storage Project and Viva Energy Gas Terminal Project) were screened out as not relevant to marine mammals and turtles. Five projects with a low potential for spatial incidence were also screened out, including Midwest Offshore Wind Farm (Copenhagen Energy) and Samphire Offshore Wind Farm (Copenhagen Energy) on the basis cumulative impacts on blue whale, southern right whale, humpback whale and other mysticetes would not be appreciable.

Table 14-2: Cumulative impact zone of influence and projects further assessed for marine mammal and turtle receptors. Bold face denotes projects or actions carried forward for CIA

Project or action	Data Confidence	Scale parameter	Receptor impact	Temporal overlap	Conclusion
(Within the ZOI)	Certainty tier	Is the project or action of sufficient scale to warrant inclusion in the CIA?	Will the project / action adversely affect the same receptors as the project? And have a spatial overlap	Will the project / action result in adverse impacts, impacts to the same receptors as the project at the same time or on a timescale that could result in a cumulative impact?	Is the project / action shortlisted for the CIA?
Blue Mackerel North Offshore Wind Farm, Parkwind.	Tier 3 - Proposed	Yes, similar activities. Project will contribute to elevated underwater noise and increased vessel traffic.	Yes, project located in the north portion of the Gippsland Offshore Wind Zone, directly northeast of the Star of the South Offshore Wind farm. Foraging ranges of Blue whale, Southern right whale, Humpback whale and other mysticetes can be expected to overlap with areas where similar effects from underwater noise could be experienced cumulatively.	Unknown	No. Tier 3 project - screened out of the CIA due to a lack of information. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans.
Blue Mackerel North Offshore Wind Farm Marine Surveys, Parkwind	Tier 1 - Approved	Yes, similar activities. Project will contribute to elevated underwater noise and increased vessel traffic.	Yes. Foraging distributions of subject species overlap with areas where similar effects from underwater noise could be experienced cumulatively.	No, indicatively, the surveys would start in Q4 2024 and end in Q1 2028 and would therefore be concluded at least a year before the construction phase of the Star of the South Offshore Wind Farm commences.	No. Timing of activities offshore does not overlap.
Aurora Green, Offshore Wind Farm Iberdrola Australia	Tier 3 - Proposed	Yes, as above.	Yes, as above.	Unknown	No. Tier 3 project - screened out of the CIA due to a lack of information. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans.
Aurora Green Offshore Wind Farm Preliminary Surveys, Iberdrola Australia	Tier 1 - Approved	Yes, as above.	Yes, as above.	No, the proposed activities are estimated to commence in late 2024 through to 2025 and would therefore be concluded at least a year before the construction phase of the Star of the South Offshore Wind Farm commences.	No. Timing of activities offshore does not overlap.
Great Eastern Offshore Wind Farm - Preliminary Site Investigations, Corio - previously Macquarie Green Investment Group	Tier 1 - Approved	Yes, as above.	Yes, as above.	Unknown, the proposed activities were estimated to commence on 01 August 2024 and conclude on 01 December 2025 and would therefore be concluded at least a year before the construction phase of the Star of the South Offshore Wind Farm commences, however, project delays mean that the time frames are now unknown.	No. Unsure if timing of activities offshore will overlap.
Novocastrian Offshore Wind Farm, Oceanex Energy	Tier 3 - Proposed	Yes, as above.	Very unlikely; project is located off Newcastle, NSW approximately 750 km north of the Star of the South Offshore Wind Farm OPA. Spatial coincidence is possible, but unlikely.	Unknown	No. Tier 3 project - screened out of the CIA due to a lack of information. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans that includes communication with NSW regarding SRW sightings.
Spinifex Offshore Wind Farm, Alinta Energy	Tier 3 - Proposed	Yes, as above.	Yes, the application is located on the western side of the same Declared Area as the Star of the South Offshore Wind Farm.	Unknown	No. Tier 3 project - screened out of the CIA due to a lack of information. If additional information becomes available or

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Project or action	Data Confidence	Scale parameter	Receptor impact	Temporal overlap	Conclusion
(Within the ZOI)	Certainty tier	Is the project or action of sufficient scale to warrant inclusion in the CIA?	Will the project / action adversely affect the same receptors as the project? And have a spatial overlap	Will the project / action result in adverse impacts, impacts to the same receptors as the project at the same time or on a timescale that could result in a cumulative impact?	Is the project / action shortlisted for the CIA?
					the project moves forward, cumulative impacts will be addressed through the project management plans that includes communication with DEECA regarding SRW sightings.
Spinifex Offshore Wind Farm - Offshore Investigations, Alinta Energy	Tier 2 - Seeking approval	Yes, direct impacts from the geophysical investigations include underwater noise (from the survey methods).	Very limited potential for spatial overlap, geophysical investigations will occur approximately 60 km south-east from Point Danger to approximately 19 km offshore of Port Fairy.	Yes, small potential for additive effects; the full program of offshore investigations is targeted to be complete by 30 April 2029, which includes contingency. On this schedule, works could complete 8 months prior to the start of the Star of the South Offshore Wind Farm construction phase.	No. Very limited potential for spatial and temporal overlap.
Gippsland Offshore Wind Farm 1, Ørsted	Tier 3 - Proposed	Yes, as above.	Yes, as above.	Unknown	No. Tier 3 project - screened out of the CIA due to a lack of information. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through project management plans.
Gippsland Offshore Wind Farm 2, Ørsted	Tier 3 - Proposed	Yes, as above.	Yes, as above.	Unknown	No. Tier 3 project - screened out of the CIA due to a lack of information. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans.
Gippsland Offshore Wind Farm Marine Survey Investigations, Ørsted	Tier 1 - Approved	Yes, similar activities. Project likely to contribute to elevated underwater noise and increased vessel traffic.	Yes. Spatial relevance: project located approximately 130 kilometres north-east of the Star of the South Offshore Wind Farm OPA. Foraging ranges of Blue whale, Southern right whale, Humpback whale and other mysticetes can be expected to overlap with areas where similar effects from underwater noise could be experienced cumulatively.	Yes, marine surveys are expected to commence once a feasibility licence is gained for the project. Geophysical and geotechnical surveys may span up to an seven-year period.	Yes.
Great Eastern Offshore Wind Farm Project, Corio	Tier 3 - Proposed	Yes, as above.	Yes. Spatial relevance: project located directly adjacent to Star of the South Offshore Wind zone. Foraging ranges of Pygmy blue whale and southern right whale. Humpback whale and other mysticetes expected to overlap with areas where similar effects from underwater noise could be experienced cumulatively.	Yes. Four-year construction phase scheduled to commence in 2028 and 30-year operation phase in 2032	Yes.
High Sea Wind, Offshore Wind Project, Ocean Winds (EDP Renewables & ENGIE)	Tier 3 - Proposed	Yes, as above.	Yes, project proposed to be located in the south east portion of the Gippsland Offshore Wind Zone. Foraging ranges of Blue whale, Southern right whale, Humpback whale and other mysticetes can be expected to overlap with areas where similar effects from underwater noise could be experienced cumulatively.	Unknown	No. Tier 3 project - screened out of the CIA due to a lack of information. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans.

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Project or action	Data Confidence	Scale parameter	Receptor impact	Temporal overlap	Conclusion
(Within the ZOI)	Certainty tier	Is the project or action of sufficient scale to warrant inclusion in the CIA?	Will the project / action adversely affect the same receptors as the project? And have a spatial overlap	Will the project / action result in adverse impacts, impacts to the same receptors as the project at the same time or on a timescale that could result in a cumulative impact?	Is the project / action shortlisted for the CIA?
Gippsland Skies, Offshore Wind Project, AGL & Mainstream Renewable Power & Reventus Power & Direct Infrastructure	Tier 3 - Proposed	Yes, as above.	Yes, Western portion of the Gippsland Offshore Wind Zone, 30 km from Wilsons Prom. Foraging ranges of Blue whale, Southern right whale, Humpback whale and other mysticetes can be expected to overlap with areas where similar effects from underwater noise could be experienced cumulatively.	Unknown	No. Tier 3 project - screened out of the CIA due to a lack of information. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through project management plans.
Gippsland Skies Offshore Wind Project marine surveys (investigations), AGL & Mainstream Renewable Power & Reventus Power & Direct Infrastructure	Tier 2 - Seeking approval	Yes, as above.	Yes, as above.	Yes. Surveys from early 2025 over multiple campaigns until 2029 (phase 1) and 2032 (phase 2 & 3). Phase 3 survey campaigns scheduled to occur until 2032 overlap with the construction phase of the Star of the South Offshore Wind Farm.	Yes.
Navigator North Offshore Wind Project Origin Energy & RES	Tier 3 - Proposed	Yes, as above.	Yes, project located in the north portion of the Gippsland Offshore Wind Zone in the far east in the area off Golden Beach (behind Gippsland Dawn). Foraging ranges of Blue whale, Southern right whale, Humpback whale and other mysticetes can be expected to overlap with areas where similar effects from underwater noise could be experienced cumulatively.	Unknown	No. Tier 3 project - screened out of the CIA due to a lack of information. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through project management plans.
BMG Closure Project, Oil and Gas. 2, Cooper Energy Limited	Phase Tier 1 - Approved	Yes, as above.	Yes, project located offshore of Lakes Entrance and overlap with the foraging ranges of subject species is assumed.	No, all decommissioning activities (e.g. monitoring) to be completed by end of 2027 and therefore concluded at least a year before the construction phase of the Star of the South Offshore Wind Farm commences.	No - timing of activities offshore does not overlap
Minerva Field Decommissioning Program, Woodside	Tier 1 - Approved	Yes, as above.	Yes, project located waters approximately 8 km south of the town of Port Campbell, Victoria. Overlap with the foraging ranges of subject species is assumed.	No. Indicative timing for works is between Q3 2023 to end Q2 2025. Works would therefore be concluded at least a year before the construction phase of the Star of the South Offshore Wind Farm commences.	No - timing of activities offshore does not overlap
Otway Offshore Operations, Cooper Energy Limited	Tier 1 - Approved	Yes, as above.	Yes, project located offshore near Port Campbell, Victoria. Overlap with the foraging ranges of subject species is assumed.	No. Indicative timing for works is between Q4 2022 and Q4 2027. Works would therefore be concluded at least a year before the construction phase of the Star of the South Offshore Wind Farm commences.	No - timing of activities offshore does not overlap
West Seahorse-3, Oil and Gas, Carnarvon Hibiscus Pty Ltd	Tier 1 - Operational	No, no vessel-based inspection or maintenance activities are required, with environmental impact and risks limited to the physical presence of the WSH-3 wellhead on the seabed.	Yes, project located in eastern Bass Strait approximately 13 km off the Gippsland coast and immediately north of the Star of the South Offshore Wind Farm.	Unknown	No. Impact pathways do not overlap
Kut-Wut Brataualung, Offshore Wind Project CIP	Tier 3 - Proposed	Yes, similar activities. Project will contribute to elevated underwater noise and increased vessel traffic	Yes, project located the western portion of the Gippsland Offshore Wind Zone. Overlap with the foraging ranges of subject species is assumed.	Unknown	No. Tier 3 project - screened out of the CIA due to a lack of information. If additional information becomes available or the project moves forward, cumulative impacts will be

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Project or action	Data Confidence	Scale parameter	Receptor impact	Temporal overlap	Conclusion
(Within the ZOI)	Certainty tier	Is the project or action of sufficient scale to warrant inclusion in the CIA?	Will the project / action adversely affect the same receptors as the project? And have a spatial overlap	Will the project / action result in adverse impacts, impacts to the same receptors as the project at the same time or on a timescale that could result in a cumulative impact?	Is the project / action shortlisted for the CIA?
					addressed through the project management plans.
Bass Strait Development Esso Australia resources Pty Ltd	Tier 1 - Operational	No, ongoing operational activities are considered part of the baseline.	Yes, project located immediately north of the Star of the South Offshore Wind Farm.	Yes, currently operational.	No – part of baseline assessment
Cape Hardy Deep Sea Port, Iron Road Limited	Tier 1 - Approved	Yes, similar activities. Project will contribute to elevated underwater noise and increased vessel traffic during construction piling works.	Yes, the project's impact assessment lists 6 key species at risk, including Southern right whale, Humpback whale and other mysticetes. The same species could be present in the ZOI for this project and the Star of the South Offshore Wind Farm.	No, completion of works is expected by May 2028. Works would therefore be concluded at least a year before the construction phase of the Star of the South Offshore Wind Farm commences.	No. Timing of activities, receptors and impact pathways do not overlap.
Kent Offshore Wind Project, RWE	Tier 3 - Proposed	Yes, as above.	Yes, project located in the south east portion of the Gippsland Offshore Wind Zone. Blue whale, Southern right whale, Humpback whale and other mysticetes could be present in the ZOI for this project and the Star of the South Offshore Wind Farm.	Unknown	No. Tier 3 project - screened out of the CIA due to a lack of information. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans.
CarbonNet, Carbon capture and storage, CarbonNet	Tier 3 - Proposed	Yes, as above.	Yes, project located approximately 45 km north of the Star of the South Offshore Wind Farm, off Ninety Mile Beach. Blue whale, Southern right whale, Humpback whale and other mysticetes could be present in the ZOI for this project and the Star of the South Offshore Wind Farm.	Unknown	No. Tier 3 project - screened out of the CIA due to a lack of information. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans.
Decommissioning of Bass Strait assets, Esso Australia resources Pty Ltd	Tier 1 - Under construction	Yes, as above.	Yes, project located immediately north of the Star of the South Offshore Wind Farm.	Underway since 2020. Facility removal until early 2028. Plans are being progressed to remove some pipelines, including shallow buried umbilicals and flexible flowlines in Commonwealth waters, commencing in 2028/2029.	No, timing doesn't overlap
Eastern Rise, Offshore Wind Project, Blue Float Energy + Origin Energy	Tier 3 - Proposed	Yes, as above.	Yes, but low potential for spatial incidence, with project located in NSW off Newcastle.	Unknown	No. Tier 3 project - screened out of the CIA due to a lack of information. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans including communication with NSW regarding SRW sightings.
Leeuwin Offshore Wind Farm, Copenhagen Energy	Tier 2 - Seeking approval	Yes, similar activities. Project will contribute to elevated underwater noise and increased vessel traffic during construction.	Yes, low potential for spatial incidence for large whales on migration, with project located in Western Australia (130km South of Perth).	Yes, construction is expected to begin in the first quarter of 2029. The project would take approximately two years to construct. On this schedule, the constructions phase would overlap with the construction phases for the Star of the South Offshore Wind Farm.	No. Limited potential for spatial overlap of impacts.

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Project or action	Data Confidence	Scale parameter	Receptor impact	Temporal overlap	Conclusion
(Within the ZOI)	Certainty tier	Is the project or action of sufficient scale to warrant inclusion in the CIA?	Will the project / action adversely affect the same receptors as the project? And have a spatial overlap	Will the project / action result in adverse impacts, impacts to the same receptors as the project at the same time or on a timescale that could result in a cumulative impact?	Is the project / action shortlisted for the CIA?
Gippsland Offshore Operations, Cooper Energy Limited	Tier 1 - Operational	Yes, similar activities. Project will contribute to elevated underwater noise and increased vessel traffic during construction	Yes, whale species may reside or migrate through both project areas, although no direct spatial overlap with the pipeline and the Star of the South Offshore Wind Farm OPA.	Possible; vessel-based activities expected to occur every 1-2 years for a duration of 2-4 weeks, up to ~8 weeks for a major repair.	No – part of baseline assessment
Gippsland Regional Port Project, Qube Energy Pty Ltd	Tier 3 - Proposed	Yes, similar activities. Project will contribute to elevated underwater noise and increased vessel traffic during construction.	Yes, project located immediately east - Barry Beach marine terminal (Corner Inlet).	Unknown	No. Tier 3 project - screened out of the CIA due to a lack of information. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans.
Golden Beach-2 Gas Project, GB Energy	Tier 1 - Approved	No. Offshore drilling completed winter 2023.	Yes, Golden Beach gas field is approximately 50 kilometres north-east of the OPA. The EES indicates that 25 whale species may reside or migrate through the project area, including the blue whale, southern right whale and humpback whale.	No. Construction operations spanned 2023 and 2024 Offshore drilling completed winter 2023. Therefore, no overlap with the construction phases for the Star of the South Offshore Wind Farm.	No. Timing of activities, receptors and impact pathways do not overlap.
Midwest Offshore Wind Farm, Copenhagen Energy	Tier 2 - Seeking approval	Yes, similar activities. Project will contribute to elevated underwater noise and increased vessel traffic during construction.	Low potential for spatial incidence for large whales on migration, with project located in Western Australia (500km north of Perth).	Yes, construction phase of 2027 – 2030 indicated (over approximately 36 months). On this schedule, the project may be in its construction phase during 2030 concurrently with the Star of the South Offshore Wind Farm.	No. Limited potential for spatial overlap.
Samphire Offshore Wind Farm, Copenhagen Energy	Tier 2 - Seeking approval	Yes, similar activities.	Low potential for spatial incidence, with project located in Western Australia (60 – 120km north of Perth).	Yes, the developer aims to start construction of the Samphire offshore wind farm in 2029	No. Limited potential for spatial overlap.
Cape winds Offshore Windfarm Australis Energy & Sky born Renewables (JV)	Tier 3 - Proposed	Yes, as above.	Low potential for spatial incidence, with project located in the Otway region (Portland).	Unknown	No. Tier 3 project - screened out of the CIA due to a lack of information. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans including communications with DEECA regarding SRW sightings.
Longtom Gas, SGH Energy VICP54 Pty Ltd	Tier 1 - Operational	Yes, similar activities.	Low potential for spatial incidence, with project located in East Gippsland (Orbost).	Yes, project operational.	No. Activities for this project are limited. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans.
Marinus Link, Transmission Cable, Marinus Link Pty Ltd (TasNetworks)	Tier 1 - Seeking approval	Yes, similar activities. Project will contribute to elevated underwater noise during cable laying activities and increased vessel traffic.	Yes. The EP indicates that the project could affect seven whale species that may reside or migrate through the project area, including Blue whale, Southern right whale, Humpback whale and other mysticetes. These species could be present in the ZOI for this project and the Star of the South Offshore Wind Farm.	Yes, as construction is expected to begin in 2026 and be completed by 2030, there is 1 year of potential overlap with the construction phase of the Star of the South Offshore Wind Farm.	Yes
Bass Offshore Wind Energy Project, Nexsphere	Tier 3 - Proposed	Yes, similar activities. Project will contribute to elevated underwater noise	Yes, project located 30 km off northeastern Tasmania, west of Cape Barren Island. Blue whale, Southern right whale, Humpback whale and other mysticetes could be present in the	Unknown	No. Tier 3 project - screened out of the CIA due to a lack of information. If additional

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Project or action	Data Confidence	Scale parameter	Receptor impact	Temporal overlap	Conclusion
(Within the ZOI)	Certainty tier	Is the project or action of sufficient scale to warrant inclusion in the CIA?	Will the project / action adversely affect the same receptors as the project? And have a spatial overlap	Will the project / action result in adverse impacts, impacts to the same receptors as the project at the same time or on a timescale that could result in a cumulative impact?	Is the project / action shortlisted for the CIA?
		and increased vessel traffic during construction.	ZOI for this project and the Star of the South Offshore Wind Farm.		information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans.
Patricia-Baleen (PaB) Gas Plant (Longtom) Upgrade, Santos Ltd	Tier 1 – Completed	No, ongoing operational activities are considered part of the baseline.	Yes, 7 species of marine mammals, including 6 migratory whale species (including blue, southern right and humpback whales may occur around the PaB asset and the Star of the South Offshore Wind Farm.	Unknown	No – part of baseline assessment
South East Australia Carbon Capture and Storage Project (SEA CCS Project), Esso Australia resources Pty Ltd	Tier 2 - Seeking approval	No, there will be no construction activities associated with use of the existing Bream pipeline for transport of CO2 within Bass Strait waters. Subsea pipeline surveillance during operations is considered to be low impact (EPBC Referral 2024-R01).	Yes, the project spans multiple jurisdictions in the Gippsland region of Victoria, including the waters of the Bass Strait. The existing Bream pipeline intersects BIAs associated with blue whales and southern right whales.	Unlikely, according to the project lifecycle depicted on the project website, construction could commence in 2025. Start up (CO ₂ injection) could occur anytime from 2026 to 2027. On this schedule, there is no potential for overlap with the construction phase of the Star of the South Offshore Wind Farm.	No. Very minimal offshore activities; no similar activities.
South Victorian Offshore Petroleum Exploration, BHP Petroleum Pty Ltd	Tier 1 – Operational	No. It is assumed that impacts from all operations are being managed to same standards as the Star of the South. In accordance with the OPGGS Act, vessels transiting to site do not comprise project activities.	Low potential for spatial incidence, with project located in the Otway region (Portland).	Unknown	No. Limited potential for spatial overlap and minimal activity. If additional information becomes available or the project moves forward, the potential cumulative impacts will be evaluated and addressed through the project management plans.
Turrum Phase 2 Development Project, Esso Australia resources Pty Ltd	Tier 1 – Operational	No, ongoing operational activities are considered part of the baseline. In accordance with the OPGGS Act, vessels transiting to site do not comprise project activities.	Yes, offshore activities in the Bass Strait will overlap with foraging ranges of subject species; with works to occur 42 km offshore from Ninety Mile Beach.	Unknown; No Specific Phase 2 Date	No – part of baseline assessment
Jack-Up Turrum Phase 3 Drilling, Esso Australia resources Pty Ltd	Tier 3 - Proposed	Yes, similar activities. Project will contribute to elevated underwater noise and increased vessel traffic during construction.	Yes, as above.	Unknown	No. Tier 3 project - screened out of the CIA due to a lack of information. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans.
Viva Energy Gas Terminal Project, Viva Energy	Tier 2 - Seeking approval	No, limited scope of offshore activities expected to be small scale and/or result in low magnitude, temporary adverse impacts.	Low potential for spatial incidence, with project located in Geelong with no direct spatial overlap between the Star of the South Offshore Wind Farm OPA and the proposed floating gas terminal	Unknown, Delays due to EES process. No updated timelines.	No, very limited overlap of impact and spatial pathways. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans.
Otway Exploration Drilling Program, ConocoPhillips Australia	Tier 1 - Approved	No, project has committed to avoid impacts to whales, therefore no potential for cumulative impacts.	Low potential for spatial incidence, with project located in the Otway region.	No, scheduled to commence no earlier than 1 of April 2024 and will be completed no later than 31 of December 2028. Therefore, no potential for overlap with the construction phase of the Star of the South Offshore Wind Farm.	No. Currently no temporal overlap. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans.

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Project or action	Data Confidence	Scale parameter	Receptor impact	Temporal overlap	Conclusion
(Within the ZOI)	Certainty tier	Is the project or action of sufficient scale to warrant inclusion in the CIA?	Will the project / action adversely affect the same receptors as the project? And have a spatial overlap	Will the project / action result in adverse impacts, impacts to the same receptors as the project at the same time or on a timescale that could result in a cumulative impact?	Is the project / action shortlisted for the CIA?
Regia MSS (marine seismic survey), CGG Services Australia	Tier 2 - Seeking approval	No, project has committed to avoid impacts to whales, therefore no potential for cumulative impacts	Low potential for spatial incidence, with project located to the South-West of the state in the Otway Basin.	No	No. Currently no temporal overlap. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans.
Offshore Gas Victoria Geophysical and Geotechnical Seabed Survey	Tier 1 – Operational	No, ongoing operational activities are considered part of the baseline.	Low potential for spatial incidence, with project located in the Otway region.	No, seabed surveys will be carried out no earlier than the 1 February 2024 and no later than the 31 December 2028. Therefore, no potential for overlap with the construction phase of the Star of the South Offshore Wind Farm.	No. Currently no temporal overlap. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans
Otway Offshore Gas Victoria Project, Beach Energy (Operations) Limited	Tier 2 - Seeking approval	Yes, similar activities. Project will contribute to elevated underwater noise and increased vessel traffic.	Low potential for spatial incidence, with project located in the Otway region	No, initial drilling to commence in 2025 with the installation of subsea facilities in 2026. Therefore, no potential for overlap with the construction phase of the Star of the South Offshore Wind Farm.	No. Currently no temporal overlap. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans
Decommissioning of the Minerva Pipeline in Victorian state waters, Woodside	Tier 1 - Approved	Yes, as above.	Low potential for spatial incidence, with project proposed to occur approximately 5.5 km south-southwest (SSW) of the township of Port Campbell, Victoria.	No, works scheduled between October 2024 and March 2025. Therefore, no potential for overlap with the construction phase of the Star of the South Offshore Wind Farm.	No. Currently no temporal overlap. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans
Minerva Decommissioning and Field Management, Woodside	Tier 1 - Approved	Yes, as above.	Low potential for spatial incidence, with project proposed to occur approximately 11 km south-southwest (SSW) of the township of Port Campbell, Victoria.	No, works planned to commence as early as Q4 2024 and require approximately three to five months. Therefore, no potential for temporal overlap with the construction phase of the Star of the South Offshore Wind Farm.	No. Currently no temporal overlap. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans
Jack-Up Rig Kipper Stage 1B Drilling, Esso Australia Resources Pty Ltd	Tier 1 - Approved	Yes, similar activities. Project will contribute to elevated underwater noise and increased vessel traffic during the Drilling of a new well at the Kipper well.	Low potential for spatial incidence, with project located 61km off coast at Lakes entrance to the North East of the Star of the South Offshore Wind Farm.	No, works expected to be in 2025 with potential for some remedial work to occur in 2026 or early 2027. Therefore, no potential for temporal overlap with the construction phase of the Star of the South Offshore Wind Farm.	No. Currently no temporal overlap. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans.
Gippsland Basin Geophysical and Geotechnical Investigations, Esso Australia Resources Pty Ltd	Tier 2 - Seeking approval	Yes, geophysical and geotechnical investigations and drilling will contribute to underwater sound levels.	Low potential for spatial incidence, with project to be undertaken in a large area off the coast of Seaspray and Lakes Entrance to the North East of the Star of the South Offshore Wind Farm.	Temporal overlap is possible, but unlikely. The EP Lodged in May 2024 and is under consideration. The surveys will be carried out during the life of the EP 5 years from the date of accepted EP.	No. Currently no temporal overlap. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans
Jack-Up Rig Plug and Abandonment, Esso Australia resources Pty Ltd	Tier 1 - Approved	Yes, similar activities. Project will contribute to elevated underwater noise and increased vessel traffic	Low potential for spatial incidence, with project to be undertaken in a large area off the coast of Seaspray and Lakes Entrance to the North East of the Star of the South Offshore Wind Farm.	No, works scheduled to start in the fourth quarter of 2024 with the expected completion at the start of 2026. Therefore, no potential for temporal overlap with the construction phase of the Star of the South Offshore Wind Farm.	No. Currently no temporal overlap. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans

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Project or action	Data Confidence	Scale parameter	Receptor impact	Temporal overlap	Conclusion
(Within the ZOI)	Certainty tier	Is the project or action of sufficient scale to warrant inclusion in the CIA?	Will the project / action adversely affect the same receptors as the project? And have a spatial overlap	Will the project / action result in adverse impacts, impacts to the same receptors as the project at the same time or on a timescale that could result in a cumulative impact?	Is the project / action shortlisted for the CIA?
West Seahorse Oil Development, Carnarvon Hibiscus Pty Ltd	Tier 1 – Operational	Yes, similar activities. Project could contribute to elevated underwater noise and increased vessel traffic.	Yes, project located immediately north of the Star of the South Offshore Wind Farm. Blue whale, Southern right whale, Humpback whale and other mysticetes could be present in the ZOI for this project and the Star of the South Offshore Wind Farm.	No, ongoing operational activities are considered part of the baseline.	No – part of baseline assessment
SMAP telecommunications submarine cable installation, SUBCO SOUTH PTY LTD	Tier 1 - Approved	Yes, similar activities. Project will contribute to elevated underwater noise and increased vessel traffic	Yes, project will pass through the Bass Stright for some distance to the south of the Star of the South Offshore Wind Farm. Blue whale, Southern right whale, Humpback whale and other mysticetes could be present in the ZOI for this project and the Star of the South Offshore Wind Farm.	No, cable installation is scheduled to begin in March 2025 and be completed by March 2026. Therefore, no potential for temporal overlap with the construction phase of the Star of the South Offshore Wind Farm.	No. Currently no temporal overlap. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans
Tasmanian gas pipeline, owned by Palisade Investment Partners (PIP) and operated by the Zinfra Group	Tier 1 – Operational	Yes, similar activities. Project could contribute to elevated underwater noise and increased vessel traffic	Yes, project located between Victoria and Tasmania to the south and east of the Star of the South Offshore Wind Farm. Blue whale, Southern right whale, Humpback whale and other mysticetes could be present in the ZOI for this project and the Star of the South Offshore Wind Farm.	Yes, project is operational.	No – part of baseline assessment
Offshore Gas Victoria Drilling and P&A Activities, Beach Energy (Operations) Limited	Tier 2 - Approved	Yes, similar activities. Project will contribute to elevated underwater noise and increased vessel traffic	Low potential for spatial incidence, with project located in the Otway region, noting that animals may move between regions.	No direct temporal overlap; project to be undertaken between 1 January 2025 and 31 December 2028.	No. Currently no temporal overlap. If additional information becomes available or the project moves forward, cumulative impacts will be addressed through the project management plans

14.3.3 Projects short-listed for cumulative impact assessment

Based on the screening process (Table 14-2), six Tier 1 or Tier 2 projects were short-listed for an assessment of cumulative impacts on blue whale, southern right whale, humpback whale and other mysticetes from elevated underwater noise during construction.

Projects included in this assessment (Table 14-3) include one offshore wind project (Great Eastern Offshore Wind Farm); one transmission project (Marinus Link), and three marine survey (investigations) campaigns for offshore wind projects.

The CIA for blue whale, southern right whale, humpback whale and other mysticetes is presented in Section 14.4.

Table 14-3 Short-list projects assessed for marine mammal and turtle receptors

Project	Stage	Project description	Relevance to this assessment	Certainty	Assessment Assumptions
Gippsland Offshore Wind Farm Marine Survey Investigations, Ørsted	Approved	The EPBC referral covers marine field investigations that include marine geophysical and geotechnical surveys to be undertaken within the offshore marine environment, wind measurement surveys using Floating LiDAR (buoy/uncrewed surface vessel to establish turbine locations.	<u>Spatial relevance:</u> The survey area indicated in the referral overlaps with the Star of the South site and extends to the south and east. <u>Temporal relevance:</u> The marine surveys are expected to commence once a feasibility licence is gained for the project. Geophysical and geotechnical surveys may span up to an eight-year period and may therefore, overlap temporarily with those of the Star of the South project. <u>Potential cumulative impact pathway (and relevant receptors):</u> Disturbance to blue whale, southern right whale, humpback whale and other mysticetes from elevated underwater noise during piling and drilling and vessel activities.	Tier 1 – Approved (high)	Environmental protection measures will be implemented to ensure the field work is undertaken in a manner that does not cause environmental harm, as per Ørsted's environmental management framework and Quality, Health, Safety and Environmental (QHSE) policy cited in the Referral (EPBC Number: 2023/09682
Gippsland Skies Offshore Wind Project marine surveys	Referred	Marine survey investigations which include geophysical investigations, geotechnical investigations, benthic habitat surveys and wind and oceanography surveys.	<u>Spatial relevance:</u> The survey area indicated in the referral overlaps with the Star of the South site and extends to the south & east. <u>Temporal relevance:</u> Geophysical investigations: Campaign 3 - notionally proposed to commence in 2028 or 2029, taking up to six weeks (potential for additive impact) Geotechnical investigations: Campaign 3 – notionally proposed to commence between 2029 and 2032 (potential for concurrent impact) <u>Potential cumulative impact pathway (and relevant receptors):</u> Disturbance to blue whale, southern right whale, humpback whale and	Tier 2 Seeking Approval (Medium)	Surveys phases are up to 6 weeks in duration. Standard environmental protection measures will be implemented to avoid or minimise impacts from underwater noise.

Project	Stage	Project description	Relevance to this assessment	Certainty	Assessment Assumptions
			other mysticetes from elevated underwater noise during piling and drilling and vessel activities.		
Marinus Link – transmission cable installation	Referred	The proposed Marinus Link interconnector will comprise two 750 MW high voltage direct current (HVDC) cables running 255km undersea and 90km underground HVDC cables between Burnie, Tasmania and Latrobe Valley, Victoria. The operational phase of the project is 40 years.	<u>Spatial relevance:</u> Marinus Link's cables will cross Bass Strait. The EP indicates that seven whale species may reside or migrate through the project area, including the blue whale, southern right whale and humpback whale. <u>Temporal relevance:</u> Construction is expected to begin in 2026 and be completed by 2030. Therefore, the construction phase of the project may overlap with the construction the Star of the South project. <u>Potential cumulative impact pathway (and relevant receptors):</u> Disturbance to blue whale, southern right whale, humpback whale and other mysticetes from elevated underwater noise during piling and drilling and vessel activities.	Tier 2 Seeking Approval (Medium)	The avoidance and mitigation measure proposed in the Environmental Impact Statement/Environment Effects Statement to avoid, minimise, offset, and manage impacts will be implemented. The construction phase of the Marinus Link project will overlap with the Star of the South construction phase for a period of 1 year.
Great Eastern Offshore Wind Farm Project, Corio	Referred – Assessment Approach Determined. Assessment Active	Proposed project located approx. 24 km off the central Gippsland coast aiming to generate up to 2.5 GW of electricity. Fixed bottom wind project including offshore export cables and underground cables.	<u>Spatial relevance:</u> The survey area indicated in the referral is located directly adjacent to the Star of the South site and extends to the south and north east of the site. Therefore, spatial coincidence is high. <u>Temporal relevance:</u> Construction is expected to begin in 2028 and take 3-4 years. Therefore, the construction phase of the project may overlap with the construction of the Star of the South project. <u>Potential cumulative impact pathway (and relevant receptors):</u> Disturbance to blue whale, southern right whale, humpback whale and other mysticetes from elevated underwater noise during piling and drilling and vessel activities.	Tier 2 Seeking Approval (Medium)	Environmental protection measures will be implemented to ensure the work is undertaken in a manner that does not cause environmental harm, as per environmental management framework and Quality, Health, Safety and Environmental (QHSE) policy cited in the Referral (EPBC Number: 2024/10088)

14.4 Cumulative impact assessment

14.4.1 Auditory impairment and behavioural disturbance to baleen whales from elevated underwater noise during construction

The screening process identified six projects that have the potential to cause cumulative impacts to baleen whales (i.e. categorised in this report as blue whale, southern right whale, humpback whale and other mysticetes) from elevated underwater noise associated with the construction phase of the Star of the South Offshore Wind Farm. This includes the potential for concurrent effects (with activities happening simultaneously) and additively (from projects concluded within the year prior) to result in a cumulative impact.

To assess the cumulative impacts of wind energy development adequately and meaningfully, assessments will be more informative when all potential developments are considered for a region with an understanding of species that may be impacted, the expected scale of the industry at full build out, demographic rates and the impact of other stressors (Masden et al., 2010; Croll et al., 2022). As these projects are in the same region, it can be assumed that the suite of species present in the respective Zols will be broadly similar, however without project specific information about the level of impacts that are likely, the following assessment is necessarily qualitative.

14.4.1.1 Offshore wind farm projects

Great Eastern OW Project Pty Ltd (Corio Generation)

Great Eastern Offshore Windfarm (GEOW) is a proposed offshore wind project to be located immediately adjacent to the southern boundary of Star of the South offshore. The project is expected to comprise of up to 140 fixed foundation wind turbines and five offshore sub-stations. The proposed site is in the south-eastern corner of Part 1 of the declared Gippsland Offshore Wind Zone. With GEOW and the Star of the South Offshore Wind Farm located in the same Offshore Wind Zone, the potential for spatial coincidence (and for mysticetes to be present in the Zols for both projects) is high, if both projects are constructed.

The construction phase for GEOW project is indicatively expected to last 3 to 4 years, commencing between 2028 and 2032 (although noise generating activities are not expected to be continuous over this period). On this schedule, there could be three years (through 2030 to 2032) of direct overlap with the Star of the South Offshore Wind Farm construction phase. Construction activities in the year prior (i.e. 2029) could also contribute to additive effects.

The EPBC Referral acknowledges that there is potential for direct impacts to threatened species as a result of underwater noise associated with construction of the project. Underwater noise, primarily from construction activities such as foundation installation, has the potential to result in PTS and TTS and behavioural effects to marine mammals, specifically the blue whale and southern right whale, which have BIAs overlapping the project area. Impacts from the GEOW project on marine mammals and turtles as a result of underwater noise are expected to be similar to those discussed in Section 8.1 for the Star of the South Offshore Wind Farm. This establishes the potential for cumulative impacts from underwater noise emissions during construction to mysticetes that transit either east or west along the Gippsland coastline. As such, it will be important for liaison between the two wind farm projects to assess and mitigate potential cumulative impacts from noise emissions via a simultaneous operations protocol (SIMOPS plan) if they are occurring at the same time, which is described below.

In addition, it is expected that GEOW will manage underwater noise so that impacts will be consistent with the blue whale and southern right whale recovery plans, that is, no behavioural disturbance that prevents feeding, breeding or migrating within BIAs, and in accordance with the significant impact guidelines for MNES for humpback whales and other mysticetes. Therefore there would not be any significant disturbance to marine fauna from both wind farms combined.

14.4.1.2 Offshore wind project feasibility surveys

Two projects are proposing marine surveys and data collection (geotechnical and geophysical surveys) within the Gippsland region:

- Gippsland Offshore Wind Farm Marine Survey Investigations, Ørsted
- Gippsland Skies Offshore Wind Project Marine Surveys (investigations).

The construction of the Star of the South Offshore Wind Farm, should this coincide with the Tier 2 projects identified, could result in cumulative disturbance to mysticetes. In practice, the timelines currently available are indicative, subject to change and highly unlikely to coincide (either with each other, or with the construction phase of the Star of the South Offshore Wind Farm). This assessment of cumulative potential is based on the premise that hearing impairment and behavioural disturbance to marine mammals from elevated underwater noise during site investigation surveys will be mitigated by undertaking activities in a particular manner to avoid impacts.

Gippsland Offshore Wind Farm Marine Survey Investigations, Ørsted.

Although the feasibility licence area for the Gippsland Offshore Wind Farm Marine area is offshore on the other side of the shipping channel in Part 2 of the Gippsland Declared Area, the Survey Investigations (as indicated in the EPBC referral (EPBC Number: 2023/09682)) overlaps with the Star of the South site and extends to the south and east as it covers the transmission cable route. The potential for spatial coincidence is therefore high. The potential for temporal incidence is, however, low; Ørsted will undertake multi-year marine survey programmes intermittently over 8 years and the initial commencement date is uncertain. Once a feasibility licence is gained for the Gippsland Offshore Wind Farm, marine surveys will be undertaken over a two-year period, at various times of the year. The proposed surveys are short-term (weeks to a few months) and intermittent (i.e. survey equipment will not be operating continuously).

The EPBC referral acknowledges that the proposed geophysical activities and, to a lesser extent, geotechnical activities and vessel transit may generate underwater noise that may interfere with marine fauna. Koessler and McPherson (2021) modelled noise for an Offshore Supply Vessel, using Dynamic Positioning (DP) (at the Thylacine location in the Otway basin in Victoria) at ~100m water depth. PTS thresholds were found to be reached at 90 m, TTS at 950m and behavioural disturbance at 7.1 km. The Gippsland Offshore Wind Farm Marine Survey Investigations could be expected, therefore, to generate a noise footprint of around 7 km in radius from a DP vessel on station continuously, for a period of months. This could contribute to behavioural disturbance and masking. Ørsted predict that residual impacts will be of minor significance in view of a commitment to implement environmental protection measures to ensure the field work does not cause environmental harm. It is expected that these provisions will include measures to avoid the coincidence of noise generating activities with other projects within the disturbance impact range for marine mammals.

The cumulative impact of the Gippsland Offshore Wind Farm site investigation surveys, together with construction activities for the Star of the South Offshore Wind Farm (should this occur simultaneously) could not impede corridors for migration and individuals could be exposed to noise levels that could result in behavioural disturbance. However, it is expected that mitigation will be in place to ensure there is no behavioural disturbance to blue whales or southern right whales or hearing impairment to other mysticetes from this project, therefore there cannot be cumulative effect for these species.

Given the intermittent and relatively short-term nature described for the individual activities, and that SIMOPS protocols will be implemented to avoid spatial coincidence of noise generating activities, the chance of overlap is considered to be very low. It will be important for liaison between the two wind farm projects to manage the potential cumulative impacts from noise emissions.

The cumulative impact of the Gippsland Offshore Wind Farm site investigation surveys is predicted to be negligible with individual project mitigations in place. The interaction of Gippsland Dawn with other screened-in projects is illustrated in Table 14-5.

Gippsland Skies Offshore Wind Project marine survey investigations

Gippsland Skies Pty Ltd proposes to undertake marine survey investigations to support the Gippsland Skies Offshore Wind Project. The investigations will include geophysical and geotechnical investigations. The survey area indicated in the EPBC referral (EPBC Number: 2024/09991) overlaps with the Star of the South site and extends to the south & west. Although the feasibility licence area is located in Part 3 of the Gippsland Declared area, the potential for spatial coincidence is considered to be high due to the location of the transmission cable route traversing a coastal corridor inshore of the Star of the South Offshore Wind Farm site. However, the potential for temporal coincidence is considered to be low. The following aspects could overlap both spatially and temporally with the Star of the South Offshore Wind Farm construction phase:

- Geophysical investigations: Campaign 3 - notionally proposed to commence in 2028 or 2029, taking up to six weeks. Proposed activities include use of multibeam echosounder, side scan sonar, sub-bottom profiling, magnetometry surveys and 2D shallow seismic equipment (i.e. mini air guns). There is no direct temporal overlap with the Star of the South Offshore Wind Farm construction phase, but a small potential

for additive effects (with the campaign potentially concluding within 12 months of the start of the Star of the South Offshore Wind Farm construction phase).

- Geotechnical investigations: Campaign 3 – notionally proposed to commence between 2029 and 2032. Likely to involve taking one borehole sample and one downhole cone penetration test sample at each of the proposed wind turbine locations. The horizontal directional drilling exit pit location will be subject to borehole and CPT sampling in this campaign. There is the potential for cumulative (concurrent) and additive impacts from disturbance.

In the EPBC referral, Gippsland Skies Pty Ltd acknowledge underwater noise (from geophysical and geotechnical equipment and vessels) as a potential environmental impact associated with the investigations. The significance of that harm is considered to be minor following the implementation of environmental protection measures to ensure the investigations are undertaken in a manner that does not cause environmental harm.

JASCO Applied Sciences (JASCO) report 'Geophysical and geotechnical survey investigation sources: acoustic effect estimation' (2024) have described effect ranges for geophysical and geotechnical investigation sources as 240 m from the source for behavioural disturbance effects with TTS for low frequency cetaceans being reached at 40m from the source for a UHRS sparker source. For a multi-bean echosounder, noise emissions would not be heard by low frequency cetaceans and would have ranges of 700 m for TTS and 277 m for PTS in very high frequency cetaceans. Similarly, for side scan sonar noise emissions, ranges are 378 m for TTS and 125m for PTS in very high frequency cetaceans. For sub-bottom profilers ranges are 20 m for TTS in very high frequency cetaceans.

This review demonstrates that even when using the fauna group with the most sensitive hearing range, effect distance ranges are less than 1 km for all types of equipment but requires cetaceans to be within this distance for a period of 24 hours.

With respect to the geophysical investigations, there is no direct temporal overlap and given the high reversibility of the impact, the consequences related to additive (an accumulation of impacts starting in 2029) is considered to be negligible.

With respect to the geotechnical investigations there is the potential for direct spatial and temporal overlap with the Star of the South Offshore Wind Farm construction phase. On the expectation that environmental protection measures will be implemented to prevent impacts from underwater noise to baleen whales, the cumulative contribution of the Gippsland Skies Offshore Wind Project marine survey investigations is predicted to be negligible.

14.4.1.3 Transmission projects

Marinus Link

The Marinus Link project involves the installation of two 750 MW subsea electricity interconnector cables 250 kilometres across Bass Strait between Waratah Bay in Victoria (on the other side of Wilson's prom) and Burnie in Tasmania, approximately 50 kilometres south-west of the Star of the South Offshore Wind Farm OPA. Construction is expected to begin in 2026 and be completed by 2030. Therefore, the construction phase of the project may overlap with the construction the Star of the South Offshore Wind Project, but only for a period of 12 months. It can be assumed that the suite of whale species present in the respective project Zols will be broadly similar. Therefore, spatial and temporal coincidence is established.

Construction of the Marinus Link will involve a pre-lay grapnel run of each cable corridor to clear the route of obstructions such as debris or discarded fishing gear, followed by installation of the cable by a cable lay ship. Several small 'guard' vessels will be engaged to monitor for maritime traffic and communicate with surrounding vessels if needed. Guard vessels typically engaged by these projects are medium sized 'multipurpose' vessels of around 20 metres length that operate at speeds of 8 knots or less (e.g. the Dell Richey II, Northern Star). The construction vessels by their nature will be very slow moving and it is therefore assumed they will pose negligible risk of collision with marine megafauna.

The Marinus Link EES commits to the development of species-specific management plans that will be implemented to mitigate noise impacts. These plans are expected to include provisions that seek to identify and avoid the coincidence of noise-generating activities within behavioural disturbance ranges.

Noting the limited potential for temporal overlaps during the project's respective construction phases (a maximum of 12 months) and in expectation of the implementation of environmental protection measures to

avoid impacts from underwater noise, the contribution of the of the Martinus Link project to a cumulative impact is predicted to be negligible.

14.5 Summary

Though it is acknowledged that the duration of underwater noise generating activities for offshore wind farms, particularly during construction, may be greater than other non-wind farm projects, it is not possible to determine whether there are potential cumulative impacts until the project design envelopes are designated, project specific noise modelling is undertaken, and project timing is known. Therefore, the potential for cumulative underwater noise impacts from the Star of the South together with other projects is currently difficult to predict.

The Star of the South project will manage noise generating activities from the activity, and as such, contributions to cumulative impacts to baleen whales during construction are proposed to be minor and not significant or impact with any species recovery. The Marine Mammals and Turtles Monitoring and Management Plan includes steps and procedures for the identification of concurrent activities at the time of activity commencement. This simultaneous operations protocol will ensure that if other activities coincide with the construction of the SOTS wind farm, adequate steps are taken to ensure impacts are as predicted in the EIA. The SIMOPS protocol will be established in the MMTMMP as well as the OEI Act Management Plans.

SOTS will be able to determine, prior to activity commencement, if there is the potential for overlap in timing between activities with other offshore wind developers or other industries such as the petroleum industry via government websites, on which approvals, including proposed time frames, are published (i.e. NOPSEMA and OIR websites).

Should construction of another offshore wind farm or a petroleum activity be underway when SOTS wish to commence construction, it will be important for liaison between the two projects to avoid potential cumulative impacts from elevated noise emissions and risks from increased numbers of vessels. SOTS will engage with other proponents and implement control measures as per general SIMOPS arrangements including measures such as:

- buffer zones between activities such as piling, with the distance determined by the noise modelling
- a minimum distance apart for vessels to be determined by the noise modelling
- consultation with other projects to determine if work can be undertaken as far apart within the licence areas as reasonably practicable.

As a result, the residual consequence for underwater noise for blue whale, southern right whale, humpback whale and other mysticetes is Minor. The CIA residual consequence for this receptor group is considered on current information to be Minor (Table 14-1) for each project with the potential to interact cumulatively with the Star of the South Offshore Wind Farm and in sum (Table 14-5).

Table 14-4 Cumulative impact associated with increased underwater noise

Receptor	Impact/Risk Pathway	SOTS Residual Consequence	CIA Residual Consequence
Construction			
Blue whale, Southern right whale, Humpback whale and other mysticetes	Elevated underwater noise	Minor	Minor

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Table 14-5 Potential contributions to cumulative impacts from elevated underwater noise during construction on blue whale, southern right whale, humpback whale and other mysticetes. X denotes potential occurrence of other project activities

Project	2029	2029	2030	2030	2031	2031	2032	2032	2033	2033	2034	2024	2035	2035
	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2
Star of the South Offshore Wind Farm			MINOR	MINOR	MINOR	MINOR	MINOR	MINOR	MINOR	MINOR	MINOR	MINOR	MINOR	MINOR
Great Eastern Offshore Wind Farm	x	x	x	x	x	x								
Gippsland OWF: Offshore Surveys	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Gippsland Skies OWF: Offshore Surveys	x	x	x	x	x	x								
Marinus Link (Transmission cable)	x	x	x	x										
CIA Residual Consequence	x	x	x	x	x	x	x	x	x	x	x	x	x	x

15 SUMMARY OF MITIGATION, MANAGEMENT AND MONITORING

15.1 Project environmental outcomes

The EIS guidelines for the project require a description of the environmental outcomes (EOs) that the project mitigation and management measures are expected to achieve. In developing the project EOs the Commonwealth Government's Outcomes-based Conditions Policy – EPBC Act 1999 (DOE 2016) was consulted. The EOs were developed to be consistent with the objects of the EPBC Act and to ensure achievement of beneficial conservation and protection outcomes for each MNES relevant to the project.

The EOs have also been informed by the project risk and impact assessment results to adopt a risk-based approach and are consistent with the range of requirements and guidance that are reflected in the pre-determined assessment criteria (see Section 0 of this Technical Report). The EOs are listed in Table 15-1. Table 15-1 together with the relevant statutory instruments and guidance documents that the requirements have been derived from.

Table 15-1: Project environmental outcomes and alignment with EPBC Act and other requirements.

Environmental outcomes	Alignment with requirements
EO 1 - No significant impact, such as a long-term decrease in a population, or disruption of a breeding cycle, to marine mammal or turtles that are values of Commonwealth Marine Reserves within the SE Network during all stages of the Project.	Significant Impact Guidelines 1.1 South-east Network Management Plan 2025
EO 2 - No significant loss of or adverse effects on important migratory, foraging or breeding habitat or a decrease in the availability or quality of habitat to the extent that a population is likely to decline for marine mammal or turtle species during all stages of the Project.	Significant Impact Guidelines 1.1 Conservation Management Plan for the Blue Whale National Recovery Plan for the Southern Right Whale
EO 3 - No displacement from, barrier effects in accessing, or a reduction in habitat occupancy to the extent that a population is likely to decline for marine mammal or turtle species during all stages of the Project.	Significant Impact Guidelines 1.1
EO 4 – Anthropogenic noise will be managed such that: - Any blue whale continues to utilise biologically important areas without injury and is not displaced from a foraging area - It does not prevent any southern right whale from utilising biologically important areas or habitat critical to the survival of a species or cause auditory impairment. - Actions within and adjacent to southern right whale biologically important areas or habitat critical to the survival are undertaken such that the risk of behavioural disturbance is demonstrably minimised.	Significant Impact Guidelines 1.1 Conservation Management Plan for the Blue Whale National Recovery Plan for the Southern Right Whale
EO 5 - No substantial changes in water quality, seabed quality or hydrodynamics to cause significant impacts to marine mammal or turtle species because of the project activities during all stages of the Project.	Significant Impact Guidelines 1.1 Threat Abatement Plan for Marine Debris
EO 6 – No significant impacts to marine mammals or turtles because of underwater noise produced by project activities during all stages of the Project.	Significant Impact Guidelines 1.1 Conservation Management Plan for the Blue Whale National Recovery Plan for the Southern Right Whale Fin and Sei Whale Conservation Advice
EO 7 – No significant impacts to marine mammals or turtles because of vessel strike by project vessels during all stages of the Project.	Significant Impact Guidelines 1.1 National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna Conservation Management Plan for the Blue Whale National Recovery Plan for the Southern Right Whale Fin and Sei Whale Conservation Advice

The project will achieve these EOs by implementing a range of design features, mitigation and management measures to avoid, minimise or manage environmental impacts to at or below levels that are consistent with the assessment criteria. These design features, mitigation and management measures, covering the main impact and risk pathways relevant to the Project and the marine mammals and turtles known to occur in this location, are summarised in Table 15-2 and outlined throughout Sections 8-11 of this Technical Report.

In situations where there is either residual scientific uncertainty in the risk or impact assessment, or uncertainty in the efficacy of mitigation measures, a program of monitoring coupled with adaptive management where necessary will be used to ensure that EOs are achieved.

15.2 Mitigation and adaptive management

The mitigation and adaptive management measures that are proposed to avoid, mitigate or manage impacts and achieve the EOs associated with the project are summarised in Table 15-2. Monitoring is described in Section 15.3.

Table 15-2: Mitigation measures relevant to marine mammals and turtles technical report

Measure ID	Mitigation measure and description	Impact / risk pathway ID	Effect	Phase
Initial Mitigations				
EMI-M01	Depth of cable burial Subsea cables will have a minimum depth of lowering (MDoL) of 1.0 metres for offshore export cable and 0.6 metres for inter-array cables	MMT-I006	Burial and protection of cables will minimise expose to electromagnetic interference (EMI) for sensitive receptors such as fish and invertebrates which are prey for marine mammals and turtles and for direct impacts to marine mammals and turtles.	Operations
LIT-M01	Infrastructure light management Wind farm and vessel lighting during all phases of the project will comply with National Light Pollution Guidelines for Wildlife (DCCEEW, 2023), to limit the effects of artificial lighting on wildlife, where these do not conflict with safety (i.e. needed for safe work, navigation and aviation). This includes: • the minimisation of light spill; • avoidance of long wavelength light sources; • avoidance of blue, violet or ultra-violet wavelengths; and • lighting in each maintenance area will be kept to the minimum requirement for safe passage when personnel are not required to be working in the area. Construction lighting and marking requirements will be included in the Marine Operations Framework, including vessel lighting and temporary lighting and marking on structures within the Offshore Wind Farm Area (OWFA). For the operation phase, an operational lighting and marking plan will be developed in consultation with relevant regulators, such as the Civil Aviation Authority and the Australian Maritime Safety Authority. The plan sets out the design and operation of lighting within the Offshore Wind Farm Area, including on turbines and substations for both aviation and navigational safety requirements. During good weather while in operations, lighting on turbines and substations will be reduced where practicable as agreed with relevant regulators, including the Civil Aviation Safety Authority (CASA) and the Australian Maritime Safety Authority (AMSA). The specific requirements	MMT-I004	Reduction in light intensity and minimise light spill where safe to do so to reduce impacts to sensitive receptors.	Construction Operations Decommissioning

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Measure ID	Mitigation measure and description	Impact / risk pathway ID	Effect	Phase
	for lighting will be set out in the Operations Lighting and Marking Plan, in agreement with relevant authorities.			
OFF-M02	Marine debris minimisation During all phases of the project, all activities will be undertaken in accordance with the management actions provided in the Commonwealth “Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia’s coasts and ocean (2018)” to limit impacts of marine debris on sensitive marine receptors. The project will take practicable actions to avoid and minimise the loss of marine debris from offshore installations and project vessels. Appropriate training will be communicated during crew induction. In the event of debris lost, if practicable, Star of the South will retrieve the debris. Reporting and monitoring will be undertaken according to the Environmental Management Framework.	MMT-R003	Compliance will ensure that impacts of marine debris on marine fauna does not occur	Construction Operations Decommissioning
OFF-M04	Low toxicity marine drilling fluids During the construction period, only water-based drilling fluids (such as those containing xanthan gum and bentonite, or low toxicity alternatives) will be used for marine drilling activities, including trenchless installation of the shore crossing (at Reeves Beach) and drilling monopiles in the Offshore Windfarm Area (OWA) in the event of pile refusal. Low toxicity fluids will limit potential environmental harm, including impacts to sensitive marine receptors associated with decreased water quality.	MMT-I002	Reduces the potential impacts associated with reduced water quality	Construction Operations Decommissioning
SNV-M04	Cable burial risk assessment A cable burial risk assessment will be undertaken as part of detailed design to ensure that cables will be buried to adequate depth, for the safety of other marine users. Factors considered include shipping activity, use of anchors, fishing activity, substrate type and metocean conditions. Where possible cable burial will be the preferred option for cable protection. Where sufficient depth of cover cannot be achieved during installation, remedial protection will be used.	MMT-I006	Burial and protection of cables will minimise expose to electromagnetic interference (EMI) for sensitive receptors such as fish and invertebrates which are prey for marine mammals and turtles and for direct impacts to marine mammals and turtles.	Operations

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Measure ID	Mitigation measure and description	Impact / risk pathway ID	Effect	Phase
SNV-M07	Vessel Passage Plan During all phases of the project, a Vessel Passage Plan (VPP) will be produced by the vessel 'master for navigation' for relevant vessels entering Corner Inlet, in consultation with the Gippsland Ports Harbour Master as per requirements set out in the <i>Port Information Handbook for the Port of Corner Inlet and Port Albert</i>. The VPP is required on the first entry to the Port of Corner Inlet for relevant vessel classes, or if the vessel has not entered for a period exceeding six months. The vessel master must submit to the Harbour Master (or their delegate) a formal passage plan, to be lodged with the Notification of Arrival/Departure and Application for Berth form. The VPP, provides active management of vessels to reduce the choke points and provision of safe separation distances limiting impacts to third-party vessels and port congestion. The VPP, will include requirements as set out in the <i>Port Information Handbook for the Port of Corner Inlet and Port Albert</i>.	MMT-R001 MMT-R002	Avoid vessel strike	Construction Operations Decommissioning
SPL-M01	Refuelling and resupply limitations To minimise the likelihood of vessel collision and hydrocarbon release, project vessels (during all phases of the project) will comply with all statutory requirements, including MARPOL (Marine Order 97). This includes the following refuelling measures: • Wherever possible, routine refuelling of project vessels will occur in port; • Should refuelling be required at sea, refuelling will not occur within shipping lanes or areas of high traffic to minimise the likelihood of vessel collision and fuel spill. • Vessel fuel must only contain a maximum sulfur content of 0.50 per cent m/m in compliance with MARPOL and Marine Order 97. • Materials and equipment that have the potential to spill onto the deck or into the marine environment will be stored within a contained area. • Spill response kits will be available and routinely checked to ensure adequate stock is maintained • Bunkering and bulk liquids will be transferred in accordance with bulk transfer procedures to reduce the risk of an unintentional release to sea during transfer. The procedures include standards for: • Certified equipment with confirmed integrity (e.g. hose and valves). Transfer process (e.g. safety, communication, monitoring, inventory, emergency shut down procedures, procedural documents, and spill incident details)	MMT-R002	Reduces the likelihood of an MGO spill during refuelling / resupply	Construction Operations Decommissioning

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Measure ID	Mitigation measure and description	Impact / risk pathway ID	Effect	Phase
SPL-M02	Spill Response Plan Develop, implement and maintain a Spill Response Plan (SRP) for accidental hydrocarbon release from project activities within the marine environment, including prevention, response and management during all project phases to minimise risk to sensitive marine receptors. The SRP describes first strike management measures (initial response measures) for vessel spills until the Australian Maritime Safety Authority (AMSA) takes over the response as the designated Control Agency for vessel spills. If a spill was to occur the SRP would be activated and will include the following: • Initial response measures • Notification and reporting requirements • Determine if oil spill modelling and/or tracking buoys are required • Monitoring of the spill such as water quality monitoring • Response tactics to be implemented, such as subsea or surface dispersants, mechanical dispersion, containment and recovery and in-situ burning, depending on the nature and scale of the spill • Determine if shoreline protection and deflection and shoreline clean up are needed. • Monitoring and assessment of ecological impacts	MMT-R002	Reduces the impact of a spill on wildlife	Construction Operations Decommissioning
SPL-M03	Maintenance of offshore substation transformers To reduce the risk of potential hydrocarbon spill in the marine environment, the following measures will be undertaken during the operations phase: • Substation transformers will be maintained in accordance with manufacturer's requirements. • All transformers will be banded appropriate to the oil capacity to reduce the risk of hydrocarbon release to the environment. • Regular inspection of items that have a potential hydrocarbon spill risk	MMT-R002	Reduces the potential risk of a spill associated with substation transformers.	Operations
UWN-M01	Piling soft start procedure The project will implement soft start and ramp-up of hammer energy measures at the commencement of each impact pile driving activity for both monopile and jacket pile foundations during the construction phase. The soft start will involve the implementation of lower hammer energies at the beginning of the piling sequence before the energy input applied by the hammer is 'ramped up' (increased) over time to the required higher levels. Soft start and ramping up of energy during piling is aimed at discouraging wildlife (e.g. fish, diving seabirds and marine mammals) from remaining in	MMT-I001	Provides an opportunity for marine mammals and turtles to leave the vicinity of the piling locations before hammer energy is increased. Aligns with principle of EPBC Act PS 2.1 Procedure A.3.2.	Construction

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Measure ID	Mitigation measure and description	Impact / risk pathway ID	Effect	Phase
	close proximity to the noise source and reduce the number of individuals potentially occurring within hearing impairment ranges. It is proposed that each piling event would commence with a minimum of 10 minutes at 10% of the maximum hammer energy, followed by a gradual ramp-up for at least 20 minutes up to 80% of the maximum hammer energy for all pile driving activities.			
UWN-M02	Maintenance of turbines Maintain turbines to reduce problems arising (e.g., vibration) that could contribute to unnecessary underwater noise	MMT-I001	Reduces the noise generated by the OWF that could disturb marine fauna	Operations
VES-M01	Vessel operations framework To ensure vessel safety and to reduce the risk of accidents (such as vessel collision and fuel spills) the project will develop, implement and maintain a vessel operations framework to be approved by the regulator, in accordance with International and Australian maritime legislation, including: - the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS) (implemented in Australia by Marine Order 30 (Prevention of collisions) 2016), - the International Convention for the Safety of Life at Sea (SOLAS) as part of the Navigation Act 2012 (lights and signals to be used by a vessel and to reduce potential vessel collisions), - the International Convention for the Prevention of Pollution from Ships (MARPOL) (regulations aimed at preventing both accidental pollution and pollution from routine vessel operations) implemented through the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Commonwealth), the Navigation Act 2012 (Commonwealth) and the Pollution of Waters by Oil and Noxious Substances Act 1986 (Victoria). All project vessels will ensure that they are operated in accordance with this framework (as required by vessel size and class) during every project stage (construction, operation and decommissioning) within both Commonwealth and state waters (including at Port, transiting to and from the offshore project area and within the offshore project area). Star of the South will ensure that prior to procuring project vessels, all vessels have a record of inspections and compliance.	MMT-I002 MMT-I004 MMT-R001 MMT-R002 MMT-R003 MMT-R004	Prevent pollution of the marine environment including pollution from light emissions, vessel discharges and accidental hydrocarbon releases. Minimise the risk of a collision that may result in an accidental hydrocarbon release by governing lighting and signals required for navigational and work safety. Reducing and mitigating risk of accidents at sea will decrease any risk to fauna within the operational area from a hydrocarbon spill.	Construction Operations Decommissioning
VES-M03	Marine coordination centre To minimise risk of third-party vessel interactions, a Marine Coordination Centre (MCC) will manage movements of project vessels to and within the Offshore Project Area (OPA). The marine coordination centre will also monitor third party vessels and aircraft around the project area.	MMT-R001 MMT-R002	Reduce the likelihood of a vessel collision and spill. Reducing and mitigating risk of accidents at sea will decrease any risk to fauna within the operational area from a hydrocarbon spill.	Construction Operations Decommissioning

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Measure ID	Mitigation measure and description	Impact / risk pathway ID	Effect	Phase
	The marine coordination centre will operate 24/7 in the construction phase and in the operations phase it will be staffed during working hours and operate 24/7 during large scale maintenance campaigns such as blade replacement.			
VES-M04	Vessel movement controls To reduce the likelihood of interactions with third party vessels or an accidental hydrocarbon release from a vessel collision occurring within the marine environment the following measures will be applied: • All construction, operations and decommissioning activities will occur within the designated Offshore Project Area (OPA) • Project vessels will use defined shipping routes between construction feeder ports and the OPA, as well as within Corner Inlet. Vessel routes will be further defined in consultation with relevant stakeholders. Deviation from recommended routes can occur for safety or environmental reasons. • All project vessels that require dynamic positioning (DP) will comply with the DP Certification scheme.	MMT-R001 MMT-R002	Avoid vessel strike	Construction Operations Decommissioning
VES-M05	Vessel biosecurity controls Project vessels and subsea equipment will be compliant with relevant biosecurity legislation and guidelines, including: • Prior to commencing project activities, all installation and support vessels will have a project-approved Ballast Water Management Plan and a Ballast Water Management Certificate. • Reporting and management of ballast water will be in accordance with The Biosecurity Act 2015 and the Ballast Water Management Convention's Guidelines for Ballast Water Management and Development of Ballast Water Management Plans. • An Invasive Marine Species (IMS) risk Assessment Procedure (IMS-RAP) will be undertaken in accordance with the International Maritime Organisation Guidelines for the Management of Ships Biofouling for all vessels undertaking project activities, and the vessel will be confirmed to be a low biosecurity risk before approval to enter the Offshore Project Area (OPA) and Corner Inlet. • Biosecurity clearance prior to entering Australian Waters for foreign vessels: ◦ Vessels that are intending to discharge internationally sourced ballast water within Australian waters must submit a Ballast Water Report through Maritime Arrivals Reporting System (MARS) at least 12 hours prior to arrival to gain biosecurity clearance.	MMT-I002 MMT-R004	Reduce the impact of routine discharges and the likelihood of accidental discharges, including a decline in water quality, increase in turbidity and temporary toxicity to fauna from bilge water discharge.	Construction Operations Decommissioning

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Measure ID	Mitigation measure and description	Impact / risk pathway ID	Effect	Phase
	- Ballast tank sediment must be disposed of in an area outside 200 nautical miles from the nearest land, and in at least a depth of 200 metres, or at an approved land-based reception facility. - Management of anti-fouling and in-water cleaning in accordance with the Australian anti-fouling and in-water cleaning guidelines"			
VES-M06	Vessel collision - marine mammals All project vessels will implement the following requirements during all project phases (construction, operation and decommissioning) as prescribed by the EPBC Regulations 2000 Part 8 and Victorian State Wildlife (Marine Mammal) Regulations 2019 to minimise the risk of collision with a whale or dolphin: - Implementation of 'no approach' and 'caution' zones for whales, dolphins and seals: - No approach zone (whales): within 100 metres of a whale, and within 300 metres to the front and rear of a whale - No approach zone (dolphins): within 50 metres of a dolphin, and 150 metres in front and to the rear of a dolphin - No approach zone (seals): within 30 metres of a seal, if the seal is on land or a haul out; or within 5 metres if the seal is on water infrastructure within state waters - Caution zone (whales): within 300 metres of a whale - Caution zone (dolphins): within 150 metres of a dolphin. - Vessels must not enter the 'no approach zone' and must not wait in front of the direction of travel when a calf is present	MMT-R001	Minimise disturbance to marine fauna, avoid vessel strike	Construction Operations Decommissioning
Additional Mitigations				
UWN-M03	Noise abatement system (NAS) The project will implement the best available NAS techniques at the point of construction that meets the noise level limit (refer UWN-M04) and is feasible for the site's water depths, metocean conditions, pile size and vessels, as detailed in the Construction Underwater Noise Framework. Currently the NAS includes a Double Big Bubble Curtain (DBBC), to ensure the efficacy of this NAS the SOTS project team will have a DBBC management procedure in place that will involve hose drilling, testing and flushing, visual assessments of bubbles, connection maintenance, compressor pressure monitoring, metocean monitoring and reporting to ensure that piling continues only while the DBBC is functional.	MMT-I001	Modelling and measures indicated NAS such as DBBC, HSD and MHS provide effective noise reduction.	Construction
UWN-M04	Noise level limit for pile driving activities and model validation Piling activities will be managed to ensure that the noise level at set distances are equal to, or less than, those defined in the pre-construction modelling as per the Construction Underwater Noise Framework.	MMT-I001	This measure will ensure that precaution zone sizes are appropriate through targeted noise measurements	Construction

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Measure ID	Mitigation measure and description	Impact / risk pathway ID	Effect	Phase
	Therefore demonstrating that the noise levels / zones of effect correspond appropriately to the precaution zone (as detailed in the Construction Underwater Noise Framework).		at representative piling locations and that NAS is effective.	
UWN-M05	Southern Right Whale Reproductive Biological Important Area Limit Ensure SRW are not exposed to noise levels of greater than 140 dB SPL (impulsive piling) when within the Reproduction BIA between May to September. Where reasonably practicable, install piles on the offshore side of the project area during the months of May to September and inshore piles during October to April. If this is not reasonably practicable, management controls on piling operations would be as per the monitoring and adaptive management procedure for pile driving operations in Section 4.4 of the Construction Underwater Noise Framework	MMT-I001	Highly effective as it avoids noise exceeding behavioural response range within this Habitat Critical to Survival (HCTS) for the southern right whale. Aligns with EPBC Act PS 2.1 Procedure A.1.	Construction
UWN-M06	Marine Fauna Observers (MFOs) Sufficient MFOs and vessels deployed to ensure visible coverage of the precaution zone based on the final round of modelling, as per the Construction Underwater Noise Framework. Any crew that will be used as MFOs will be trained. All MFOs will be suitably qualified and experienced in accordance with EPBC Act PS 2.1.	MMT-I001	Highly effective and standard practice for noise generating activities. The number of MFOs will reflect observation distances, heights and ranges to behavioural disturbance and TTS thresholds. Aligns with EPBC Act PS 2.1 Procedure A.2 and B.1.	Construction
UWN-M07	Passive acoustic monitoring (PAM) PAM systems will be used to support detection of vocalising species of whales that are not easily observed at the surface, and during low visibility conditions and at nighttime, noting that only some animals in a population might vocalise. Long range detection and real time systems will be investigated. All PAM operators will be qualified and experienced.	MMT-I001	Commonly used systems for vocalising marine fauna detections during low visibility and time-time conditions. Will require range validation and testing during implementation prior to use as a trigger for whale detection. Aligns with EPBC Act PS 2.1 Procedure B.5.	Construction
UWN-M08	Pre start-up marine mammal surveillance A 30 minute pre-start whale surveillance period will apply before the commencement of the soft start procedure at each piling location with sufficient trained and experienced Marine Fauna Observers to ensure coverage of the precaution zone and supplemented by a PAM array.	MMT-I001	Ensures effective detection of marine mammals. Aligns with EPBC Act PS 2.1 Procedure A.3.1 and B.4.	Construction
UWN-M09	Start-up Delay Procedure	MMT-I001	Delaying start-up will be effective at preventing close-range noise	Construction

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Measure ID	Mitigation measure and description	Impact / risk pathway ID	Effect	Phase
	If a whale, dolphin, pinniped or turtle is detected within the relevant precaution zone of a piling location, start-up will be delayed until marine fauna has been confirmed to have left the zone or a period of 30 mins has elapsed since the last detection.		exposure to marine mammals and turtles. Aligns with EPBC Act PS 2.1 Procedure A.3.3.	
UWN-M10	Operations procedure Species specific precaution zones will be under continuous surveillance (visual and acoustic) during all pile driving operations (low power and full operations). The size of the precaution zones will be refined in response to pre-construction noise modelling and in-field noise verification around representative piling locations. If piling is paused for operational reasons, marine fauna observations should continue and if marine fauna are detected within their precaution zones, re-start should be delayed until the precaution zone is clear of marine fauna. Once the precaution zone is clear for a period of 30 minutes, soft start procedures can be recommended.	MMT-I001	The ongoing effectiveness of whale detections will be monitored and optimised in accordance with the MM EMP. Aligns with EPBC Act PS 2.1 Procedure A.3.4, B.3 and B.4.	Construction
UWN-M11	Stop Work Procedure If marine fauna are detected within the relevant precaution zone (define by pre-construction modelling as per the Construction Underwater Noise Framework) for each species, pile driving should cease or hammer energy reduced to the lowest feasible level when safe to do so. The pile driving operation must not resume until the animal has moved out of the precaution zone or has not been sighted for 30 minutes. Following this, operations may resume following the stop work procedure that will be developed prior to construction.	MMT-I001	Effectiveness will largely be limited by the potential for delays in mitigation action when it is not safe to cease pile driving or reduce hammer energy. Aligns with EPBC Act PS 2.1 Procedure A.3.5.	Construction
UWN-M12	Night-time monitoring Effective detection of whales at night will be achieved through a combination of a PAM array and 360 degree scanning thermal infra-red (IR) cameras (or similar) on support vessels ensuring coverage of the precaution zone. Whale detections at night will trigger the mitigation measures outlined in UWN-M09, UWN-M10 and UWN-M11 above.	MMT-I001	The effectiveness of novel detection techniques such as thermal IR cameras will be validated before implementation. Where effectiveness cannot be validated, night-time and low visibility procedures will be applied (UWN-M13). Aligns with EPBC Act PS 2.1 Procedure B.1 and B.5.	Construction
UWN-M13	Night-time and low visibility procedures If three or more whales are detected within the relevant precaution zone (as detailed in the Construction Underwater Noise Framework) on any day, piling activities will be ceased at night-time (as soon as safe to do so) during non-daylight hours, in the event that no effective night time	MMT-I001	This measure sets out a clear trigger to cease night-time operations when effective night-time / low visibility monitoring is not available or validated, and listed threatened whale	Construction

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Measure ID	Mitigation measure and description	Impact / risk pathway ID	Effect	Phase
	detection is available. Piling can recommence in daylight hours the following day, and night operations can continue that night as long as less than three shutdown events are observed within the precaution zone during daylight hours.		species have been detected during the day / good visibility conditions. There may be times where piling is commenced during the day and it is not safe to immediately cease piling at sunset. In this event, piling will cease as soon as safe to do so. Aligns with EPBC Act PS 2.1 Procedure A.3.6.	
UWN-M14	Adaptive management procedure for whales An adaptive management procedure will be implemented if behaviour, occurrence or abundance is different to what has been predicted for the noise management, as detailed in the Construction Underwater Noise Framework. Examples of behavioural triggers include: • Three or more SRW or BW abundance recorded in the precaution zone • Repeated or sustained (>30 minutes) blue whale feeding activity is observed by qualified MFOs within or adjacent to the construction precaution zone for blue whales. • A Southern Right Whale (SRW) mother and calf pair are observed resting by qualified MFOs within or adjacent to the construction precaution zone for SRW Examples of adaptive management include: • Larger precaution zones that can be realistically managed • Long range surveys • Increased observation platforms and/or methods • Increased coverage of MFOs • Additional NAS • Modified NAS	MMT-I001	This measure accounts for the possibility that behaviour, re-occurrence or abundance is different to predicted and enables different or additional mitigation measures to be included. This measure is consistent with advice provided in DCCEEW Guidance - Key environmental factors for offshore windfarm environmental impact assessment under the EPBC Act.	Construction
UWN-M15	Installation of export cable within southern right whale BIA If reasonably practicable, the project will avoid installing the export cable within the SRW reproduction BIA during the months of May to September. If this is not reasonably practicable, and a SRW is detected by the vessel MFO, DP will be powered down to the lowest possible safe setting. DP will not be powered up until at least 30 minutes has elapsed since the most recent sighting of a SRW. This measure is designed to limit noise from operations during periods when southern right whales are utilising the area.	MMT-I001	Avoiding installation during SRW reproductive season or alternatively, powering down if SRW are present during the reproductive season will ensure that the activity will not prevent SRW from utilising the BIA.	Construction

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Measure ID	Mitigation measure and description	Impact / risk pathway ID	Effect	Phase
Additional Mitigations				
VES-M08	Vessel discharge controls Routine discharges No routine discharges within 500 m of the boundaries of State or Australian marine parks, the southern right whale reproduction BIA / HCTS (between May and September), or if a marine mammal or turtle is within 500 metres of the vessel. No routine waste discharges from vessels within State Waters. Accidental Discharges In the event of an accidental discharge from a vessel, the discharge will be reported and monitored, including recording of any marine mammals and turtles that encounter the discharge.	MMT-I002 MMT-R004	Although discharges disperse after entering the water, this mitigation will reduce the likelihood of vessel discharges encountering sensitivities	Construction Operations Decommissioning
VES-M09	Vessel crew environmental induction Provide an environmental induction to all crew member(s) including training for marine mammal observations whilst vessels are in transit	MMT-R001	Increases the knowledge and expertise of all crew onboard, with the aim of increasing the chances of early detection Any incidents of vessel strike will be observed and reported.	Construction Operations Decommissioning
VES-M10	Restricted speed in southern right whale BIA Project vessels working on the transmission cable in the southern right whale Biologically Important Area (BIA) for reproduction will maintain a speed of less than 10 knots) during peak calving months of May to September..	MMT-R001	Reduces the likelihood and consequence of vessel strike to southern right whales transiting slowly in the BIA, and particularly vulnerable female and calf pairs.	Construction Decommissioning
VES-M11	Adaptive management procedure for southern right whales and blue whales Vessels will watch and act for the presence of southern right whales and blue whales during all project phases. If a southern right whale or blue whale is sighted: • increased caution zone to 500 m • reduced vessel speed to 5 knots within the caution zone	MMT-R001	Reduces the likelihood and consequence of vessel strike to southern right whales and blue whales.	Construction Operations
DEC-M01	Marine Decommissioning Management Plan A Marine Decommissioning Management Plan will be developed prior to decommissioning activities commencing to assess the impacts on the final agreed methodologies of removing offshore infrastructure. The plan will include: • Details on marine infrastructure proposed to be removed or left in situ • Assess potential impacts of decommissioning activities for the removal or retention of infrastructure on protected matters	-	Ensures appropriate assessment and management of potential decommissioning impacts.	Decommissioning

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Measure ID	Mitigation measure and description	Impact / risk pathway ID	Effect	Phase
	- Specify how activities associated with decommissioning will be carried out in accordance with the project approval conditions - Describe measures to be implemented to avoid or reduce impacts arising from the removal of infrastructure (if required) - Consider management measures adopted in construction and apply where similar impacts could occur.			

15.3 Monitoring

Monitoring that is proposed to detect impacts associated with the project are summarised in

In addition, the Construction Underwater Noise Framework includes details of how the precaution zones will be determined from future noise modelling and noise verification, and therefore the monitoring of noise in the environment and marine fauna that will be undertaken during construction. The MMTMMP will be developed using the outputs that result from implementing the framework.

Table 15-3. Adaptive management may be required if monitoring identifies changes to environmental noise or marine mammal presence, abundance or behaviour that is different to EIA predictions.

The following monitoring programs were selected due to the uncertainty, particularly regarding the behavioural response of mysticete whales, to construction and operation of an offshore wind farm. The continuation of monitoring will allow for detection of change throughout the construction period and beyond with respect to marine mammal distribution, abundance and behaviour, but will also require consideration of the fact that natural variation and climate change may also play a role in any changes observed.

In addition, the Construction Underwater Noise Framework includes details of how the precaution zones will be determined from future noise modelling and noise verification, and therefore the monitoring of noise in the environment and marine fauna that will be undertaken during construction. The MMTMMP will be developed using the outputs that result from implementing the framework.

Table 15-3: Long term monitoring relevant to marine mammals and turtles

Measure ID	Monitoring	Impact / risk pathway ID	Phase
MEMP-M01	Underwater noise monitoring Implement an in-field noise verification to validate model outputs and confirm that the noise levels/zones of effect correspond appropriately to the precaution zone defined in the pre-construction phase. It enables decisions to be made to reduce or increase precaution zone size based on results and also identifies when additional mitigation measures such as further NAS may be required. Noise level verification will take place on a representative number of pile driving locations (approximately 4-6) based on geoacoustic properties, pile design and water depth. Noise measurements will be in accordance with ISO 18406:2017 Underwater acoustics — Measurement of radiated underwater sound from percussive pile driving. This standard outlines the methodologies, procedures and measurement systems for assessing radiated underwater noise generated during percussive pile driving. This standard will be used to develop a detailed in-field measurement survey design including hydrophone placement, distance from the source for near and far field measurements, hydrophone validation, sampling rate, data processing and metrics.	MMT-I001	Construction
MEMP-M02	Marine mammal and turtle monitoring – maintenance Monitoring the presence of marine mammals and turtles during WTG inspection and maintenance activities. Recording details on the date, time, location, species, direction of travel and behaviour of marine mammals observed within the OPA from project vessels or infrastructure.	MMT-I005 MMT-I007	Operations
MEMP-M04	Marine mammal and turtle monitoring – operations Monitoring of noise emissions to validate operational noise of WTGs	MMT-I001	Operations
MEMP-M10	Marine mammal monitoring – construction and decommissioning Monitoring of marine mammal distribution, abundance and behaviour within relevant precaution zones and underwater noise verification as part of mitigation trigger observations	MMT-I001	Construction and Decommissioning

during the construction and decommissioning programs to provide ongoing estimates of marine mammal and turtle presence in the offshore wind farm area and surrounds.

This data can also be combined with data becoming available from other offshore wind developer baseline programs, state-run programs such as visual aerial surveys for SRW, citizen science reporting, studies undertaken by the oil and gas industry and other research programs such as NESP, RERI and university and other research institutions to characterise the marine fauna distribution and abundance in the Gippsland Region using a similar multiple lines of evidence approach as was used for the marine environmental baseline surveys, and to verify that the assessment criteria and environmental outcomes have been met.

16 CONCLUSION

16.1 Overview

This report was prepared to address the requirements of the EIS and EES. Future management plans and a MMTMMP will link EPBC and EE Act assessments through to delivering requirements under the *Offshore Electricity Infrastructure Act 2021* (OEI Act). To assess the acceptability of predicted impacts and risks of the project, refine the design, and identify further mitigation and/or management measures that may be needed, those predicted impacts and risks were compared against pre-defined assessment criteria Section 0

The impact and risk assessment completed for the Star of the South Offshore Wind Farm found that the project, inclusive of the implemented mitigations, is unlikely to have an unacceptable level of impact on marine mammals and turtles, including Commonwealth (EPBC Act) and State (FFG Act) listed threatened species and Commonwealth listed migratory species, nor the Commonwealth marine environment in which they occur.

Threatened species

Considering the significant impact criteria for threatened species, the project is not predicted to:

- Lead to a long-term decrease in the size of a population
- Reduce the area of occupancy of a species
- Fragment an existing population into two or more populations
- Adversely affect habitat critical to the survival of a species
- Disrupt the breeding cycle of a population, modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat
- Introduce disease that may cause the species to decline
- Interfere with the recovery of the species (Commonwealth of Australia 2013).

Migratory species

Considering the significant impact criteria for migratory species, the project is not predicted to:

- Substantially modify, destroy or isolate an area of important habitat for a migratory species
- Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species
- Seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species (Commonwealth of Australia 2013).

Commonwealth marine environment

Considering the significant impact criteria for the Commonwealth marine environment, the project is not expected to:

- Result in a known or potential pest species becoming established in the Commonwealth marine area
- Modify, destroy, fragment, isolate or disturb an important or substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area results
- Have a substantial adverse effect on a population of a marine species or cetacean including its life cycle (for example, breeding, feeding, migration behaviour, life expectancy) and spatial distribution
- Result in a substantial change in air quality or water quality (including temperature) which may adversely impact on biodiversity, ecological integrity, social amenity or human health

- Result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, social amenity or human health may be adversely affected
- Have a substantial adverse impact on heritage values of the Commonwealth marine area, including damage or destruction of an historic shipwreck.

16.2 Impact assessment findings

An assessment of potential impacts associated with the project, considering the existing environment within the study area and associated construction, operation and decommissioning activities identified the following key point:

- Underwater noise emissions have the potential to cause auditory impairment and behavioural to marine mammals and turtles, and communication masking in marine mammals. If significant, this could lead to disruption in feeding, migrating or reproductive behaviours.
 - The species groups most likely to be affected by underwater noise emissions are low frequency baleen whales, due to the noise generated by offshore wind farm activities overlapping with the spectral range of hearing and vocalisations in these species. Of particular concern are blue whales and southern right whales, which have biologically important areas that the noise footprint of the activity overlaps and are threatened species protected by recovery plans that are legislative instruments under the EPBC Act.
 - Underwater noise emissions were determined to be highest during the construction and decommissioning phases when large construction vessels will be used to complete works during 24-hour operations in the OWFA over a period of years. Underwater noise emissions during operations is likely to be limited to low-level turbine noise and noise from maintenance vessels which are of a much smaller scale and duration compared to the construction period and similar to vessel activity from current oil and gas operations in the Gippsland region.
 - A suite of mitigation measures during construction and decommissioning, including optimisation of piling procedures such as hammer energy used, pile diameter and length, soft starts, use of noise abatement systems, noise modelling verification, visual and acoustic whale detection methods that trigger power downs or shutdowns to prevent hearing impairment or behavioural disturbance, additional vigilance in relation to whale detection in the coastal breeding area for the southern right whale, and adaptive management procedures in the event that real world events are different to the assumptions or parameters that have informed the EIA.
 - Implementation of these measures will ensure that anthropogenic noise in biologically important areas for southern right whales and blue whales will be managed so that any blue whale continues to use the area without injury and is not displaced, that southern right whales are not prevented from using the area or subject to auditory impairment, and that effects on other species of low frequency whales, other cetaceans, pinnipeds and turtles will be limited to short term behavioural disturbance to individuals only and will not have population level impacts for any species.
 - There is also the potential for underwater noise to affect prey species for marine mammals and turtles. This is expected to only occur during the construction and decommissioning phases, as the noise generated during operations will be of a lesser extent, severity and duration. During construction and decommissioning, the effects will be localised around the area of vessels and likely to result in prey moving away from the project area. Since mitigations will be implemented when marine mammals and turtles are sighted, it is not anticipated that there will be impacts from indirect effects on prey.
 - All measures will be included in the Commercial Licence Management Plan (CLMP), or sub-plans, as part of the OEI Act management plan requirements.
- The physical presence of turbines during the operations phase of the OWF was determined to have the potential to attract some species of marine fauna and their prey, create barriers to migration or breeding events or result in displacement of marine fauna due to the change to the habitat.
 - Considering the scale of the WTGs and proposed distance between them (minimum of approximately one km) it was determined to be unlikely that they would cause barriers to migration or displacement to marine mammals and turtles. However, evidence for this is not well documented in the literature and monitoring during the project will verify these predictions.

- However, marine fauna may be attracted to OWF infrastructure, as evidenced by attraction to oil and gas facilities in Gippsland particularly for pinnipeds that haul out on them, but also for other species as a result of the attraction of prey species. It is not expected that these effects will have significant negative effects on populations of marine fauna, in fact, effects may be positive, and monitoring during the project will verify these predictions.
- Electromagnetic interference will be generated from the installation and operation of inter-array cables to carry electrical current produced from WTGs to OSS, and export cables and inter-link cables, however it is thought unlikely that marine mammals and turtles have a low likelihood of being affected by the interference generated by the cable.
 - Due to their high mobility and location generally higher in the water column it is thought unlikely that marine mammals and turtles would encounter the electromagnetic interference, as they would have to be within a few metres of it to detect it. However, there is some evidence to suggest that some dolphins and prey species can detect this interference, and monitoring during the operations phase of the project will verify these predictions, particularly for benthic feeders.

The impact assessment identified a number of pathways that are likely to have limited impacts to marine mammals and turtles. These include:

- Routine discharges from vessel activities during construction, operations and decommissioning have the potential to cause a decline in the water quality in the immediate vicinity of the discharge and cause temporary toxicity to marine fauna that encounter the discharge.
 - Routine discharges may have very localised and short-term effects on marine fauna, or on the benthic and fish fauna that may be prey of marine mammals and turtles or components of their trophic systems.
 - Standard industry vessel management practices will apply to vessel routine discharges, with an additional mitigation included that discharges will not occur within 500 m of marine fauna or sensitive areas (SRW reproductive area or marine parks). Therefore, the consequence of these discharges for marine mammals and turtles is negligible at an individual and population level
- Seabed disturbance and sediment plumes generated by activities such as seabed preparation and cable installation during construction have the potential to cause small scale disturbance and suspension of sediments resulting in temporary disturbance and displacement to marine mammals and turtles and their prey.
 - Modelling of sediment dispersal due to trenching for the construction of both the export cable and inter-array cable showed suspended sediment concentrations were generally highest near the seabed, closest to the source of disturbance. Due to the low level of initial suspended sediment concentrations resulting from the export cable and inter-array cable trenching, plumes dissipated below the reporting thresholds within hours resulting in a low overall potential for impact to marine mammals and turtles.
 - Seabed disturbance was therefore determined to have potentially only short-term effects to individuals of benthic foraging species such as dolphins, Australian fur seals and marine turtles, and no population level consequences.
- Artificial light will be present in the OWFA from construction, maintenance and decommissioning vessels and from turbines during operations, and although light can disturb marine fauna, it is not thought to affect marine mammals and there are no nesting beaches for marine turtles, which is the most vulnerable stage of the life cycle, near the OWFA.
 - Artificial light may also attract prey species, that may in turn attract marine mammals and turtles, however this is unlikely to have a negative effect on populations, and like aggregation described above, may result in positive population effects.

16.3 Risk assessment findings

An assessment of potential risks associated with the project, considering the existing environment within the study area and associated construction, operation and decommissioning activities identified the following key point:

- Vessel strike leading to injury or mortality of marine mammals and turtles is a key project risk, particularly where it concerns threatened species with low population numbers.
 - To avoid vessel strike risk legislative requirements in relation to approach zones and vessel speeds for marine mammals will be adhered to (Commonwealth EPBC Regulations 2000 Part 8, Victorian State Wildlife (Marine Mammal) Regulations 2019, Australian National Guidelines for Whale and Dolphin Watching) with additional restrictions on vessel speeds restrictions during April to October whilst transiting through the southern right whale reproduction BIA to reduce risks to a level that meets the acceptance criteria.

The risk assessment identified accidental discharges or debris escape as other low likelihood risks to marine mammals and turtles from the project:

- Accidental hydrocarbon release is an extremely rare occurrence but could have potentially serious consequences at population levels depending on the magnitude of the event
- Accidental vessel discharges being similarly rare but more likely to be limited in extent and therefore more likely to affect marine mammals at an individual rather than population level
- Debris escape leading to entanglement or ingestion also being an unlikely occurrence and more likely to affect marine mammals and turtles at an individual rather than population level

With the implementation of appropriate vessel management plans and procedures to manage simultaneous operations to prevent vessel collisions, oil pollution response plans in the event of a major spill event and vessel accident prevention procedures to avoid unplanned discharges or equipment loss, potential impacts to marine mammals and turtles to the extent that populations are significantly affected from these events are extremely unlikely.

16.4 Marine mammals and turtles monitoring and management plan

A Construction Underwater Noise Management Framework has been developed, and the outputs of the implementation of this framework will inform the development of the Marine Mammals and Turtles Monitoring and Management Plan (MMTMMP) prior to construction. This plan will include key monitoring, management and mitigation measures that will ensure there will be no significant impacts to marine mammals and turtles and that the offshore wind farm will not interfere with the recovery of any threatened species. The MMTMMP will be designed to provide evidence that the project mitigations are effective and to verify that impact predictions made in the EIA are accurate. A range of design features, mitigation and management measures have been developed to prevent or reduce potential impacts and risks to marine mammals and turtles. Importantly, the Construction Underwater Noise Management Framework adopts an approach recognising that offshore wind farm construction, mitigation and monitoring technologies are in a rapid innovation phase and so includes flexibility to ensure that the best available technology at the time of construction and operation that also meets the objectives of the wind farm program will be used.

Monitoring results will be used to inform adaptive management responses and additional mitigation measures if it is demonstrated that proposed mitigation measures are not as effective as predicted, so that management can be updated to ensure that project Environmental Outcomes will be met.

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