Attachment IV

Matters of National Environmental Significance

Viva Energy Gas Terminal Project

Prepared for
Viva Energy Gas Australia Pty Ltd
ABN: 645 450 059

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Viva Energy Gas Terminal Project Environment Effects Statement

25-Feb-2022
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Client: Viva Energy Gas Australia Pty Ltd

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Abbreviations

Term	Definition
°C	Degrees Celsius
µg/L	Micrograms per litre
CAMBA	China-Australia Migratory Bird Agreement
CPS	Components, processes and services
CSM	Convention on Conservation of Migratory Species of Wild Animals (Bonn Convention)
dB	Decibel
ECD	Ecological character description
EES	Environment Effects Statement
EVC	Ecological vegetation class
FSRU	Floating storage and regasification unit
HDD	Horizontal directional drilling
IUCN	International Union for Conservation of Nature
JAMBA	Japan-Australian Migratory Bird Agreement
KBA	Key Biodiversity Area
km	Kilometres
LAC	Limits of Acceptable Change
LNG	Liquified natural gas
m	Metres
m^3	Cubic metres
mg/L	Milligrams per litre
MHF	Major hazard facility
MNES	Matters of National Environmental Significance
NGZ	No go zone
NTGVVP	Natural Temperate Grassland of the Victorian Volcanic Plain
PJ	petajoule
PMST	Protected Matters Search Tool
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
STCS	Subtropical and Temperate Coastal Saltmarsh
SWP	South West Pipeline
VBA	Victorian Biodiversity Atlas
VTS	Victorian Transmission System

1.0 Introduction

This attachment to the Viva Energy Gas Terminal Project (the project) Environment Effects Statement (EES) presents the findings of the investigations and impact assessments undertaken into Matters of National Environmental Significance (MNES) for the project.

1.1 Purpose of the attachment

This attachment summarises the assessments of MNES undertaken as part of the following technical studies prepared for the project:

- Technical Report A: *Marine ecology and water quality impact assessment*
- Technical Report D: *Terrestrial ecology impact assessment*
- Technical Report E: *Surface water impact assessment*
- Technical Report F: *Groundwater impact assessment*

More detail on the matters discussed in this attachment can be found in these reports and in the relevant chapters of the EES.

1.1.1 Matters of National Environmental Significance

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides the legal framework to protect and manage designated MNES. There are nine MNES protected under the EPBC Act:

- World heritage properties
- National heritage places
- Wetlands of international importance (listed under the Ramsar Convention)
- Listed threatened species and ecological communities
- Migratory species protected under international agreements
- Commonwealth marine areas
- The Great Barrier Reef Marine Park
- Nuclear actions (including uranium mines)
- A water resource, in relation to coal seam gas development and large coal mining development.

Under the EPBC Act, if the Commonwealth Minister for the Environment decides that a project could potentially have a significant impact on a MNES, the project becomes a ‘controlled action’ that must be assessed and approved by the Minister before it can proceed. The matters which the project may have a significant impact on are known as the controlling provisions.

On 21 January 2021, the delegate for the Commonwealth Minister for the Environment determined the project to be a controlled action. The relevant controlling provisions for the project include:

- The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site (a wetland of international importance) (sections 16 & 17B of the EPBC Act)
- Listed threatened species and communities (sections 18 & 18A of the EPBC Act)
- Listed migratory species (sections 20 & 20A of the EPBC Act).

The EES process is the accredited environmental assessment process for the controlled action decision under the EPBC Act in accordance with the bilateral agreement between the Commonwealth and Victorian governments.

1.1.1.1 Ramsar wetlands

A Ramsar wetland is a wetland that has been designated under Article 2 of the Ramsar Convention, or which has been declared by the Federal Environment Minister to be a Ramsar wetland under the EPBC Act.

The Ramsar Convention encourages the designation of sites containing representative, rare or unique wetlands, or wetlands that are important for conserving biological diversity. Once designated, these sites are added to the Convention's List of Wetlands of International Importance and become known as Ramsar sites.

In designating a wetland as a Ramsar site, countries agree to establish and oversee a management framework aimed at conserving the wetland and ensuring its wise use. Wise use under the Convention is broadly defined as maintaining the ecological character of a wetland.

1.1.1.2 Listed threatened species and communities

The EPBC Act provides for the listing of nationally threatened native species and ecological communities, native migratory species and marine species. Threatened species refers to those species that are considered 'threatened, including species that are listed as 'vulnerable', 'endangered' or 'critically endangered' under the EPBC Act.

The EPBC Act protects Australia's native species and ecological communities by providing for:

- Identification and listing of species and ecological communities as threatened
- Development of conservation advice and recovery plans for listed species and ecological communities
- Development of a register of critical habitat
- Recognition of key threatening processes
- Where appropriate, reducing the impacts of these processes through threat abatement plans.

1.1.1.3 Listed migratory species

Migratory species are those animals that migrate to Australia and its external territories or pass though or over Australian waters during their annual migrations. These are species that are subject to the following international agreements relating to migratory species conservation to which Australia is a signatory:

- Bilateral agreements:
    - Japan-Australian Migratory Bird Agreement (JAMBA)
    - China-Australia Migratory Bird Agreement (CAMBA)
    - Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA)
- Convention on Conservation of Migratory Species of Wild Animals (also known as the CMS or the Bonn Convention).

1.1.2 Responding to the controlled action

In response to the controlled action decision under the EPBC Act, this attachment has been prepared to summarise the findings of the EES assessment with respect to the three controlling provisions discussed above (Ramsar wetlands, listed threatened species and listed migratory species).

In order to provide necessary commentary on the likelihood of significant impacts specific to MNES identified in the determination under the EPBC Act, this attachment provides an assessment of the potential mechanisms through which impact on those MNES as a result of the project could be realised. Potential mechanisms of impact on MNES considered in this assessment include:

- Marine water quality changes
- Entrainment of marine organisms
- Habitat removal

- Noise and lighting
- Additional shipping movements
- Construction of the pipeline impacting waterways or groundwater.

The assessment concluded that construction, operation and decommissioning of the project would not present a substantial change to the existing industrialised environment of Corio Bay and the proposed pipeline corridor, and significant impacts on MNES are unlikely to occur.

1.2 Project overview

Viva Energy is planning to develop a floating gas terminal using a ship known as a floating storage and regasification unit (FSRU) which would be continuously moored at Refinery Pier in Corio Bay, Geelong. The key objective of the project is to facilitate supply of a new source of gas for the south-east Australian gas market where there is a projected supply shortfall in coming years.

The gas terminal would be located adjacent to Viva Energy's Geelong Refinery, which has been operating since 1954. Refinery Pier is the primary location within the Port of Geelong for movement of bulk liquids. Vessels up to 265 metres in length currently utilise the four berths at Refinery Pier which service Viva Energy refinery operations. The majority of ship visits to the port are to Refinery Pier, with Viva Energy accounting for over half of the trade through the Port of Geelong.

The FSRU would store liquefied natural gas (LNG) received from visiting LNG carriers and regasify the LNG as required to meet residential, industrial, and commercial customer demand.

The FSRU would be up to 300 metres (m) in length, 50 m in breadth and 65 m in height, with the capacity to store approximately 170,000 cubic metres (m^3) of LNG. LNG would be received from visiting LNG carriers that would moor directly adjacent to the FSRU for approximately 36 hours. The FSRU would store the LNG in cryogenic storage tanks at a temperature of about 160 degrees Celsius below zero (-160°C).

The FSRU would receive up to 160 petajoules (PJ) per annum (transported via approximately 45 LNG carriers) depending on demand. The number of LNG carriers would also depend on their storage capacity, which could vary from 125,000 to 180,000 m^3 of LNG.

When required, the FSRU would convert the LNG back into a gaseous state by heating the LNG using seawater (a process known as regasification). The gas would then be transferred through the 3-kilometre (km) aboveground pipeline from the FSRU to the treatment facility where odorant and nitrogen would be added, where required, to meet Victorian Transmission System (VTS) gas quality specifications. Nitrogen injection would occur when any given gas cargo needs to be diluted to meet local specifications. Odorant (mercaptan) is added as a safety requirement so that the normally odourless gas can be smelt when in use. From the treatment facility, the 4 km underground section of the pipeline would transfer the natural gas to the tie-in point to the South West Pipeline (SWP) at Lara.

The project would leverage Viva Energy's experience as a major hazard facility (MHF) operator and provide opportunity for potential synergies between the refinery and the project, such as the reuse of FSRU seawater discharge within the refinery operations. Co-locating the project with the existing Geelong Refinery and within the Port of Geelong offers significant opportunity to minimise potential environmental effects and utilise a number of attributes that come with the port and industrial setting.

For over 60 years, Viva Energy's Geelong Refinery has been using approximately 350 megalitres (ML) per day of seawater from Corio Bay for cooling purposes. This seawater is then discharged to Corio Bay at temperatures warmer than the ambient seawater temperature and with residual levels of chlorine, associated with biofouling control, through four licenced discharge outlets. The project would also require the use of 350ML of seawater per day to regasify LNG (at peak operation).

This provides a beneficial synergy between the project and the adjacent refinery involving the reuse of seawater. Seawater discharges would continue through the licenced discharge outlets at the same rate and the same residual chlorine concentrations as the existing refinery operations, and the temperature differential of the discharged seawater from ambient conditions would be less.

The FSRU is anticipated to operate for approximately 20 years. An overview of the project is shown in Figure 1-1.

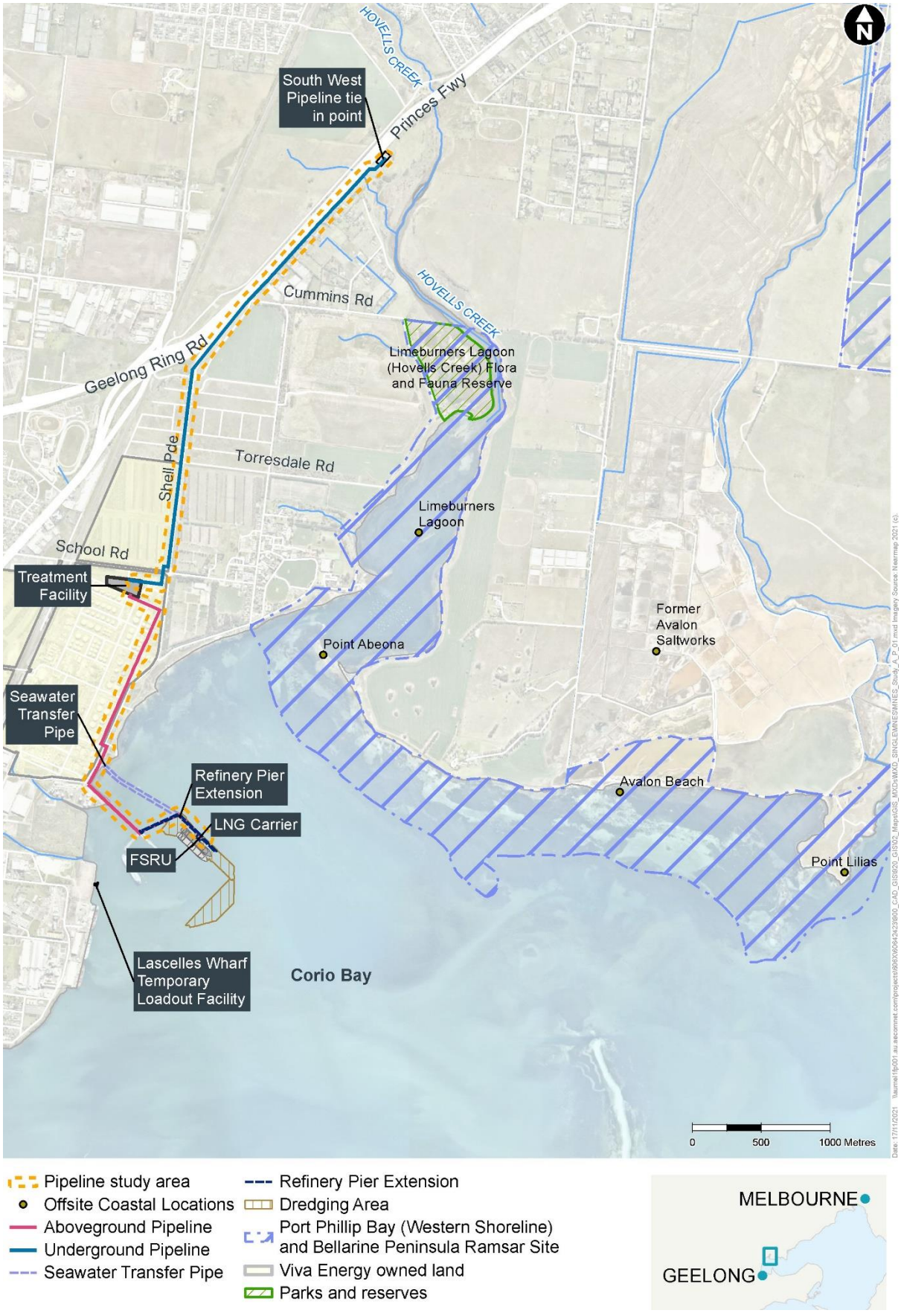


Figure 1-1 Project overview

1.3 Assessment overview

An assessment of the existing conditions in the study area to inform the environmental impact assessment for the works was undertaken for each controlling provision:

- Ramsar wetlands (Section 2)
- Threatened species and ecological communities (Section 3)
- Migratory species (Section 4).

To understand the potential for the presence of MNES, the existing conditions assessment incorporated:

- A desktop assessment and synthesis of government-curated biodiversity datasets including the Protected Matters Search Tool (PMST) and the Victorian Biodiversity Atlas (VBA)
- Field investigations, including current, temperature and water quality monitoring in Corio Bay, plankton and larvae surveys in Corio Bay, habitat assessments and targeted surveys for threatened and migratory species.

An impact assessment was undertaken for each of the three controlling provisions in accordance with the methodology described in Chapter 7: *Assessment framework* and responding to the significant impact criteria in *Matters of National Environmental Significance Significant impact guidelines 1.1 - Environment Protection and Biodiversity Conservation Act 1999* (DoE, 2013) ('Significant impact guidelines') and/or species-specific guidelines. This is discussed in Section 5 of this attachment.

Detailed descriptions of the assessment methodologies used are provided in Technical Report A: *Marine ecology and water quality impact assessment* and Technical Report D: *Terrestrial ecology impact assessment*.

1.3.1 Marine assessment

The marine assessment undertaken for the EES considered the environmental context of Corio Bay. This included assessing the bathymetry (depth of water), monitoring currents and water quality, plankton and larvae surveys over 12 months and surveys of seabed habitat.

These investigations informed the development, calibration and verification of hydrodynamic and water quality modelling for Corio Bay as the basis of the impact assessment. These models were developed to simulate:

- Existing currents, temperatures and salinities in Corio Bay, including response to tides, meteorological conditions, Hovells Creek inflow and existing refinery intake and discharges
- Dilution in the temperature and chlorine plumes created by the various discharges
- Fate and transport of the proposed refinery and FSRU discharges (open loop, closed loop and ballast water) including heated, cooled and chlorinated discharges
- Fate and transport of fine sediments (clay and silt) likely to be mobilised during dredging and dredge material disposal
- Potential transport, dispersion and entrainment of plankton and larvae from different regions in the bay.

The modelling predictions benefited from the observed data collected during field surveys of the marine environment beneath the existing discharge plumes from the Geelong Refinery. The discharges into Corio Bay have been occurring for more than 60 years, with elevated temperature and residual chlorine associated with biofouling control. Accordingly, the results of the impact assessment (of the future discharges on the marine environment with the project) are supported by empirical evidence from the baseline conditions under the existing discharges.

1.3.2 Terrestrial assessment

A detailed existing ecological conditions assessment of the terrestrial environment was undertaken within a 50 m buffer of the proposed pipeline route between Lara City Gate and Refinery Pier, Corio, Geelong. Some additional areas were also assessed which extended beyond this buffer including the

Corio Native Grassland Reserve and an area referred to as ‘the paddocks’ along the western side of the pipeline adjacent to the north of the refinery. Collectively, these assessments are referred to as within the ‘pipeline study area’.

A contextual study was also undertaken to identify ‘offsite’ MNES for consideration in relation to potential impacts via the marine environment. This included targeted surveys for migratory shorebirds which use intertidal habitats and the Ramsar site.

Field assessments informed a threatened species preferred habitat assessment for those species with previous records within 5 kilometres of the study area to determine the likelihood of the pipeline study area to support threatened terrestrial flora and fauna species. Habitat requirements were compared to existing conditions of the study area and a precautionary approach taken to their likelihood of occurrence.

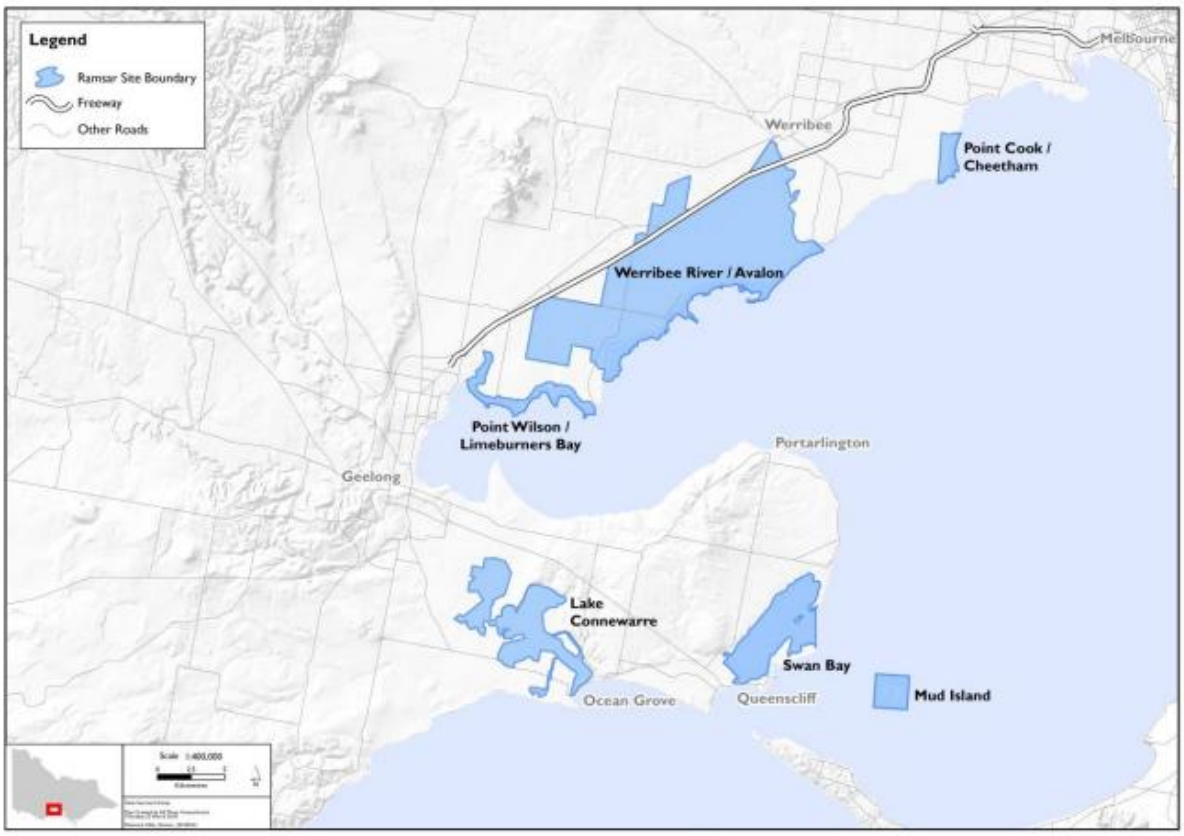
2.0 Ramsar wetlands

There is one Ramsar wetland in the ‘offsite’ study area – the Port Phillip Bay Western Shoreline and Bellarine Peninsula Ramsar site. The Point Wilson/Limeburners Bay section of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site is located along the northern shoreline of Corio Bay; the southern boundary following the 2 m depth contour within the bay.

At its closest, the pipeline study area is approximately 700 m to the west of the Ramsar site at the northern end near the refinery. The Ramsar site is approximately one kilometre to the north-east of the Refinery Pier extension where the FSRU would be moored. In addition, the northernmost end of the pipeline alignment traverses Hovells Creek Reserve approximately 300 m west of Hovells Creek. Hovells Creek drains into Limeburners Lagoon, a part of Limeburners Bay.

2.1 Overview of Ramsar site

Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site covers 22,650 hectares and is comprised of six distinct areas: Point Cook/Cheetham, Werribee River/Avalon, Point Wilson/Limeburners Bay, Lake Connewarre, Swan Bay and Mud Island (Figure 2-1). The Ramsar site consists of parts of the shoreline, intertidal zones, adjacent wetlands and the Western Treatment Plant wastewater treatment facility.



Source: extract of Figure 2 from DELWP 2018

Figure 2-1 Map of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site

The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site was nominated for Ramsar listing in 1982 on the basis of four of the eight wetland criteria at the time. An assessment against the current criteria indicates that the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site would have met six of the nine criteria at the time of listing and continues to do so (DELWP, 2020). Further discussion on the wetland criteria is provided in Section 2.2.

Of specific interest to the project is the Point Wilson/Limeburners Bay area of the Ramsar site.

2.1.1 Limeburners Bay / Limeburners Lagoon (Hovells Creek) Flora and Fauna Reserve

As part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site, Limeburners Bay is recognised as a wetland of international importance and also has a state significance rating. The area is known broadly as Limeburners Bay State Nature Reserve and comprises Limeburners Bay, Port Phillip Bay Coastal Reserve, and Limeburners Lagoon (Hovells Creek) Flora and Fauna Reserve. Hovells Creek Reserve occurs further upstream between Cummins Road and the Princes Highway.

Limeburners Bay is located on the northern shore of Corio Bay and is managed by Parks Victoria in partnership with the City of Greater Geelong.

Limeburners Bay is the best-preserved estuary system in Port Phillip Bay and an excellent example of a funnel-shaped, compound estuary (DSE, 2003). Limeburners Bay is a broad, sandy estuarine inlet which is characterised by open, shallow water at the mouth of Hovells Creek. Hovells Creek is mapped as being a high potential Groundwater Dependent Ecosystem (GDE), The shorelines and sandy spits of Limeburners Bay are important feeding and roosting habitat for birds.

The entrance of the estuary at Point Abeona is the deepest point in Limeburners Bay at over 6 m in the throat of the flood tide channel which shallows rapidly to 2-3 m opposite the boat launching area. The upper basin north of the spit averages one metre in depth and a broad area of sand and mud is exposed around its margins at low tide.

Limeburners Bay is a valuable fish breeding ground for many of the commercial fish species in Port Phillip (DSE, 2003). Large beds of seagrass are supported by the shallow waters of the inlet. Seagrass meadows and mangroves provide habitat for adult fish, nursery areas of juvenile fish and are an important component of the food chain, particularly for international migratory shorebirds. Seagrasses and mangroves also stabilise sediments and contribute to the transfer of nutrients and energy. Seagrass beds are an important component of the ecological character of the Ramsar site.

Extensive seagrass meadows are mapped in the area (Figure 2-2). Four species of seagrass are found in Corio Bay: *Zostera muelle*ri, Zostera *nigricaulis*, *Zostera tasmanica* and *Halophila australis. Zostera nigricaulis* is typically found in subtidal areas whereas *Zostera muelleri* is typically found in the intertidal zone and survives a period of exposure to the air. *Halophila* is generally found at lower depths and is typically sparse. The fourth species Zostera *tasmanica* grows sparsely in deeper water in patches, and there is very little deep water within the Ramsar boundary.

The most extensive seagrass in the Ramsar site, *Zostera nigricaulis,* grows to approximately 3.5 m water depth. Growth of this species is seasonal, with strongest growth in spring and relatively dormancy over winter. Consequently, it is susceptible to light reduction in spring and can tolerate substantial reduction in light over winter (Bulthuis, 1983).

Benthic (sea floor) habitats in Corio Bay range from muddy to sandy substrates which support infauna (burrowing invertebrates) assemblages, and the sea surface and water column are foraging habitats for seabirds and marine mammals. There is a small area of reef on the northern shore of Corio Bay by Point Lillias.

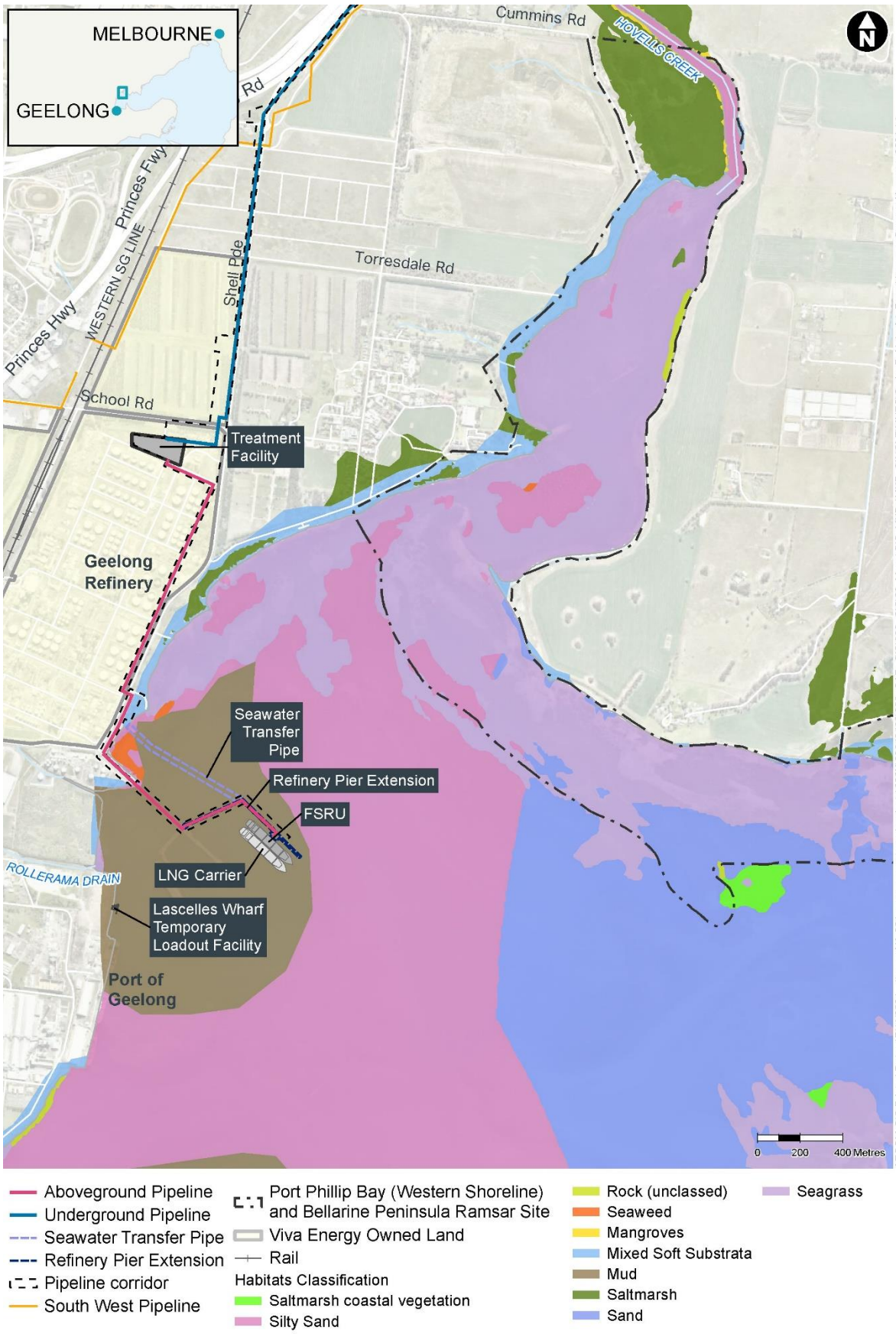


Figure 2-2 Habitats of Corio Bay – Limeburners Bay

The stand of White Mangrove *Avicennia marina* subsp. *australasica* on Hovells Creek (Plate 4) is the most extensive remaining in Port Phillip and the Coastal Saltmarsh (EVC 9) of the Limeburners Bay (Hovells Creek) Flora and Fauna Reserve (Plate 2) is probably the most intact (DSE, 2003).

Unlike most Victorian coastal saltmarshes, there is no broad zone dominated by Beaded samphire *Sarcocornia quinqueflora* and the zone of Shrubby Samphire *Tecticornia halocnemoides* (formerly *Halosarcia halocnemoides*) is broader than elsewhere in Victoria. An assemblage of halopyhytes established where silt deposits raise the level of the marsh forms a low type of saltmarsh that had not been noted elsewhere in Victoria at the time (DSE, 2003). Coastal saltmarsh within the reserve (Plate 5) is vulnerable in Victoria and also represents the EPBC Act listed threatened ecological community - Subtropical and Temperate Coastal Saltmarsh (Section 3.4.2).

The bay is home to more than 40 bird species. Migratory shorebirds include Common Greenshank *Tringa nebularia*, Red-necked Stint *Calidris ruficollis*, Sharp-tailed Sandpiper *Calidris acuminata*, Curlew Sandpiper *Calidris ferruginea* and Red Knot *Calidris canutus*. The terrestrial habitats also support a range of wildlife including Whistling Kite *Haliastur sphenurus* (Marine) and White-bellied Sea-eagle *Haliaeetus leucogaster* (Marine and FFG Act listed).

Although not recognised as a winter stronghold for Orange-bellied Parrot *Neophema chrysogaster* (critically endangered under the EPBC Act), the reserve supports suitable habitat for the species and may be used for foraging while on the mainland or may facilitate movement along the coast to their winter stronghold at the Western Treatment Plant, Werribee.

Plate 1 Limeburners Lagoon (February 2021)

Plate 2 Limeburners Bay (Hovells Creek) Flora and Fauna Reserve (February 2021)

Plate 3 Extensive mudflat and seagrass beds exposed in Limeburners Bay at low tide (February 2021)

Plate 4 Mangrove on Hovells Creek (February 2021)

Plate 5 Boardwalk through Coastal Saltmarsh in the Limeburners Bay (Hovells Creek) Flora and Fauna Reserve (February 2021)

Plate 6 Limeburners Bay with Black Swan, Australian Pelican, Royal Spoonbill and Pied Oystercatcher (February 2021)

2.1.2 Avalon Beach (foreshore and saltworks)

The Port Phillip Bay Coastal Reserve extends around the coast past Avalon Beach to Point Lillias in the east, some 5 km east of the project. Avalon Beach is located within the Avalon Coastal Reserve which is part of the Port Phillip Bay Coastal Reserve, Werribee-Avalon Key Biodiversity Area (KBA) nature hotspot identified by BirdLife Australia, and the Port Phillip Bay (Western Shoreline) and Bellarine Ramsar site.

Avalon Coastal Reserve extends along the northern shore of Corio Bay and incorporates the former Avalon saltworks at Avalon Beach, Point Lillias, Point Wilson and the lagoons of the Western Treatment Plant at Werribee. Avalon Coastal Reserve is also known as 'Avalon Wetland' by City of Greater Geelong and 'Avalon Coast Day Visitor Area (Avalon Coastal Reserve)' by Parks Victoria.

The marine environment of Corio Bay links the project area to the environs of the Avalon Coastal Reserve. The foreshore of Avalon Beach includes a boat ramp, a row of dwellings and an extension of Avalon Foreshore Road which is a walking track on top of a bund between Port Phillip Bay and the lagoons of the former Avalon Saltworks (Plate 7).

The habitat that is provided by this area of the Ramsar site comprises the coastal reserve (beach) and shallow pond system of the old saltworks site, which provides an important foraging habitat for migratory shorebirds, including Curlew Sandpiper, Sharp-tailed Sandpiper, Red-necked Stint *Calidris ruficollis* and Red Knot.

Plate 7 **Walking track along Avalon Foreshore Road reserve with Port Phillip Bay on right and lagoon of the former Avalon Saltworks on left (February 2021)**

2.2 Significance and listing

A Ramsar wetland is a wetland that has been designated under Article 2 of the Ramsar Convention, or which has been declared by the Federal Environment Minister to be a declared Ramsar wetland under the EPBC Act. The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula was listed as a Ramsar site in December 1982 (RS266) and is Australian Ramsar site number 18.

According to DELWP (2020), an assessment against the nine Ramsar listing criteria indicates that the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula meets six criteria: 2, 3, 4, 5, 6 and 8 (Table 1).

Table 1 Ramsar criteria met by Port Phillip Bay (Western Shoreline) and Bellarine Peninsula

Criteria	Justification (from DELWP 2020)
Criterion 2 - Supports vulnerable, endangered, or critically endangered species or threatened ecological communities	The site regularly supports one wetland dependent threatened ecological community and 13 threatened fauna species listed under the EPBC Act and or International Union for Conservation of Nature (IUCN) Red List 2012: • Subtropical and Temperature Coastal Saltmarsh – vulnerable ecological community (EPBC Act) • Australasian Bittern (*Botaurus poiciloptilus*) – endangered (EPBC Act and IUCN) • Australian Fairy Tern (*Sternula nereis nereis*) – vulnerable (EPBC Act) • Bar-tailed Godwit (*Limosa lapponica baueri*) – vulnerable (EPBC Act) and near threatened (IUCN) • Curlew Sandpiper (*Calidris ferruginea*) – critically endangered (EPBC Act)

Criteria	Justification (from DELWP 2020)
	• Eastern Curlew (*Numenius madagascariensis*) – critically endangered (EPBC Act) and endangered (IUCN) • Great Knot (*Calidris tenuirostris*) – critically endangered (EPBC Act) and endangered (IUCN) • Greater Sand Plover (*Charadrius leschenaultia*) – vulnerable (EPBC Act) • Hooded Plover (*Thinornis rubricollis rubricollis*) – vulnerable (EPBC Act and IUCN) • Lesser Sand Plover (*Charadrius mongolus*) – endangered (EPBC Act) • Red Knot (*Calidris canutus*) – endangered (EPBC Act) • Orange-bellied Parrot (*Neophema chrysogaster*) – critically endangered (EPBC Act and IUCN) • Australian Grayling (*Prototroctes maraena*) – vulnerable (EPBC Act) • Growling Grass Frog (*Litoria raniformis*) – vulnerable (EPBC Act)
Criterion 3 - supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region	The Ramsar site supports a high diversity of waterbirds, most likely relate to the diversity of habitats provided by the site. A total of 130 species of waterbird have been recorded within the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site; the site represents the most species rich Ramsar site in the South East Coast (Victoria) Drainage Division when compared with other large marine and coastal wetland systems in the bioregion.
Criterion 4 - Supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions	Port Phillip Bay (Western Shoreline) and Bellarine Peninsula supports large numbers of migratory waterbirds, breeding of waterbirds and frogs, nursery grounds for fish and supports waterfowl during moulting of their primary flight feathers. The permanent freshwaters of Reedy Lake and the Western Treatment Plan provide valuable habitat for waterfowl and other species when most inland, freshwater wetlands in southern Victoria are dry.
Criterion 5 - Regularly supports 20,000 or more waterbirds	Waterbird counts across the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site are very high (mostly due to the large numbers of birds supported by the Western Treatment Plant). Counts of shorebirds indicate the site has supported > 20,000 every year from 1981 with a maximum count of over 300,000 in 1993. Counts of waterfowl are generally > 80,000.
Criterion 6 - Regularly supports 1% of the individuals in a population of one species or subspecies of waterbird	Data provided by BirdLife Australia and from the DELWP Annual Summer Waterfowl Counts, indicate that 12 species meet this criterion at the time of listing. More recent records (2000 – 2019) indicate the site supports >1% of the population of 15 species: • Australasian Shoveler (*Anas rhynchotis*) • Australian Fairy Tern (*Sternula nereis nereis*) • Australian Pied Oystercatcher (*Haematopus longirostris*) • Australian Shelduck (*Tadorna tadornoides*) • Blue-billed Duck (*Oxyura australis*) • Chestnut Teal (*Anas castanea*)

Criteria	Justification (from DELWP 2020)
	• Curlew Sandpiper (*Calidris ferruginea*) • Double-banded Plover (*Charadrius bicinctus*) • Hoary-headed Grebe (*Poliocephalus poliocephalus*) • Musk Duck (*Biziura lobata*) • Pink-eared Duck (*Malacorhynchus membranaceus*) • Red-necked Stint (*Calidris ruficollis*) • Red-necked Avocet (*Recurvirostra novaehollandiae*) • Sharp-tailed Sandpiper (*Calidris acuminata*).
Criterion 8 - An important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.	Seagrass beds and other habitats within the Ramsar site are known to provide important nursery habitat for numerous fish species, including several that have important fisheries resource values.

2.2.1 Ecological character (values)

As a signatory to the Ramsar convention, Australia is expected to conserve and maintain the ecological character of all Ramsar wetlands in its territory. To achieve this, ecological character descriptions (ECD) are being prepared for all Ramsar sites. These provide a benchmark against which to assess any future change in ecological character.

The *Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site Ecological Character Description* has been prepared by DELWP (DELWP, 2020). The ECD identifies and describes the components, processes and services (CPS) that are critical to the ecological character of the Ramsar site. This covers values across the 6 areas of the Ramsar site, not all of which apply to the Point Wilson/Limeburners Bay area. Critical CPS are summarised in Table 2.

The critical CPS of the site are:

Components:

- Hydrology
- Freshwater vegetation
- Seagrass
- Saltmarsh
- Mangroves
- Native fish
- Waterbird abundance

Processes:

- Waterbird breeding

Services:

- Supports threatened species
- Provides physical habitat for waterbirds
- Provides physical habitat for fish
- Ecological connectivity

Table 2 Values of the Ramsar site

Value	Description (extract from DELWP 2020)
Critical components and processes	
Hydrology	Two aspects of hydrology are considered critical to the ecological character: • Interaction between freshwater inflows and tidal exchange in the Lake Connewarre Complex. • Artificial water regimes that maintain the highly productive lagoons of Cheetham Wetlands and the Western Treatment Plant.
Vegetation	*Seagrass* – seagrass is present at three locations: Mud Islands, Swan Bay and the coastal areas adjacent to Point Wilson / Limeburners Bay. It is dominated

Value	Description (extract from DELWP 2020)
	by two species of Zostera, with smaller areas of *Halophilla ovalis*. Extent and density are highly variable. *Saltmarsh* – seven community types are present, dominated largely by succulent shrubs of the genera *Tecticornia* and *Sarcocornia*. *Mangroves* – there are small areas of Grey Mangrove (*Avicennia marina* subsp. *australasica*) in the Barwon Estuary (~52 hectares) and adjacent to the Ramsar site in Limeburners Bay and at Point Cooke. *Freshwater wetland vegetation* – tall marsh dominated by common reed occurs at Reedy Lake. An unusual salt tolerant lignum shrubland also occurs at this location. A variety of comment emergent, submerged and floating aquatic species occur in parts of the Western Treatment Plant.
Native fish	The site supports a diversity of fish with different life histories. Freshwater fish are supported in the Little River, Western Treatment Plant and Lake Connewarre Complex. The site also supports a number of diadromous fish (i.e. those that regularly migrate between fresh and saltwater). The nationally vulnerable Australian Grayling has been recorded in the Lake Connewarre Complex. Large number of marine and estuarine fish occur in the subtidal and intertidal habitats. Swan Bay supports a high diversity of species and is an important nursery for King George Whiting. Mud Islands habitats support marine species including a number of sharks and rays.
Waterbird diversity and abundance	The site supports more than 120 species of wetland dependent bird, including 22 species of migratory shorebirds that are regularly recorded within the site. At the time of listing annual maximum abundance was around 180,000 birds. Large numbers of waterfowl use the Western Treatment Plant and fish-eating species such as gulls and terns are supported by Mud Islands.
Waterbird breeding	Breeding has been recorded for at least 49 species of wetland dependent birds. Beach nesting species (Red-capped Plover, Australian Pied Oyster Catchers) breed at Cheetham Wetlands and on Mud Islands. A number of waterfowl and an established colonial nesting colony dominated by Pied Cormorants are supported at the Western Treatment Plant. Mud Islands also supports very large numbers of colonial nesting species with combined totals of > 100,000 nests.
Critical benefits and services	
Provides physical habitat (for waterbirds)	The site provides a network of habitats for waterbird feeding, roosting, moulting and breeding. Species that are supported by the site represent a wide range of functional groups (e.g. shorebirds, ducks, fish-eaters, large-bodied waders) each with different habitat requirements.
Provides nursery habitat for native fish	Saltmarsh and seagrass communities in Swan Bay are significant nursery habitats for juvenile fish. In particular, the larval stages of some fish species, such as King George Whiting, Blue Rock Whiting, Leatherjackets and pipefish settle directly on sub-tidal seagrass beds and then the structural habitat of seagrass and saltmarsh provide protected waters for young fish.
Threatened wetland species and ecosystems	The site provides important habitat for 13 species of threatened fauna, including: seven international migratory shorebirds (Bar-tailed Godwit, Eastern Curlew, Curlew Sandpiper, Great Knot, Red Knot, Lesser Sand Plover and Greater Sand Plover), Australasian Bittern, Australian Fairy Tern, Hooded Plover, Orange-bellied Parrot, Growling Grass Frog and Australian Grayling. The nationally vulnerable Subtropical and Temperate Coastal Saltmarsh community is also present within the site.

Value	Description (extract from DELWP 2020)
Ecological connectivity	The Ramsar site has a range of distinct wetland types which are ecologically connected. The connection between the marine, estuarine and freshwater components is significant for fish migration and reproduction. The site also supports significant numbers of international migratory shorebird species.

The Limeburners Bay to Point Wilson section supports values which are limited elsewhere within the Ramsar site. Those values include intertidal rocky reefs, typically colonised by mat forming brown algae; the mangrove area in Limeburners Bay, which provides good habitat for fish and invertebrates and plays a role in stabilising the soft sediments in the site; and seagrass beds which are only known from three locations within the Ramsar site.

2.2.2 Limits of Acceptable Change

The ECD for the Ramsar site sets Limits of Acceptable Change (LAC) for each critical CPS. LAC is the term used to describe the acceptable variation in a particular component of a Ramsar site without a change in ecological character leading to a reduction or loss of a value for which the site was listed as a Ramsar site. LAC are a tool by which change in ecological character and management effectiveness can be measured.

LAC for the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site are summarised in Table 3. It is noted that the LAC corresponds to all 6 areas of the site and may not be specifically measurable for the Point Wilson/Limeburners Bay area. The main values which have the potential to be affected by the project are seagrass in north Corio Bay, saltmarsh, mangroves in Limeburners Bay and migratory shorebirds which rely on intertidal areas for foraging and mangroves and seagrass to maintain their food supply.

Table 3 Limits of Acceptable Change for the Ramsar site (Extract from pg. 67-69, DELWP, 2020)

Component/ process	Limit of Acceptable Change	DELWP assessment (2020)
Ecological connectivity	Connectivity between the Barwon River and the Southern Ocean is not impeded between March and November for more than two consecutive years.	Connectivity has been maintained through operational fishways. **LAC is met.**
Hydrology	Reedy Lake will not be continuously wet for more than 10 continuous years, or continuously dry for more than five. At least 75% of aerobic treatment lagoons at the Western Treatment Plant will contain permanent water. At least 75% of the lagoons at Cheetham will contain permanent water.	Wetlands at the Western Treatment Plant and Cheetham Wetlands have remained inundated and managed according to management plans. Reedy Lake had a wet-dry seasonal cycle in 2005-6 and 2006-7, inundated continuously for 9 years from 2001-8 to 2015-16, then successful wet-dry cycles in 2016-17 and 2017-18 (Corangamite CMA 2018). **LAC is met.**
Vegetation: seagrass	Seagrass extent will not fall below 1500 hectares for a period of greater than 20 continuous years.	Mapping from 2000 indicate a total of 2900 hectares of seagrass within the Ramsar site boundary in 2000. A recent assessment indicated that seagrass cover in Swan Bay had changed little from 2008 to 2012 (Ball et al. 2014). **LAC is met.**
Vegetation: saltmarsh	Total saltmarsh extent will not fall below 900 hectares.	The most recent assessment of saltmarsh extent in the Ramsar site (Boon et al. 2011) indicates 1225 hectares. There is

Component/ process	Limit of Acceptable Change	DELWP assessment (2020)
		no evidence of a significant decline in saltmarsh extent. **LAC is met.**
Vegetation: mangroves	Total mangrove extent will not fall below 40 hectares.	The most recent assessment of mangrove extent in the Ramsar site indicates 52 hectares. **LAC is met.**
Vegetation: freshwater aquatic vegetation	A habitat mosaic will be maintained at Reedy Lake that comprises open water, emergent native vegetation (sedges, rushes and reeds) and lignum shrubland with no habitat comprising more than 70 percent of the total wetland area for more than five successive years.	Assessments of vegetation in 2014, indicated 63% emergent vegetation (sedges and reeds); 21% open water; 12% lignum shrubland and 4% other communities (Ecological Associates 2014). More recent assessments (that did not include mapping) indicate that the habitat mosaic remains and there have been improvements in some vegetation communities (GHD 2018). **LAC is met.**
Native fish	A minimum of 3 fish species per standard haul of a 10 m seine net from three replicate hauls in subtidal habitats of Swan Bay; A minimum abundance of 5 fish per standard haul of a 10 m seine net from three replicate hauls in subtidal or intertidal habitats of Swan Bay	There are no recent assessments of fish from Swan Bay. **Insufficient data to assess the LAC.**
Waterbird abundance	Abundance of waterbirds will not decline below the following (calculated as a rolling five-year average of maximum annual count): • Total waterbirds – 100,000 • Australasian waders – 1500 • Ducks – 30,000 • Fish eating species – 2250 • Herbivores – 6000 • Double-banded Plover – 1% • Red-necked Stint – 1% • Sharp-tailed Sandpiper – 1.5%	Data from BirdLife Australia (shorebirds) and DELWP (non-shorebirds) indicates the following average annual maximum counts (2015 – 2019): • Total waterbirds – 228,000 • Migratory waders – 22,800 • Australasian waders – 6900 • Ducks – 132,000 • Fish eating species – 9400 • Herbivores – 26,000 • Double-banded Plover – 2.8% • Red-necked Stint – 1.7% • Sharp-tailed Sandpiper – 4.9% **LAC is met.**
Waterbird diversity	Diversity of waterbirds will not decline below the following (calculated as a rolling five-year average of number of species): • Total waterbirds – 70 • Migratory waders – 20 • Australasian waders – 10 • Ducks – 10 • Fish eating species – 12 • Herbivores – 2 • Gulls – 2 • Large, bodied waders – 7	Data from Birdife Australia (shorebirds) and DELWP (non-shorebirds) indicates the following annual average number of species (2015 – 2019): • Total waterbirds – 105 • Migratory waders – 23 • Australasian waders – 12 • Ducks – 17 • Fish eating species – 19 • Herbivores – 7 • Gulls – 2

Component/ process	Limit of Acceptable Change	DELWP assessment (2020)
	• Other – 2	• Large, bodied waders – 15 • Other – 5 **LAC is met.**
Waterbird breeding	Annual breeding at Mud Islands of colonial nesting species of at least 25,000 pairs / nests. Presence of all of the following species breeding in at least three in every five years: Australian Pelican, Australian Pied Oystercatcher, Australian White Ibis, Crested Tern, Little Pied Cormorant, Pied Cormorant, Silver Gull, Straw-necked Ibis and White-faced Storm Petrel. Annual breeding at Western Treatment Plant of > 300 pairs of Pied Cormorant.	There has been no dedicated or comprehensive survey of breeding waterbirds at Mud Islands since 2009. Records from the Atlas of Living Australia indicate significant breeding at Mud Islands in 2016 with the following individuals recorded (although numbers of nests are unknown): Pied Cormorant 250; Straw-necked Ibis 50,000; Australian white ibis 5000; crested tern 2500; silver gull 30,000 Nesting Pied Cormorants increased at the Western Treatment Plant to approximately 1000 nests in 2010-2012 (Loyn et al. 2014). **LAC is met, but with a low degree of confidence.**
Supports threatened species: waterbirds	Australasian Bittern, Bar-tailed Godwit, Eastern Curlew, Great Knot, Hooded Plover, Lesser Sand Plover and Red Knot recorded within the site in three out of five seasons. Abundance of waterbirds will not decline below the following (calculated as a rolling five-year average of maximum annual count; percentages calculated based on Hansen et al. (2016) for migratory shorebird species and the latest Wetlands International Waterbird Population for other species): • Australian Fairy Tern – 0.6% • Curlew Sandpiper – 1.	Data from 2015 – 2019 indicate presence of the seven species (BirdLife Australia; DELWP, Atlas of Living Australia): • Australasian Bittern – five years • Bar-tailed Godwit – five years • Eastern Curlew – five years • Great Knot – four years • Hooded Plover – five years • **Lesser Sand Plover – zero years** • Red Knot – five years. Average annual maximum abundance (2015 to 2019): • Australian Fairy Tern – 11% (171 individuals) • Curlew Sandpiper – 3% (2864 individuals) **LAC is met for all species except Lesser Sand Plover.**
Threatened species: Orange-bellied Parrot	See LAC for saltmarsh.	Although the LAC for saltmarsh is met, the decline in Orange-bellied Parrot is summarised in section 6.2 of DELWP (2020).
Threatened species: Australian Grayling	Australian Grayling continues to be supported in the Barwon River system.	Australian Grayling continues to be recorded in the Barwon River System annual including in 2019 (O'Connor et al. 2019). **LAC is met.**

Component/ process	Limit of Acceptable Change	DELWP assessment (2020)
Threatened species: Growling Grass Frog	At Western Treatment Plant > 200 Growling Grass Frogs in 3 out of 5 years. Presence of Growling Grass Frog in the Lake Connewarre complex in 3 out of 5 years.	While there was < 200 Growling Grass Frogs recorded at the Western Treatment Plant in 2011/12 and 2014/15; there have been well in excess of 200 individuals recorded each year from 2015/16 to 2018/19. This includes > 1000 frogs in 2015/16 (Melbourne Water unpublished). There are records of Growling Grass Frog from the Lake Connewarre Complex in 2016, 2017, 2018 and 2019 (Atlas of Living Australia). **LAC is met.**

2.2.3 Threats

Threats identified for Point Wilson / Limeburners Bay area of the Ramsar site in the *Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site Management Plan* (DELWP 2018) area include:

- Climate change resulting in sea level rise impacting on intertidal vegetation and waterbird habitat (priority threat).
- Changed operations at the Western Treatment Plant decreasing nutrients and carbon and emerging chemicals of concern.
- Urban development causing direct habitat removal and loss of buffer.
- Litter (including micro-plastics) effects on biota (priority threat).
- Invasive species including foxes and cats predating on waterbirds, salt tolerant weeds impacting saltmarsh and waterbird habitat (priority threat) and non-native grazing animals (rabbits and deer) impacting vegetation and habitat.
- Recreation: boats, jet skis, kite surfers, walkers and horse-riding disturbing waterbird feeding, breeding and roosting (priority threat) and vehicles damaging saltmarsh.
- Duck hunting impacts to non-target species (priority threat).

3.0 Threatened species and ecological communities

The likelihood of occurrence assessment identified that EPBC Act-listed threatened flora species are unlikely to occur in the study area. EPBC Act-listed threatened terrestrial and marine fauna species may occur in the study area. VBA records of EPBC Act listed flora and fauna species within 5 kilometres of the project are shown in Figure 3-1.

Two ecological communities were identified in the wider study area but in areas outside of the pipeline corridor.

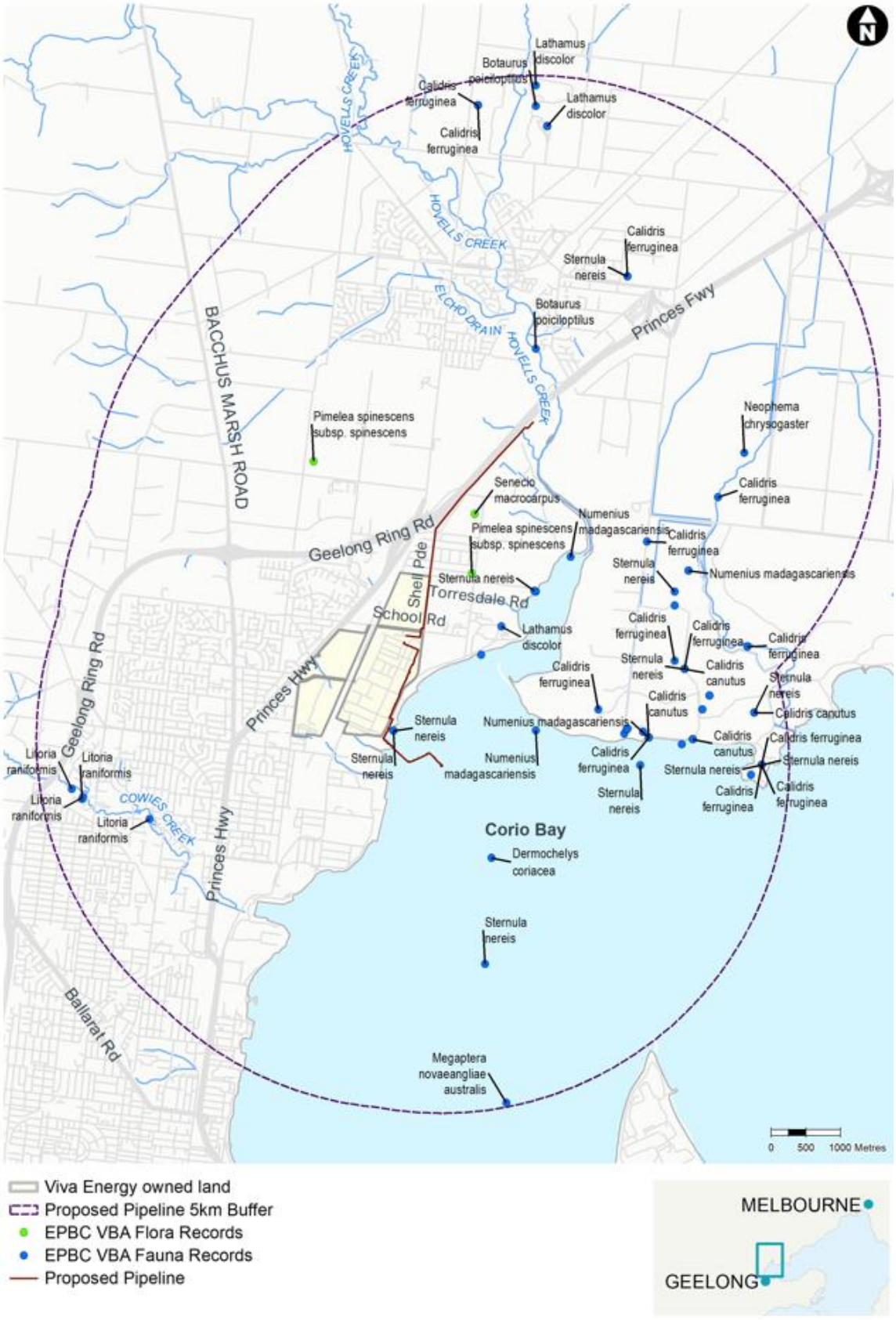


Figure 3-1 VBA records of EPBC Act listed flora and fauna species within 5 km of the study area

3.1 Threatened flora

While EPBC Act-listed threatened flora species are considered unlikely to occur in the study area, two species identified by the PMST and/or VBA were assigned an initial 'possible' likelihood of occurrence based on past records and potential grassland habitat within, or adjacent to, the study area. These species were:

- Spiny Rice-flower, a small shrub endemic to the grasslands of Victoria.
- Large-headed Fireweed, a perennial daisy also known as Large-fruit Fireweed or Large-fruit Groundsel.

Field assessments indicate these species are unlikely to occur as outlined below.

3.1.1 Spiny Rice-flower

Spiny Rice-flower is unlikely to occur in the study area.

Two historical records of the species were identified by the VBA within 5 km of the study area. One of those records is from the south-east corner of the Corio Native Grassland Reserve which is proximal to the pipeline route and was from 2013. A targeted search of the exclusion plot at the location of the VBA record did not detect the species. The exclusion plot was found to be dominated primarily by a suite of exotic grassy and herbaceous weeds with sporadic native grass also present (Plate 8).

Plate 8 Spiny Rice-flower exclusion plot

Habitat within the study area is unsuitable due to the degree of modification and past disturbance. Within the Corio Native Grassland Reserve, the dense cover of exotic species suggests the habitat is marginal for Spiny Rice-flower and it is unlikely to occur within 50 m of the pipeline alignment.

3.1.2 Large-headed Fireweed

Large-headed Fireweed is unlikely to occur in the study area.

One historical record of the species was identified on the VBA within 5 km of the study area from 1998. The location of the past record is in an area that had been recently cropped and it is unlikely the species still occurs at that location (Plate 9).

Plate 9 Cropping on east side of Macgregor Court where Large-fruit Fireweed VBA record is located

3.2 Threatened marine fauna

Given the shallow bathymetry of Corio Bay, the Bay is not visited by larger threatened marine species such as whales. Corio Bay is not known as an important area for large marine mammals as it is not an established breeding or feeding ground for whales. Some whale species may enter Port Phillip Bay for short periods as they pass along the central Bass Strait coast; however, most sightings are near the entrance to Port Phillip Bay or along the eastern shore.

Southern Right Whales *Eubalaena australis* (endangered, migratory) aggregate in sites distant from Corio Bay, including in the waters east of Warrnambool (Logans Beach) and from Portland to Port Campbell. The population of Southern Right Whales appears to be recovering.

Humpback Whales *Megaptera novaeangliae* (endangered, migratory) migrate north from June to August along the east coast of Australia, and back towards the Southern Ocean from September to November. The total number of Humpback Whales in Australian waters has increased considerably from around 1,000 individuals in 1962 to around 40,000 at present.

Australian Grayling *Prototroctes maraena* (vulnerable) is a diadromous fish species with both freshwater and marine life stages. In Victoria, Australian Grayling occur in the Yarra, Barwon, Bunyip and Lang Lang Rivers. They have also been recorded in the Lake Connewarre area of the Ramsar site (DELWP, 2020). The freshwater creek flowing to Corio Bay, Hovells Creek, is much smaller than the rivers where Australian Grayling are known to occur. While it is possible that during the marine phase, larvae of Australian Grayling could occur in Corio Bay from late autumn to early summer, the ichthyoplankton surveys conducted for the EES did not identify any Australian Grayling. Australian Grayling are unlikely to be present in Corio Bay except perhaps as isolated visitors.

Two EPBC Act-listed threatened marine fauna species (also listed as migratory) are considered to have a possible or higher likelihood to occur within Corio Bay. These species are:

- Leatherback Turtle *Dermochelys coriacea* (endangered)
- White Shark *Carcharodon carcharias* (vulnerable).

3.2.1 Leatherback Turtle

Leatherback Turtles are occasionally seen in Victoria between April and May, when the waters of Bass Strait are warmest. Sightings and strandings have been recorded all along the Victorian Bass open coast, Port Philip Bay and the Gippsland Lakes. These turtles could visit Corio Bay.

3.2.2 White Shark

White Sharks occur in all oceans of the world, including Bass Strait and Port Phillip Bay. The seal breeding colony at Seal Rock at the Western Entrance to Western Port is a known feeding area for White Sharks and these sharks have been observed and caught in Port Phillip Bay. They are highly mobile, and it is likely that individual great white sharks would pass through Corio Bay from time to time.

3.3 Threatened terrestrial fauna

Nine EPBC Act-listed threatened terrestrial fauna species were assigned an initial 'possible' likelihood of occurrence based on past records, potential habitat within the pipeline study area and/or identified as a species of interest in the scoping requirements for the EES:

- Swift Parrot *Lathamus discolor* (critically endangered)
- Grey-headed Flying-fox *Pteropus poliocephalus* (vulnerable)
- Golden Sun Moth *Synemon plana* (vulnerable)
- Striped Legless Lizard *Delma impar* (vulnerable)
- Eastern Curlew *Numenius madagascariensis* (critically endangered)
- Curlew Sandpiper *Calidris ferruginea* (critically endangered)
- Red Knot *Calidris canutus* (endangered)
- White-throated Needletail *Hirundapus caudacutus* (vulnerable)
- Fairy Tern *Sternula nereis* (vulnerable).

However, following further assessment based on suitable habitat in the study area, it is considered that Striped Legless Lizard and Eastern Curlew are unlikely to occur.

3.3.1 Swift Parrot

Swift Parrot may occasionally forage in the small, planted eucalypts of the study area while moving through to central Victoria, although the habitat is limited in extent, canopy spread and maturity.

Swift Parrot breed in Tasmania and migrate to mainland Australia during winter to forage in the forests of Victoria and New South Wales. In Victoria, Swift Parrots are primarily found in the Box Ironbark forests through central Victoria. Their preferred food trees are Red Ironbark *Eucalyptus tricarpa*, Mugga Ironbark *E*. *sideroxylon*, Yellow Gum *E. leucoxylon* and Grey Box *E. macrocarpa* (Birds Australia, 2011). There are a few records of Swift Parrot each year from the Melbourne and Geelong districts (Birds Australia, 2011).

A number of records of Swift Parrot are known from the Greater Geelong region. A review of VBA records show past observations to be clustered outside of the pipeline study area and in areas that provide more extensive foraging resources. Examples of such areas include the You Yangs Regional Park, Brisbane Ranges National Park and coastal towns such as Anglesea and Ocean Grove. Whilst records have been observed proximal to the project area within the grounds of Geelong Grammar School (1998) and Avalon Foreshore (2005), given the general lack of foraging resources provided in the study area, they would only be anticipated to use the area on an opportunistic and occasional basis.

3.3.2 Grey-headed Flying-fox

Grey-headed Flying-fox may forage in young eucalypts within the study area but are unlikely to utilise this vegetation as their primary food resource.

The Grey-headed Flying Fox is a canopy-feeding frugivore and nectarivore and utilises a range of vegetation communities ranging from rainforests to woodlands. Nectar and pollen from Eucalyptus

species and related genera such as Corymbia and Angophora as well as Banksias and Melaleucas are the primary food source. The species has a wide and varied diet that also includes pollen and nectar from non-indigenous flowering trees and fruit from horticulture fruit tree plantations.

The species requires roost sites and a wide foraging range for survival. Individuals are known to forage up to 50 km from their roost camps on a daily basis (although commuting distances are more often <20 km) and also migrate seasonally in response to food availability and temperature (DECCW, 2009).

A colony occurs in Eastern Park, Geelong which is approximately 8 km south of the pipeline study area. This colony is thought to be an offshoot of the colony initially located in the Melbourne Botanic Gardens with the majority of bats moving to Yarra Bend and some individuals moving to Geelong after intentional relocation of the bats at that location (Burroughs, 2015). Colonies of the species in Victoria are also known from Bendigo, Bairnsdale and Mallacoota. The number of bats has generally increased since 2003 with the population varying from as few as 800 individuals in winter to as many as 35,000 individuals in late summer/autumn (Burroughs, 2015).

The Geelong Colony is the southern-most permanent location of fruit bat colony in the world (Burroughs, 2015). Review of VBA records show that whilst the colony is located in central Geelong the majority of observations of the species outside central Geelong are clustered in peri urban areas in particular proximal to Colac and the Otways, showing the degree to which they disperse. No records are located within the project area and as with the Swift Parrot, any use of the area by the species would be on an opportunistic and occasional basis.

3.3.3 Golden Sun Moth

Golden Sun Moth may occur within part of the pipeline study area: Corio Native Grassland Reserve and public open space at Lara City Gate.

Golden Sun Moth is typically associated with high quality, dry, open tussock grasslands and grassy woodlands dominated by Wallaby Grass spp. but is also known from exotic grasslands containing Chilean Needle-grass that exhibit a similar structure (Braby & Dunford 2006, DEWHA, 2009a). After emerging in summer, males fly low above the grassland in in search of less abundant females that are poor fliers and tend to display their bright orange hindwings from within inter-tussock spaces (Endersby and Koehler 2006; DEWHA, 2009a). Dense swards of grass appear to be actively avoided and most occupied sites are subject to regular biomass reduction by grazing, slashing, or fire (Gilmore et al. 2008).

Whilst the species can be observed in modified grassland areas that have been previously cropped or ploughed, such areas were not considered as suitable Golden Sun Moth habitat as ground disturbance is thought to interfere with larval establishment and persistence (Gilmore and Payze 2010). A lack of inter-tussock spacing such as that seen in grasslands with a high biomass is also thought to interfere with species reproduction (Gibson, 2006).

No records of Golden Sun Moth are recorded on the VBA within 5 km of the project. The closest historic record is located approximately 8 km to the north of the pipeline study area and dates from 2009.

Most of the pipeline study area is not suitable for Golden Sun Moth. The ground within the roadsides has been historically disturbed via past earthworks (installation of pipelines and services) along the route on which the proposed new pipeline is aligned. Significant compaction has occurred since, and regular on-going maintenance and management from weed control and slashing/mowing has further reduced the habitat value. Vegetation within the study area was dominated by exotic graminoids, with limited to no Wallaby-grass or Spear Grass *Austrostipa* spp. observed. Toowoomba Canary-grass and Common Canary-grass *P. canariensis* were the most dominant species towards the southern end of the Corio Native Grassland Reserve, especially on the western side while Chilean Needle-grass was more common towards the northern end.

Canary-grasses are typically indicative of damp soils and often accumulate in high biomass with limited inter tussock spaces which are environments which do not typically support Golden Sun Moth. While Chilean Needle-grass is a known exotic food plant for Golden Sun Moth (DEWHA, 2009a), within the Corio Native Grassland Reserve, patches dominated by this grass were heavily thatched and lacked inter tussock spacing (see below). The area between Bell Road and Cummins Road was cropped and is therefore unsuitable.

Corio Native Grassland Reserve

Corio Native Grassland Reserve had the potential to provide habitat for Golden Sun Moth. However, the grassland had significant biomass dominated by Phalaris which is not a known food source for Golden Sun Moth and is not associated with its persistence for the aforementioned reasons. Large patches of dense Chilean Needle grass (a known food source) were also observed within the Reserve, but these patches were also heavily thatched and lacked the open tussock structure necessary for the male moth to find females at the base of tussocks within the grass sward. Whilst small patches of native grass were present within the study area, those present within the Corio Native Grassland Reserve were dense and heavily thatched. The structure and density of grasses within the Reserve are not considered suitable habitat for Golden Sun Moth.

Lara City Gate

An area to the south of the Lara City Gate was noted to provide the most suitable habitat of anywhere along the alignment. This area is mapped in Figure 3-2 and had a 25% or greater cover of Chilean Needle-grass. In proximity to the SWP connection point, the ground appeared to have been previously disturbed to construct the compound and to plant trees. Slashing of that area creates an ideal open structure for the moth; however, the planted trees shade the area and provide vantage points for birds which increase the predation risk to Golden Sun Moth. In addition, the area is not connected to other areas of suitable habitat beyond the area of public open space.

In the absence of targeted surveys, while it is considered that the area south of Lara City Gate is unlikely to support a population of the Golden Sun Moth, presence of the species has been assumed at this location in accordance with the precautionary approach.

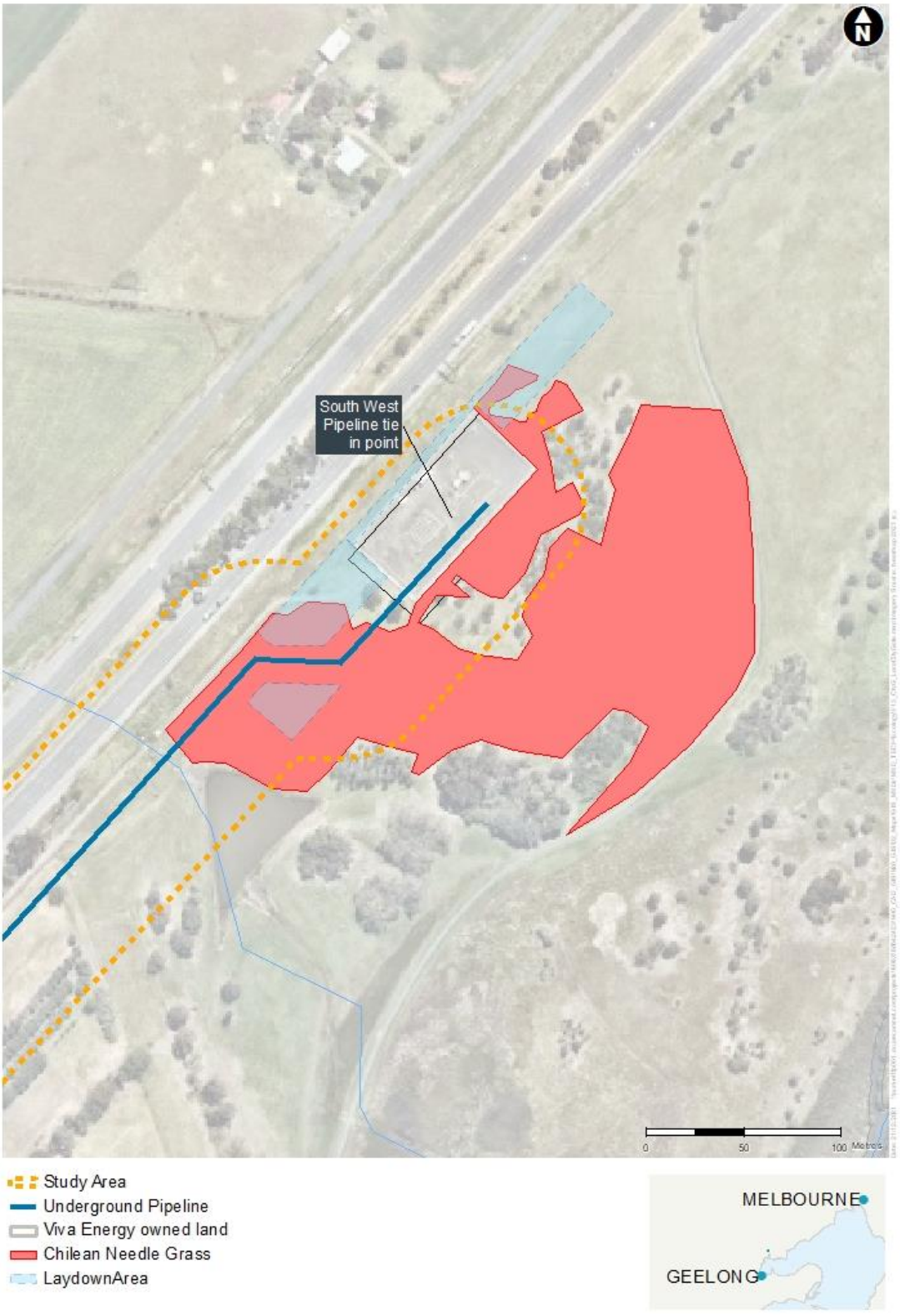


Figure 3-2 Occurrence of Chilean Needle-grass around Lara City Gate

3.3.4 Striped Legless Lizard

Striped Legless Lizard is unlikely to occur within the study area.

The species is a grassland specialist. It is generally known to inhabit native grasslands and grassy woodlands that contain native tussock-forming grasses, but it can also persist in degraded grasslands and non-native grasslands that have historically been grazed or pasture improved (DSEWPaC, 2011). As a semi-fossorial species, Striped Legless Lizards use burrows and cracks as retreats, forage at the surface and construct simple burrows only for nesting purposes (Wu et al. 2015). Habitat requirements for the species include a complex structure of grass tussocks (native or introduced) with inter-tussock spaces, rock, fallen timber and other refuges such as animal burrows and soil cracks (Smith and Robertson, 1999). Striped Legless Lizard are known to occur at sites subject to a history of grazing and pasture improvement but are less likely to occupy sites that have been subject to major disturbance such as ploughing. Habitat requirements for Striped Legless Lizard are similar to those described for Golden Sun Moth with the two species often found utilising the same habitat.

There are no nearby records of Striped Legless Lizard on the VBA. The closest historical record of the species on the VBA is from approximately 7 km north of the pipeline study area and dating from 1992.

The study area has been historically disturbed through the laying of pipework and construction of roads or is currently disturbed through slashing and mowing activities, or both. Corio Native Grassland Reserve is dominated by dense swards of Canary-grass and Chilean Needle-grass. Rocks (surface or embedded) were absent from the study area and the presence of Canary-grass suggests wetter soil conditions which are likely to restrict the availability of soil cracks as alternative refuge. The absence of surface rocks, dry, cracking soils and inter tussock spaces means the study area within Corio Native Grassland Reserve is unlikely to support Striped Legless Lizard.

Furthermore, whilst undertaking the random meander survey method in the eastern side of the Corio Native Grassland Reserve, roof tiles typically used for reptile surveys were observed. The overgrown nature of the tiles suggested that they had been placed at the site several years prior. Information was requested from the City of Greater Geelong regarding the report associated with the survey, however, no report was available, and an online search did not yield further information. It is a requirement of survey permits that records of species detected are lodged on the VBA therefore it assumed that if Striped Legless Lizard were detected during the survey, records would appear in the VBA extract (Figure 3-1).

Unlike Golden Sun Moth, Striped Legless Lizard is unlikely to occur in the public open space surrounding Lara City Gate. The area is routinely mowed and lacks rocks and soil cracks which means the area provides very little refuge from predators. Dominance by exotic grasses suggests extensive modification in the past and this may never have been suitable as habitat.

3.3.5 Eastern Curlew/Curlew Sandpiper/Red Knot

No suitable habitat for the threatened shorebird species of Eastern Curlew, Curlew Sandpiper or Red Knot (also listed as migratory) occurs along the pipeline corridor.

Offsite habitat within Limeburners Bay and at Avalon Beach provides foraging and resting opportunities for threatened and migratory shorebirds.

Eastern Curlew have not been seen in the general area since the 1970/80s and are unlikely to occur with any regularity. The last stronghold for Eastern Curlew in Victoria is French Island in Westernport Bay (Saddler, 2019).

Curlew Sandpiper and Red Knot have both been observed in Limeburners Bay (Birdlife Bellarine, pers. comm.). Those observations were of a single individual in February 2014 (Curlew Sandpiper) and February 2016 (both species). Curlew Sandpiper (single individual) was observed at Avalon Beach during the shorebird survey conducted for the EES in February 2021.

Plate 10 Curlew Sandpiper (Photo credit: J. Billington)

3.3.6 White-throated Needletail/Fairy Tern

The White-throated Needletail and Fairy Tern are considered to have a possible likelihood of occurrence within the study area.

White-throated Needletail is a migratory species, which is aerial when in Australia. It is possible this species may fly over the study area.

Fairy Tern is a seabird that may occasionally occur hunting along the shoreline of Corio Bay.

3.4 Threatened ecological communities

Threatened communities modelled to occur by the PMST are:

- Grassy Eucalypt Woodland of the Victorian Volcanic Plain (Critically Endangered)
- Natural Temperate Grassland of the Victorian Volcanic Plain (Critically Endangered)
- Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains (Critically Endangered)
- Subtropical and Temperate Coastal Saltmarsh (Vulnerable)
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Critically Endangered).

Of those, two communities were identified in association with the project but in areas outside the pipeline corridor. These communities are described below.

3.4.1 Natural Temperate Grassland of the Victorian Volcanic Plain

Natural Temperate Grassland of the Victorian Volcanic Plain (NTGVVP) was not identified within the study area (up to 50m from the proposed pipeline) but occurs adjacent to the pipeline study area on the eastern side of Shell Parade (Plate 11). Native species observed included Wallaby grasses, Spear grasses, Fireweed and Bindweed. This patch of NTGVVP was assessed against the threshold conditions for inclusion as NTGVVP (as opposed to Plains Grassland) and found to meet the condition threshold for location, dominance of native vegetation (particularly native grasses and/or other native herbs) and size, noting that it would not be intersected by the project.

Plate 11 Natural Temperate Grassland of the Victorian Volcanic Plains within Corio Native Grassland Reserve

3.4.2 Subtropical and Temperate Coastal Saltmarsh

Subtropical and Temperate Coastal Saltmarsh (STCS) occurs along the shoreline near Refinery Pier within the 50 m buffer of the proposed pipeline, noting that it would not be intersected by the project. In addition, the community occurs offsite in Limeburners Lagoon (Hovells Creek) Flora and Fauna Reserve and is indirectly connected to the marine component of the project via Corio Bay. STCS is listed as vulnerable under the EPBC Act and is also listed as threatened under the FFG Act (as ecological vegetation class EVC 9 Coastal Saltmarsh) and is vulnerable in the Victorian Volcanic Plain bioregion. Although listed as a vulnerable ecological community under the EPBC Act, for the purpose of significant impact assessment, vulnerable vegetation communities are not an MNES.

The saltmarsh community consists mainly of salt tolerant plants that are generally less than 0.5 m in height (DSEWPaC, 2013). Coastal Saltmarsh (EVC 9) identified along the shoreline near Refinery Pier is characterised by a narrow but dense strip of Coast Saltbush with occasional Shrubby Glasswort, Austral Seablite and Rounded Noon-flower. It is unclear if the Coast Saltbush is naturally occurring or has been established through revegetation of the shoreline. This community was relatively degraded and also contained several weedy species such as Carpet Weed, Boxthorn, Chilean Needle-grass, Mallow and Wild Radish.

Coastal Saltmarsh (EVC 9) within Limeburners Lagoon is characteristic of the STCS community with the lower intertidal zone dominated by succulent shrubs (glasswort and samphire of the genera Tecticornia and Sarcocornia) (Plate 12) and the landward, upper zones dominated by Coast spear grass *Austrostipa stipoides* (Plate 13) and sedges, rushes (Sea Rush *Juncus kraussii*, Clumped Sedge *Gahnia filum*). Along Hovells Creek the saltmarsh is bordered by stands of White Mangrove *Vicennia marina* subsp*. australasica* (Plate 4).

Plate 12 Subtropical and Temperate Coastal Saltmarsh, Limeburners Lagoon (February 2021)

Plate 13 Subtropical and Temperate Coastal Saltmarsh, Limeburners Lagoon (February 2021)

4.0 Migratory species

Australia's obligation under bilateral agreements and conventions is to ensure adverse effects on listed migratory species and their habitats in Australia do not occur (DoE, 2015). The Ramsar Convention of Wetlands and the East Asian – Australasian Flyway Partnership are other international agreements to ensure conservation of migratory birds in Australia.

4.1 Birds

Migratory bird species listed under the EPBC Act with potential to occur are associated with the coastal environment adjacent to the pipeline alignment (terns, shorebirds and coastal birds of prey) or are aerial species when in Australia. A small extent of the Corio Bay foreshore occurs in the 50 m buffer area of the pipeline. Otherwise, there is no suitable habitat for these species within the pipeline study area.

Shorebirds (also known as waders) include plovers, lapwings, stone-curlews, sandpipers, 'shanks', tattlers, curlews, godwits, snipes, pranticole, oystercatchers, stilts, avocets and jacana (Geering, 2006; BirdLife Australia n.d.). Shorebirds are so named as they commonly feed by wading in shallow water along the shoreline of lakes, rivers and the sea (Geering, 2006). Shorebirds use intertidal areas (between high and low waterline) to forage and supratidal areas (above high waterline) to roost.

Fifty-four shorebird species occur regularly in Australia; 17 species of resident shorebirds and 37 other species which migrate to Australia from their breeding grounds in the northern hemisphere and New Zealand to escape the cold of winter.

The EPBC Act lists the 37 migratory shorebirds that regularly visit Australia. These are species that are subject to the international agreements relating to migratory shorebird conservation to which Australia is a signatory.

Shorebirds were not observed on the shoreline of Corio Bay adjacent to the pipeline route during surveys (AECOM, 2021 – Appendix D). In comparison, surveys at Limeburners Bay and Avalon Beach (former Avalon Saltworks and foreshore) demonstrated the Ramsar site supports an abundance of aquatic birds including several species listed as migratory (Common Sandpiper *Actitis hypoleucos*, Sharp-tailed Sandpiper *Calidris acuminata*, Curlew Sandpiper and Red-necked Stint *Calidris ruficollis*).

While the overall number of birds observed in Limeburners Bay was greater than at Avalon Beach (former Avalon Saltworks and foreshore), the diversity of aquatic birds is lower (AECOM, 2021 – Appendix D).

Plate 14 Sharp-tailed Sandpipers with a single Curlew Sandpiper (circled) at the former Avalon Saltworks

4.2 Marine species

As noted in Section 3.2, possible migratory marine species in Corio Bay may include individuals of Leatherback Turtle and White Shark. It is unlikely that larger migratory marine species such as Killer Whales, Blue Whales or Southern Right Whales would enter Corio Bay due to its shallow bathymetry. There are no established breeding or feeding grounds for migratory marine mammals in Corio Bay.

5.0 Impacts on MNES

This section describes the potential impacts on MNES associated with the construction, operation and decommissioning of the onshore and offshore aspects of the project. Measures to manage or mitigate the potential impacts are recommended and any ecological impacts that remain following the adoption and implementation of those measures (residual impacts) are outlined.

As described in the following sections, with the adoption of management and mitigation measures, residual impacts on Ramsar wetlands, threatened species and ecological communities and migratory species would be minimised and significant impacts are unlikely.

5.1 Ramsar wetlands

The Significant impact guidelines (DoE, 2013) provide significant impact criteria for wetlands of international importance (Ramsar sites). An action will be deemed to have the potential for a significant impact if it will result in:

- Areas of the wetland being destroyed or substantially modified
- A substantial or measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration, and frequency of ground and surface water flows to and within the wetland
- The habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected
- A substantial and measurable change in the water quality of the wetland- for example a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity, or human health, or
- An invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland.' (DoE, 2013, p13).

The assessment against the significant impact criteria indicates that the project would not have a significant impact on the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. There would not be a substantial or measurable change in the water quality of the wetland or to vegetation (seagrass) or fauna (waterbirds) at the site. The critical CPS of the site would be unaffected by the project and LAC would continue to be met.

5.1.1 Construction

The project does not involve construction works within the Ramsar site. However, onshore construction works with the potential to impact the nearby Ramsar site include:

- Construction of the pipeline and tie-in facilities, with the crossing of one artificially constructed watercourse within the Hovells Creek Reserve
- Trenching works for the pipeline that could intersect groundwater – groundwater from the project area has the potential to feed waterways connected to the Ramsar site (Hovells Creek).

Offshore construction activities of most relevance to potential impacts on ecological values of the nearby Ramsar site are:

- Localised dredging of approximately 490,000 m^3 of seabed sediments over an area of approximately 12 hectares within the new berth and swing basin at Refinery Pier. Dredging within the new berth would be undertaken to a depth of 13.1 m and the swing basin would be dredged to a depth of 12.7 m. An additional 8,000 m^3 of sediment would be removed and replaced to install a

seawater transfer pipe between the FSRU and the existing refinery seawater intake to enable reuse of the FSRU discharge as cooling water in the refinery. Dredged material is proposed to be deposited at an existing dredged material ground (DMG) in Port Phillip Bay to the east of Point Wilson (refer to Figure 5-1**Error! Reference source not found.**).

- Construction of the new pier arm and berthing infrastructure once dredging is complete. Steel piles would be driven into the seabed by cranes mounted on floating barges. Transport of materials and installation of pier infrastructure would also be undertaken from the water using barges.

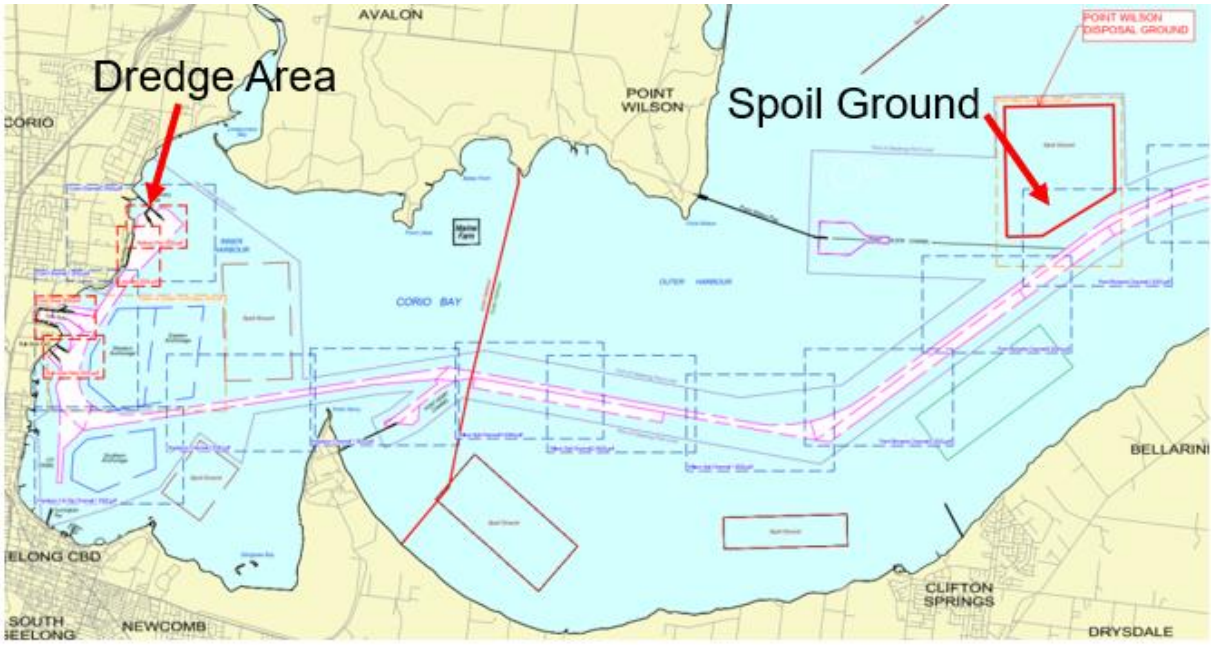


Figure 5-1 Dredging area and disposal site at the Point Wilson DMG

The primary impact pathway for the Ramsar site from construction activities is dredging for a period of 8 weeks and its potential effects on seagrass meadows and the food chain of waterbirds through sediment mobilisation affecting phytoplankton (microscopic marine algae) productivity. The dredging would not occur directly within seagrass zones as shown in Figure 5-2. Other potential impacts to the ecological character of the Ramsar site include disturbance of waterbirds and marine species through construction noise and lighting, and fuel or chemicals from construction equipment spilling into Corio Bay.

Figure 5-2 Dredged area in relation to existing seagrass zones

5.1.1.1 Flow and water quality in Hovells Creek

Surface water runoff from excavated trenches, disturbed surfaces and stockpiled material has the potential to increase sediment loads and turbidity in receiving water bodies. There is also the potential for these sediments to contain pollutants including contaminated sediments, oils and/or chemicals. If increased sediment loads reach nearby waterways and enter the Ramsar site downstream, this may impact on waterway health and aquatic vegetation.

Onshore construction works would be undertaken approximately 300m away from Hovells Creek and are not anticipated to impact the Ramsar site.

A single minor waterway crossing is required for the pipeline close to Hovells Creek; the crossing would be trenched and reinstated with minimal short-term impact. It is expected that the proposed trenching would be undertaken during dry periods (the artificially constructed waterway is ephemeral, meaning it has intermittent flow) and immediately reinstated to its current condition.

The need for groundwater dewatering to facilitate pipeline trenching and installation along the length of the pipeline is not anticipated due to the unlikely intersection of groundwater (that is, groundwater levels are anticipated to be below the depth of the trench). Therefore, potential impacts to groundwater environmental values and potential GDEs (such as Hovells Creek) from dewatering would be negligible.

Management and mitigation measures

In order to manage runoff from disturbed areas, flow diversion banks would be placed upstream of the spoil material, and an overflow spillway should be constructed to allow runoff from external catchments to pass over the spoil material at a controlled location without causing erosion and potential sedimentation to receiving waterbodies. During the construction works, sediment control devices such as bunding or silt fences would be set around stockpiled material, earthworks and disturbed areas to minimise loss of sediment to the receiving environment.

The watercourse crossing would be constructed during no flow conditions and reinstated as soon as possible. Weather forecasts would also be monitored to avoid having the watercourse trench open

when high rainfall events are expected. All obstructions to flow, if there is any flow, would be removed as soon as practicable after the pipe is laid and backfilled.

Residual impacts

With implementation of the recommended mitigation measures, the potential for sedimentation impacts to affect water quality in Hovells Creek or the Ramsar site would be negligible.

5.1.1.2 Sediment mobilisation

During dredging, there would be increased turbidity (elevated suspended solids) and increased nutrients around the dredging area. Small quantities of contaminants may be released and settling of sediments on the seabed would occur once dredging ceases. The turbidity would decline quickly after dredging ceases.

Suspended solids can influence the growth and distribution of seagrass through increased light attenuation (reduced light transmission) and smothering as the sediment settles on the seabed. Retaining healthy seagrass is essential to meet the ecological functions of the site with respect to fish nursery and habitat, as well as a wide range of other marine organisms. Increased turbidity can also have an adverse effect on phytoplankton populations. A reduction in density or extent of seagrass or reduction of phytoplankton population could have implications for the food chain for migratory shorebirds or marine species that comprise the critical components and processes of the Ramsar site.

The area on the seabed predicted to be impacted by the dredging is shown in Figure 5-3. The red outline indicates the 12-hectares of seabed that would be dredged and the 550 m long trench for the seawater transfer pipe from the FSRU to the refinery intake. The orange indicates the area predicted to be affected by 20 milligram per litre (mg/L) median suspended solids (40 hectares) and the pink indicates the area affected by 5 mg/L median suspended solids (160 hectares). The background level of suspended solids in Corio Bay is 5 mg/L, which increases regularly up to around 12 to 20 mg/L when waves re-suspend sediment near the shore.

Figure 5-3 Predicted area of impact on seabed from proposed dredging

The median 5 mg/L suspended solids contour would not extend into the Ramsar site, although there is a localised part of the Ramsar site that would experience an increase in median suspended solids concentration of around 1 mg/L as outlined below. Hydrodynamic modelling indicates that the area affected by sediments from dredging would not extend into Limeburners Bay. The Ramsar site would have only a minor increase in turbidity, similar to the increase in turbidity recorded in the 1996-1997 Corio Bay Channel Improvement Program.

Figure 5-4 shows the predicted time series of surface suspended solids above background concentrations over the 8 weeks of dredging (if it occurred in August to September) at a point on the boundary of the Ramsar site ('RAM site').

The blue line in Figure 5-4 shows the instantaneous suspended solids concentration. Peak suspended solids concentration is 12 mg/L for a few hours, which is comparable to existing conditions during storms. Storms during dredging would create a net current to the north and carry turbid waters from the dredging area into the Ramsar site. The pink line shows the 5-day moving average suspended solids concentration, which ranges from 0 to 3 mg/L. The green line shows the 8-week average, which is under 1 mg/L. Turbidity increases in the Ramsar site are quite minor.

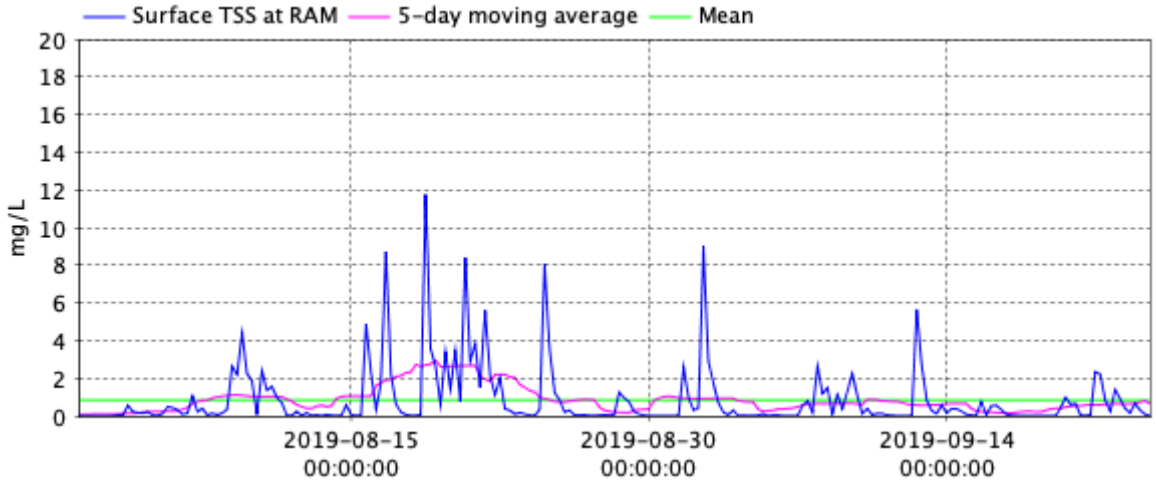


Figure 5-4 Time series of suspended solids at Ramsar site (RAM site) – August-September

An increase in turbidity and reduced light transmission would occur in the area influenced by dredging over the 8-week period and a temporary loss of productivity of seagrass is expected within an 80-hectare area. As shown in Figure 5-5, there would be increased suspended solids of 2 mg/L over a 6-hectare patch of seagrass. The increased turbidity may have a minor effect in slowing seagrass growth and productivity in Corio Bay for a day or two; however, the impact would be too small to measure and would not be of ecological consequence to seagrass beds or the Ramsar site. The light transmission would recover quickly to the original conditions after dredging ceases i.e., within one or two days.

Figure 5-5 Comparison of suspended solids on sea surface and seagrass beds

Sediment accretion modelling (settling on the seabed) suggests the highest accretion of 20 millimetres (mm) in 8 weeks is confined to the area being dredged and is therefore of no significance to the Ramsar site. Lower accretion rates of 2 to 10 mm would occur in north Corio Bay over a larger area but the rate

of accretion (calculated at 0.04 mm/day to 0.2 mm/day) would have negligible impact on the seabed, seagrass or infauna.

Dredging may also cause a short-term localised increase in concentrations of metals in the water column. Limited elevated concentrations of antimony, arsenic, lead, mercury and nickel are present in sediments in the dredging area above the default guideline values; however, subsequent sediment elutriate analysis to assess the potential for chemicals to desorb from sediment particles to water, indicates there is a low potential for bioavailability (and hence ecotoxicity) to marine biota. There would be a negligible increase in metal concentrations at the Ramsar site.

Similarly, higher levels of nutrients (namely nitrogen comprised of ammonia and nitrate) would be released from the pore water held within the sediment during dredging. Release of approximately 70 kg of total nitrogen (mainly ammonia) over the 8-week dredging period (representing around 0.03% of the total nitrogen in Corio Bay) has the potential to result in a localised phytoplankton (algae) bloom after dredging ceases and turbidity levels drop (as turbidity caused by dredging reduces light, and therefore lessens the risk of algal blooms).

Most juvenile fish species that migrate through estuaries have a wide tolerance of turbidity. However, fish in seagrass habitat are possibly less tolerant, although it is noted that there is elevated turbidity in the Ramsar seagrass beds about every 2 to 3 weeks, when storms stir up sediment near the shore. Fish populations present in the Ramsar site in Corio Bay may be particularly vulnerable to sedimentation during fish spawning and development. For key fish species in the Ramsar site, this stage occurs mostly during spring.

In summary, there would be temporary and localised turbidity increases and minor increases in nutrients and metals in the water column from dredging which could have a minor effect in slowing seagrass growth and productivity for a day or two. The sediment plumes associated with the dredging do not extend to Limeburners Bay; although it could result in minor turbidity increases at the Ramsar site (as shown by levels modelled at the RAM site). However, this is unlikely to significantly affect seagrass meadows or abundance and diversity of seagrass or algae. As such, dredging is unlikely to impact species reliant on seagrass habitat or change the ecological character of the Ramsar site.

Management and mitigation measures

While it is unlikely that dredging would impact fish populations present in seagrass habitat in the Ramsar site, as a precautionary approach, the dredging would not occur during spring (September to November), where key fish species are potentially in a more vulnerable stage of development. Furthermore, if dredging does not occur in spring, early seasonal growth of *Zostera nigricaulis*, the most extensive seagrass in the Ramsar site, would not be impacted by potential increases in turbidity.

In addition, a silt curtain is proposed to be installed to reduce the opportunity for sediment to reach the intertidal zone and seagrass bed of the western shoreline of Corio Bay adjacent to the refinery.

Residual impacts and monitoring

No significant residual impacts on the Ramsar site are anticipated. There would be no reduction in the area of seagrass in the Ramsar site, however the increased turbidity may have a minor effect in slowing seagrass growth for a short period outside of the Ramsar site without ecological consequences. Dredging in seasons other than spring would have the least effect on primary productivity and fishery replenishment. With the adoption of mitigation measures, residual impacts are anticipated to be a localised reduction in primary productivity of phytoplankton and the loss of infauna in the dredged area until they re-establish, which would not have a significant impact on the ecological character of the Ramsar site or have adverse effects on the food chain for waterbirds.

To confirm that turbidity and light attenuation meet the expected modelled outputs, turbidity would be monitored continuously during dredging (commencing 2 months prior and ending 2 months after). This would inform contingency actions if turbidity levels exceeded the proposed thresholds.

There is a small possibility that favourable weather conditions at the end of dredging could instigate a small, localised phytoplankton bloom. Monitoring of plankton during dredging (commencing 4 weeks prior and continuing for 8 weeks after) is proposed to monitor for toxic algal blooms and enable appropriate notifications to be made if required. However, if a bloom did occur, this would not alter the ecological character of the Ramsar site as such blooms occur periodically due to natural events.

5.1.1.3 Construction noise and lighting

Noise and lighting from construction of the project have the potential to disturb threatened or migratory species that contribute to the ecological character of the Ramsar site. In particular, 'waterbird abundance' is a critical component of the Ramsar site.

Light spill from construction activities does not extend to the Ramsar site therefore the ecological character of the Ramsar site is unlikely to be affected by light during construction. Large corridors for marine species to access the Ramsar site would remain, and it is considered that there would not be adverse impacts from construction lighting in the context of the significant amount of existing light pollution in Corio Bay as a result of port and industrial activities.

Dredging or construction of the Refinery Pier extension and infrastructure is unlikely to alter noise levels in the Ramsar site above those currently being experienced by waterbirds at Limeburners Bay. More detailed discussion on potential noise impacts to migratory shorebirds is provided in Section 5.3.1.

5.1.1.4 Spills during construction

Spills of fuel and chemicals during dredging and construction of the Refinery Pier extension have the potential to enter Corio Bay. The most common spills in construction involve breaks in hydraulic hoses, which typically release a relatively small volume of hydraulic fluid. If a spill of hydraulic fluid did occur, the hydraulic fluid would spread and be diluted in the currents underneath the pier. Within a few minutes, the fluid would mix with over 10 m^3 of seawater and the mixture would be below lethal concentrations. There could be a localised adverse effect of the spill but no long-term effect.

There is also potential for spills to occur during pipeline construction, from fuels or other liquid pollutants, associated mostly with refuelling, which could then enter Hovells Creek and the Limeburners Bay component of the Ramsar site. However, this would be unlikely to occur, given the small amount of fuel and chemicals being used and the distance of the pipeline construction area from the Ramsar site.

Management and mitigation measures

Spills from hydraulic hoses (and all equipment containing fuels or chemicals) would be avoided by conducting regular checks and preventative maintenance undertaken to old or worn hoses remaining in use.

Fuels and chemicals stored on site would be minimised and would not be stored close to waterways or areas within proximity to the wetland. Refuelling of vehicles and machinery would be undertaken in a designated refuelling area with auto shut off valves and would not occur within 20 metres of a receiving watercourse. For sensitive sites (such as the Ramsar wetlands), refuelling or maintenance of equipment would be conducted no closer than 50 metres.

If a spill did occur, measures would be in place to manage impacts in accordance with Viva Energy's spill response plan, such as having a spill kit available and following spill response protocols.

Residual impacts

No residual impacts on the Ramsar site are anticipated. If a spill did occur at Refinery Pier, there could be a minor, localised adverse effect at the site of the spill; however, this would not extend to the Ramsar site.

5.1.2 Operation

The primary impact pathways for the Ramsar site are related to discharge of seawater to the marine environment and for potential entrainment of plankton and larvae in the FSRU seawater intake. The FSRU would require the intake and discharge of seawater, which could lead to changes in water quality (chlorine and temperature) from ambient conditions in Corio Bay. However, as outlined below, reuse of the FSRU discharge in the refinery for cooling water results in discharges being very similar to the existing discharges from Geelong Refinery which have been occurring for more than 60 years.

Other potential impacts to the ecological character of the Ramsar site include entrainment of marine organisms, disturbance of waterbirds and marine species through noise and lighting, fuel or chemicals spilling into Corio Bay, turbidity from tugboats and the introduction and spread of marine pests from LNG carriers.

5.1.2.1 Discharge to marine environment from FSRU

Regasification of LNG (conversion back to a gaseous state) onboard the FSRU using seawater as a heat source requires the discharge of cooled seawater which contains residual chlorine.

Cooled seawater from the FSRU regasification process would be piped to the existing refinery seawater intake for reuse within the refinery as cooling water. The seawater would be discharged back to Corio Bay via the four existing discharge points known as W1, W3, W4 and W5 at the existing refinery residual chlorine concentrations. This process would use and discharge the same amount of seawater as the current refinery usage of approximately 350ML/day. The level of residual chlorine in the discharge would also be the same as the existing concentration.

Occasionally if the refinery is partially offline for maintenance or another reason, the seawater from the FSRU would be directly discharged to Corio Bay through a diffuser installed under the new pier arm. It is not anticipated that discharge through the diffuser would be a common occurrence as even during maintenance, the refinery requires between 200-250 ML/day of cooling water compared with a constant 350ML/day when fully operational.

Closed loop mode of operation is not anticipated to be a common occurrence but would involve less water being discharged to Corio Bay as water is recycled within the vessel. Closed loop operation would require excess heat to be periodically discharged as a warm water plume and have additional air emissions as LNG would be used to fuel the boilers and is not the preferred mode of operation for the project. Closed loop would only be used if FSRU maintenance precluded use of open loop for a short period or in the event of a pump or pipe failure.

To assess impacts of chlorine on marine biota, a guideline value was determined by considering the Victorian EPA Environment Reference Standard (ERS), the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG) and a recent Commonwealth Scientific and Industrial Research Organisation (CSIRO) paper specifically addressing the chlorine limit in marine waters (Batley and Simpson, 2020).

The ERS is a fundamental component of the *Environment Protection Act 2017 (Vic)* (EP Act). While the ERS does not specify a limit for chlorine, the EP Act introduces a new permissions scheme including the requirement for a development licence and operating licence for the operation of the FSRU. The ANZG lists a chronic guideline value for chlorine in freshwater of 3 µg/L, however, does not list a guideline value for chlorine in marine water.

Batley and Simpson (2020) published a guideline value for chlorine in seawater in 2020 using the method of derivation described in ANZG. Threshold chlorine produced oxidants (CPO) concentrations which would apply over a period of 24 hours were determined to be:

- CPO of 3.7 µg/L for 99% species protection
- CPO of 12 µg/L for 95% species protection
- CPO of 21 µg/L for 90% species protection

To convert the Lethal Concentration 50 (LC50) (i.e., the concentration of CPO in seawater that would be lethal to 50% of species in a single exposure) to a no or low effect concentration (Lethal Concentration 10 (LC10)), a factor of 0.6 was applied by Batley and Simpson.

The guideline value for CPO in Corio Bay is therefore **7.2 µg/L** (95% species protection 12 µg/L x 0.6).

Discharge through the refinery

The refinery has discharged warmer seawater containing residual chlorine concentrations for more than 60 years. Chlorine is added to the seawater as it enters the refinery to prevent and control the accumulation of microorganisms, plant, algae or small animals in the pipes, pumps and heat exchangers.

Field surveys undertaken as part of the EES showed no detectable impact on seagrass beds or marine biota from the existing discharges. Seagrass beds were found to be abundant and very healthy offshore from the discharge points, species such as sea urchins considered to be sensitive to chlorine were found to be flourishing under the discharges, and tests on mussels from the vicinity of the plumes showed no detectable levels of residual chlorine.

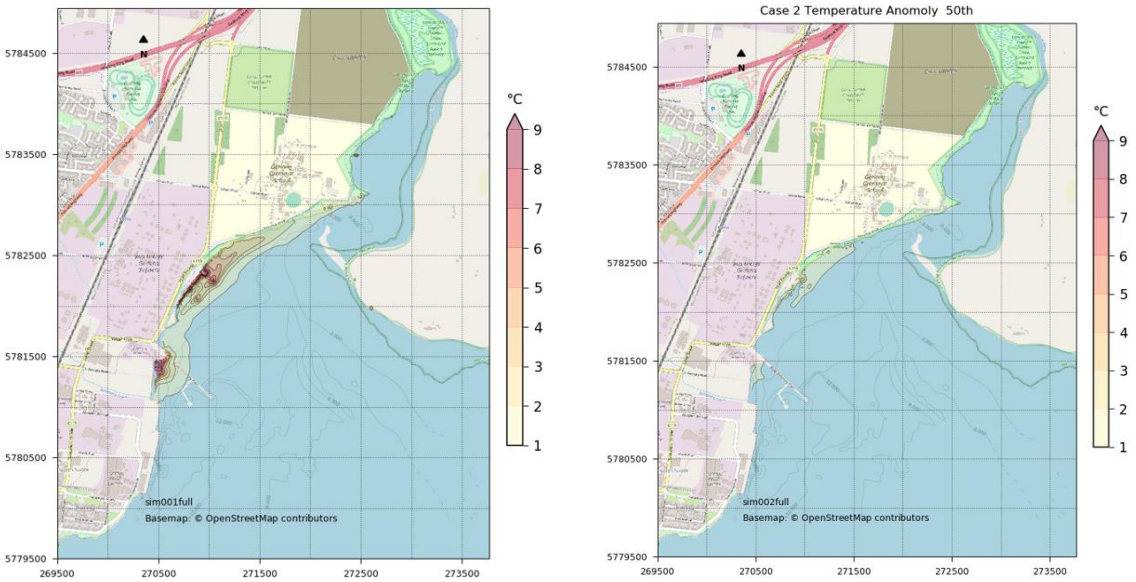
The existing warm water plume from the refinery travels to the north and reaches the mouth of Limeburners Bay, at around 1ºC above ambient. The existing chlorine plume to an extent of 3.6 µg/L is confined to an area within 200m of the shoreline in shallow water near the shore in front of the refinery does not reach Limeburners Bay or the Ramsar site.

Reuse of the cooled seawater from the FSRU within the refinery would reduce the existing temperature rise in the current discharges (from a discharge temperature of 8-10ºC above ambient to 1-3ºC above ambient) and there would be a smaller temperature plume along the shoreline than for the existing discharge as a result of using the chilled water discharge from the FSRU (see Figure 5-6). The existing temperature rise associated with the refinery and the lower temperature rise associated with reuse of cooled seawater from the FSRU represents a small change in relation to diurnal variation in temperatures experienced by biota along the shoreline, which experience diurnal variations of 10ºC in the littoral zone and 1.6ºC-5ºC in the shallow, sublittoral zones.

It is possible that the seagrass along the north shore of Corio Bay could respond to a change back to a more natural temperature cycle. However, it would still be healthy seagrass, as shown by the condition of nearby seagrass beds outside of the existing refinery plume. The warmer temperature discharge over more than 60 years has shown that seagrass is tolerant of temperature changes. The limiting factor for seagrass growth is more likely to be available light, sediment characteristics and predation.

The pattern and concentrations of the chlorine plume would essentially be the same as the existing situation with the refinery discharge as the same volume of seawater and concentration of residual chlorine would be discharged, with a minor effect of reduced spreading due to the lower temperature of the discharge plumes than existing (see Figure 5-7).

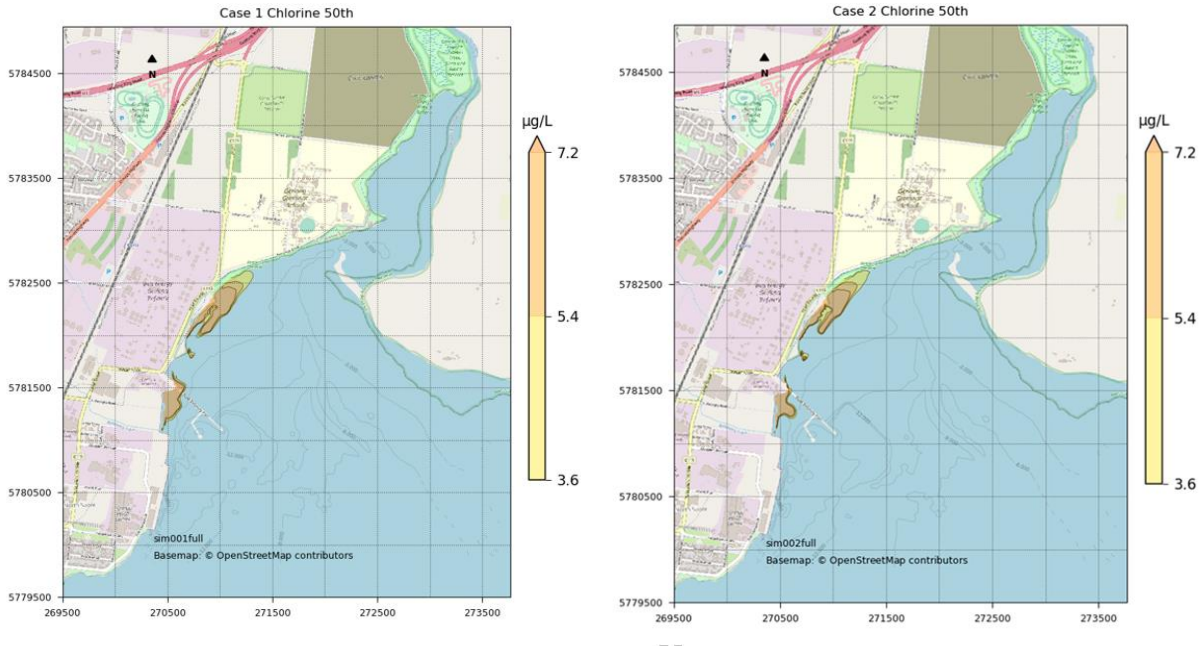
As the proposed discharge of cooled seawater from the FSRU through the refinery does not result in a substantial change in concentration of chlorine from the existing refinery discharge plumes, the project is unlikely to impact on seagrass extent in Corio Bay or food resources for migratory shorebirds. Therefore, discharges from the FSRU through the refinery would not have a significant impact on the ecological character of the Ramsar site.



a) Existing discharge

b) Discharge with the project

Figure 5-6 Predicted 50-percentile temperature change for a) existing situation and b) future situation - peak flow through refinery



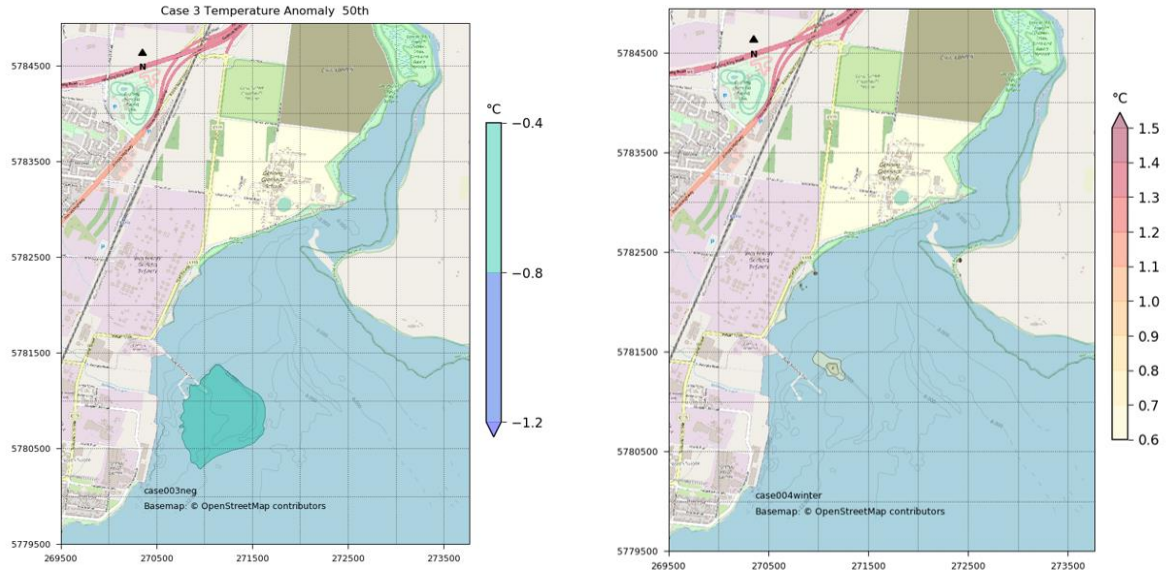
a) Existing discharge

b) Discharge with the project

Figure 5-7 Predicted 50-percentile chlorine plume for a) existing situation and b) future situation - peak flow through refinery

Discharge through diffuser or closed loop operation

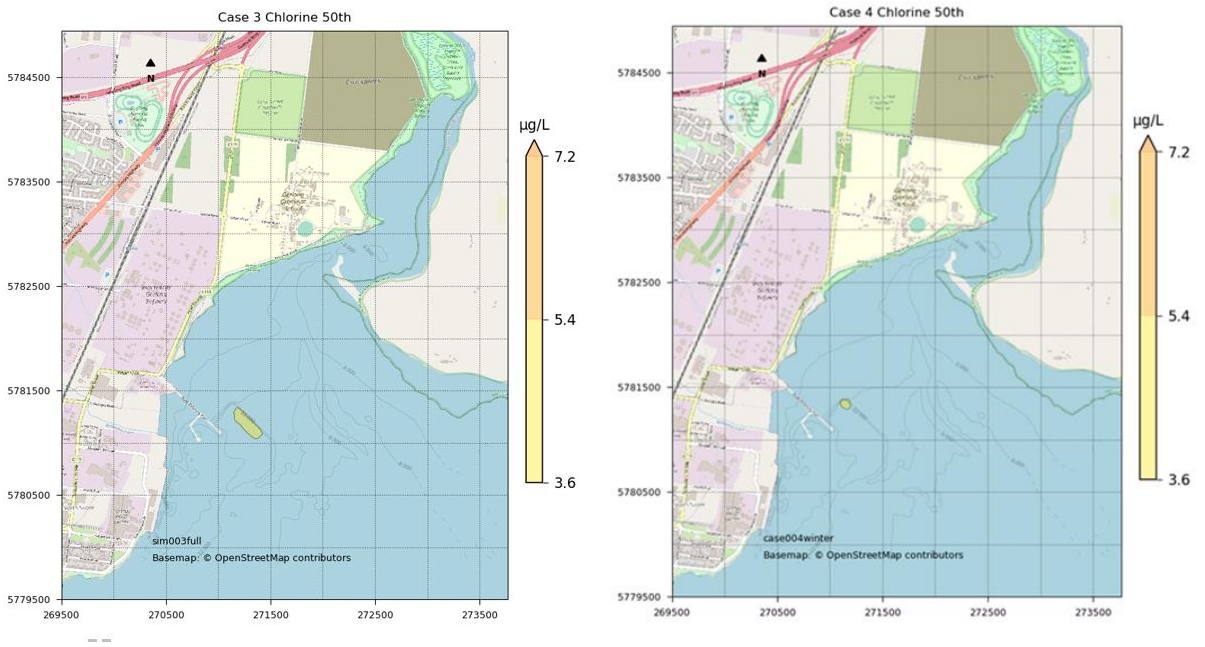
Alternately, discharge from the FSRU may occur through a cold-water discharge via the diffuser located on the proposed pier extension or limited discharge of warm water from closed loop operation. Both of these backup modes of operation are unlikely to be used on many days each year. If such discharge modes are utilised, there would be high dilution so the resulting plume would have a chlorine concentration of less than 5 micrograms per litre (µg/L) and a temperature rise of less than 1°C outside a small mixing zone. Such thermal plumes are classified as low to no risk to Limeburners Bay and the Ramsar site.



a) Diffuser cold water discharge

b) Closed loop warm water discharge

Figure 5-8 Predicted 50-percentile temperature change for a) diffuser and b) closed loop operation



a) Diffuser chlorine plume

b) Closed loop chlorine plume

Figure 5-9 Predicted 50-percentile chlorine plume for a) diffuser and b) closed loop operation

The ecological character of the Ramsar site is unlikely to be impacted by discharges from the FSRU. Chlorine and temperature plumes would be well away from Limeburners Bay and the Ramsar site and have no impact on seagrass, mangroves and saltmarsh communities. Surveys of the seagrass beds under the existing plumes indicate that the refinery discharges over more than 60 years have not had a detectible adverse impact on seagrass or on the food chain associated with species found in the Ramsar site.

Management and mitigation measures

As a result of the project, there would be:

- No increase in seawater withdrawn from Corio Bay (350 ML/day whether all from the FSRU or in combination with the existing refinery intake depending on FSRU output)
- No increase in seawater discharge to Corio Bay (350 ML/day)
- No increase in chlorine discharge to Corio Bay
- Significant reduction in temperature of the plume from the refinery discharge.

For the limited occasions where the diffuser is used, the design of the proposed diffuser achieves a high initial dilution of 20:1 which ensures that the diluted discharge would have a chlorine concentration less than the chlorine guideline value and a temperature change from ambient of less than 0.4^{o}C.

Residual impacts and monitoring

No residual impacts to the ecological character of the Ramsar site are anticipated as a result of discharges to the marine environment.

The flow rate, temperature and residual chlorine concentration of all major discharges would be monitored and recorded to confirm that the values are within the guideline values or if remedial action is required.

5.1.2.2 Entrainment

Entrainment is the unwanted passage of fish or small marine organisms through a water intake. Entrainment of fish larvae or plankton that may spawn in the Ramsar site including Limeburners Bay could affect the food chain and in turn the ecological character of the Ramsar site and food availability for migratory shorebirds.

A detailed survey of plankton (phytoplankton, zooplankton and ichthyoplankton (fish eggs and fish larvae)) in Corio Bay was conducted as part of the marine ecology and water quality impact assessment from November 2020 to November 2021, to assess the spatial distribution of plankton in Corio Bay and the effects of the circulation patterns, channel deepening and refinery use of seawater for cooling. The sampling included collection and identification of phytoplankton, zooplankton and ichthyoplankton at up to ten sites in Corio Bay. One sampling site was in the existing refinery seawater inlet, with the other nine sites distributed around Corio Bay and the Geelong Arm of Port Phillip Bay. An analysis of the results show that the plankton distribution was well mixed through the Bay with no significant difference detected between plankton in North Corio, South Corio and the Geelong Arm. Data about plankton abundance, distribution and seasonality in Corio Bay was collected as part of the 12-month monitoring program and this data formed an integral part of the entrainment modelling conducted for the project.

Modelling of particle movement in Corio Bay using neutrally buoyant particles as a proxy for fish larvae and plankton indicates that the potential impact of entrainment of fish larvae and plankton from the Ramsar site and Limeburners Bay is negligible. Dispersion simulations of plankton and larvae released at the Ramsar site along north coast of Corio Bay and fish breeding areas in northern and southern Corio Bay indicated that approximately half of the plankton and larvae from the Ramsar site move out of Corio Bay into Port Phillip after seven days. Very few plankton and larvae migrate down the west coast of Corio Bay and many remain in the north of Corio Bay near the Ramsar site. After 14 and 28 days the plankton and larvae are more evenly dispersed but there are still more present in Port Phillip Bay than Corio Bay.

The proportion of plankton and larvae from the Ramsar site that would be entrained by the proposed FSRU intake is modelled to be very small – none in 7 days and no more than 0.26% in 28 days. This is a very small proportion of the natural rate of reproduction of phytoplankton and zooplankton and indicates that the seawater intake would have a negligible effect on plankton populations in Corio Bay. The proposed FSRU intake would result in slight increases in entrainment of plankton and larvae from the Ramsar site and northern and southern Corio Bay, compared to the 0.12% of plankton from the Ramsar site currently entrained at the refinery inlet (see Table 5-1).

Table 5-1 Summary of proportion of particles entrained from the Ramsar site, northern Corio Bay and southern Corio Bay

Days since release	Ramsar site		North Corio Bay		South Corio Bay		Remainder	
	Refinery	FSRU	Refinery	FSRU	Refinery	FSRU	Refinery	FSRU
7 days	0.00%	0.00%	0.05%	0.10%	0.00%	0.00%	99.95%	99.90%
14 days	0.01%	0.06%	0.18%	0.36%	0.00%	0.06%	99.81%	99.52%
28 days	0.12%	0.26%	0.34%	0.66%	0.10%	0.39%	99.44%	98.69%

Phytoplankton mostly have a short life cycle (a day or so) and any entrained at the refinery inlet or the FSRU intake are likely to be developing locally and not from the Ramsar site. Zooplankton have a life cycle of around 14 days and the results show that entrainment rates are negligible in relation to natural factors (> 99 % loss). The majority of fish larvae from the Ramsar site including Limeburners Bay are dispersed into Port Phillip Bay and the potential entrainment after 28 days is less than 0.5%, which is very small in comparison with natural predation and other losses.

Overall, the potential impacts of plankton and larvae entrainment from operation of the FSRU are considered to be negligible on populations and species diversity and considered to have no impact on the food chain supporting species in Corio Bay and the Ramsar site.

Anecdotal reports from the refinery operator indicate that fish are seldom captured on the existing refinery intake screens, although seaweed and seagrass are an issue, particularly after storms. Observations of the existing Geelong Refinery cooling water intake confirmed that small fish were able to out-swim the net inward drift into the channel. The existing intake velocity of 0.15 metres per second (m/s) complies with the requirements set out by the US EPA in 2004 for the design of cooling water intake structures. The US EPA guideline requires that the intake velocity should allow the escape of most species of fish at their different life stages. The data suggested that a 0.5 ft/s (0.15 m/s) velocity would protect 96% of the tested fish.

Management and mitigation measures

To minimise the capture of small and large fish or other free-swimming biota moving in the shipping channel near the FSRU intake, the FSRU seawater intake would adopt an intake velocity of 0.15 m/s, which would provide the same level of protection as the existing refinery intake and is consistent with the US EPA Guideline value adopted for projects of this nature. The intake on the FSRU would also have a screen with apertures less than 100 mm which would prevent large objects and seaweed from being carried into the intake.

Residual impacts

The current refinery seawater intake has negligible effect on phytoplankton, zooplankton and fish larvae populations in Corio Bay and the proposed FSRU intake would also have negligible impact. No residual impacts on the ecological character of the Ramsar site or food availability for migratory shorebirds are anticipated as a result of entrainment during operation of the FSRU as entrainment rates are minor in comparison to natural predation and other natural losses. The use and discharge of seawater for the project would not add or subtract any nutrients or organic carbon from the marine ecosystem.

5.1.2.3 Additional shipping movements

Up to 45 LNG carriers would be received at Refinery Pier each year to transfer LNG to the FSRU. This represents an equivalent of up to 90 ship movements through the channel each year. Currently, approximately 280 vessels come into berth at Refinery Pier each year, and over 600 ships use the Port of Geelong each year. Each LNG carrier would be accompanied by two tugboats to bring them in and out of the port.

These additional shipping movements have the potential to:

- Increase the risk of spills and collisions
- Cause local turbidity and re-suspend sediments in their wake
- Introduce invasive species.

There would be a marginal increase in the risk of a spill due to increased shipping movements in Corio Bay. LNG carriers carry less oil and fuel than the tankers currently visiting Corio Bay as they use LNG as a fuel source and have multiple inbuilt protections including double hulls, coffer dams inside the vessel to contain internal spills and storage in multiple tanks to minimise the potential for an extensive spill from a tank rupture. Vessels entering and leaving Corio Bay have defined speed limits assisted by tugboats, which reduces the potential issues related to vessel navigation, and subsequent collisions and spills. As such, the environmental consequence of a spill in Corio Bay would not be greater than the current risk to the Ramsar site from existing vessels.

Tugboats would re-suspend sediment from propeller wash, mainly within the dredged channels, and this has been occurring at the Port of Geelong for many years. Seagrass areas are well away from the operating zone for tugboats and the re-suspended sediment settles well before reaching the seagrass areas or the Ramsar site. Effects on phytoplankton are transitory and minor. Overall, the effects of turbidity from additional tugboat movements associated with the project would be localised and minor and would not impact the Ramsar site.

The project has the potential to introduce pest species into the bay attached to the hull or in the ballast water of an international vessel. LNG carriers are unlikely to discharge ballast water within Corio Bay as they would be taking in ballast water while unloading their cargo. Marine pest introduction to Australian waters from shipping is rigorously managed by the Australian Government through the implementation of the National Plan for Marine Pest Biosecurity 2018-2023 (DAWR, 2018). It is well known that Port Phillip and Corio Bay have an established community of introduced marine pests. The additional vessels to the port each year would not pose a significant increase in the potential for pest species to enter the Corio Bay and the Ramsar site as Viva Energy has additional protocols in place over and above Government requirements.

Management and mitigation measures

As an established refinery that has been receiving and handling large quantities of oils and diesel for many years, Viva Energy has developed and tested effective methods for preventing, controlling and

dealing with small and large spills in Corio Bay. Viva Energy has also developed a response plan for spills that occur in Corio Bay. Spill avoidance measures at Refinery Pier include:

- Checking that all drains and sumps are sealed and do not leak into the bay.
- Maintaining all loading arms, loading and discharge hoses in good order.
- Checking that all surface water drainage valves on Berth 3 and 4 are closed whilst a ship is loading or discharging.
- Pumping out jetty sumps and collection vessels regularly to prevent overflowing.
- Before any cargo movement between ship and shore commences, the ship must have all its scuppers plugged and drip trays in position. Sea and overboard discharge valves are to be closed and lashed.
- Checking that all manifolds have a fitted blind flange; all back valves are closed, and dry break couplers are clean and functional.
- On commencement of loading or discharging, ensuring that manifold pressure does not exceed defined limits (10 bar for hoses, 12 bar for loading arms) to minimise the likelihood of a hose rupture or leak.
- Stop pumping immediately if the pressure exceeds the above operating pressure and have the ship and/or shoreline pumps and lines checked.
- If the pressure on any hose exceeds 12 bar, the hose must be taken out of service and tested.
- Only operating transfers when all these requirements are satisfied.

Measures to control and minimise the introduction of marine pests from international vessels include:

- Carriers have antifoul coating to prevent biota encrusting on the hull
- Vessels from certain ports would be cleaned before entry is allowed
- International vessels would empty ballast water in accordance with the latest version of the Australian Ballast Water Management Requirements (DAWE, 2020)
- If an imported pest is identified or suspected, then the vessel would be managed in accordance with biosecurity requirements of the *Biosecurity Act 2015*
- Vessel management activities would adhere to the National System for the Prevention and Management of Marine Pest Incursions.

Residual impacts

The additional shipping movements for the project would not have a significant impact on the Ramsar site. There would not be a substantial increase in shipping movements in the context of the ships already using the Port of Geelong each year, and LNG carriers would follow the protocols already in present within the Port of Geelong and at Refinery Pier to minimise risks of spills, collisions and introduced pest species.

5.1.3 Decommissioning

Decommissioning of the project would involve:

- Leaving the underground pipeline in situ (subject to landholder agreements) and either decommissioned completely or placed into care and maintenance.
- FSRU leaving Corio Bay on completion of the project to be used elsewhere.
- Refinery Pier berth and facilities retained for other port related uses.

Impacts on terrestrial ecological values are not anticipated to occur as the underground pipeline would remain in situ. The FSRU leaving port represents a single ship movement and the continued use of Refinery Pier means there would be no need to remove the structure.

Management and mitigation recommendations

No management and mitigation measures are recommended as decommissioning of the project is not anticipated to result in impacts to ecological values.

Residual impacts

No residual impacts on the ecological character of the Ramsar site are anticipated as a result of decommissioning of the project.

5.1.4 Summary of assessment of impact on Ramsar site

The marine and terrestrial ecology assessments conducted for the EES concluded that the ecological character of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site would not be impacted. The assessment of the project's potential effects on the Ramsar site values is summarised in Table 2.

Table 2 Assessment of values of the Ramsar site

Value	Conclusion of assessment
Critical components and processes	
Hydrology	There would be no change in hydrological inputs as there are no catchment watercourses in the project area, or to the intertidal mudflat area or wetland bathymetry. Seawater intake and discharge would be as per the existing volumes from the Geelong Refinery.
Vegetation	*Seagrass* – there would be no loss of seagrass in the coastal areas adjacent to Point Wilson / Limeburners Bay and turbidity impacts on seagrass during dredging would be localised, of short duration and sediment settlement would not be at levels where seagrass could be smothered. Turbidity monitoring would be undertaken continuously at the main seagrass beds at the boundary of the Ramsar site during dredging to identify if action is required to restrict sediment releases. *Saltmarsh* – there would be no loss of saltmarsh. *Mangroves* – there would be no loss of mangroves.
Native fish	There would be no effects on adult fish however there would be minor changes in the proportion of entrainment of fish eggs and larvae, which would have negligible effects on native fish species populations, Fish habitats and food sources are not adversely affected, and water quality is maintained within guidelines.
Waterbird diversity and abundance	There is no project infrastructure located in or near the Ramsar site which could impact on habitat and species diversity. There would be no change in zooplankton availability that would affect the food chain of waterbirds due to dredging or operation of the FSRU. Disturbance effects from noise, light and additional shipping movements are unlikely to impact waterbird abundance at the Ramsar site.
Waterbird breeding	There would be no effect on waterbird breeding at the Ramsar site as habitat is not affected, there is no impact on food availability and noise levels are below those known to impact birdlife.
Critical benefits and services	
Provides physical habitat (for waterbirds)	The physical habitat for waterbirds at the Ramsar site would not be affected. There would not be an effect on food resources for waterbirds at the Ramsar site, including zooplankton and marine invertebrates. Infauna monitoring would be undertaken closer to the dredging site to detect any significant changes to infauna communities in the dredged area and the recovery of the spoil disposal area.

Value	Conclusion of assessment
Provides nursery habitat for native fish	There would be no loss of saltmarsh and seagrass communities that provide significant nursery habitats for juvenile fish. Dredging would be avoided during spring, which is the season for high growth of seagrass and phytoplankton, and the season when key species of fish are in larval or juvenile stages.
Threatened wetland species and ecosystems	There are no significant impact pathways from marine operations for threatened fauna, including migratory shorebirds. The nationally vulnerable Subtropical and Temperate Coastal Saltmarsh community would also not be affected.
Ecological connectivity	The connection between the marine, estuarine and freshwater components of the Ramsar site would not be impacted. There would not be a significant change in sedimentation patterns during dredging or operation of the project.

5.2 Threatened species and ecological communities

An action will require approval if the action has, will have, or is likely to have a significant impact on a species listed in any of the following categories:

- Extinct in the wild
- Critically endangered
- Endangered, or
- Vulnerable.

The assessment against the significant impact criteria indicates that the project would not have a significant impact on threatened species and ecological communities. No threatened flora species or ecological communities would be removed for the project. The pipeline study area is not considered to have habitat that is critical to the survival of threatened fauna species due to the degree of modification and past disturbance. Threatened marine species, if present in Corio Bay, would likely be habituated to the existing port environment and are unlikely to be significantly impacted by the project.

5.2.1 Marine species

Construction and operation of the project would contribute to the underwater soundscape in the Port of Geelong and has the potential to lead to noise-induced impacts on marine fauna in Corio Bay. Potential noise-induced effects on marine fauna can range from increased stress, behavioural responses, and acoustic masking to hearing impairment or non-auditory injuries. Fish and marine mammals close to the construction zone may temporarily avoid the area during the period of pier construction, particularly piling.

The potential noise-induced impacts for marine fauna arising from the planned project activities are not considered severe. Due to the existing acoustic condition, dominated by continuous noise mostly emitted by vessels, it is very likely that the animals are already accustomed (habituated) to living in a noisy environment and those individuals more sensitive to noise have long left the area.

The behavioural impact ranges for operational FSRU and LNG carrier underwater noise were modelled to extend to 1.46 km for marine mammals, and temporary threshold shift (TTS) ranges (which could result in temporary hearing loss) are limited to a maximum of 40 m. The predicted ranges of exceedance of the behavioural threshold are however an overestimation of the true extent, given that the average ambient noise level already exceeds that threshold (animals in Corio Bay, in other words, are exposed daily to sustained noise levels supposed to elicit behavioural responses), and the behavioural impact from the FSRU and LNG carrier would not extend as far as modelled. TTS is unlikely to occur in marine mammals, fish species or diving birds from exposure to operational noise as the impact range is small and, moreover, this criterion is highly conservative as it is based on assuming a receiver being stationary in this sound field over 24-48 hours. It is unlikely that the operation of the new facility, which would have a relatively small acoustic and impact range will lead to behavioural responses by threatened marine fauna on an ecologically relevant level.

Similarly, the project would incrementally increase light levels in the Corio Bay, the most significant effect being light spill for approximately 400 metres around the FSRU and LNG carrier. Lighting for an extended period may influence marine fauna including fish and other pelagic species (e.g., zooplankton, squid, and larval fish) that are attracted to light. Given the existing levels of lighting associated with the port and industrialised nature of the project site, the minor increase in artificial light and application of best practice to the design of new lighting, it is considered that the adverse effects of extra lighting on threatened marine species would be negligible.

The operation of the project would see additional vessels (LNG carriers) entering Corio Bay. This has the potential to increase the risk of vessels striking threatened marine fauna (whales), causing injury and death. Whale strikes are very unlikely to occur in Corio Bay as whales do not habituate the area but could occur in Bass Strait or anywhere along the coast of Australia.

It is unlikely that the additional LNG carriers would introduce pest species that would cause threatened marine species in Corio Bay to decline as the bay is already known to have an established community of introduced marine pests.

Management and mitigation measures

Measures would be implemented during piling operations or other noisy aspects of pier construction to minimise impacts on marine species. These could include choosing the quietest operational technique possible, slow start for noisy activities to enable marine species in the area to move away and reducing pile driving effort. These measures would be included in the Construction Environmental Management Plan.

The National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (DEE, 2017) lists three main mitigation measures – keeping vessels away from whales, slowing vessel speeds and avoidance manoeuvres. All of these measures would be implemented for LNG carriers in or approaching Port Phillip and Corio Bay with speeds controlled within the shipping channels and tugs used for mooring.

Residual impact

The residual impact on threatened marine species is not anticipated to be significant, as individuals, such as whales, White Sharks or Leatherback Turtles, if present, are likely habituated to the existing industrialised environment of Corio Bay or would be able swim away from temporary areas of disturbance. Increased shipping movement increases the risk of vessel strikes; however, this low risk already exists in Corio Bay, and would be unlikely to cause a species to decline.

5.2.2 Terrestrial species

No nationally threatened flora species are likely to occur within the project area and therefore are unlikely to be impacted by the project.

Swift Parrot and Grey-headed Flying-fox may occasionally use the planted eucalypts within the pipeline study area to forage or rest despite the canopy of trees not being mature. The construction footprint avoids most planted trees and those that may be lost are an occasional and marginal resource that extends beyond the construction footprint. These species are unlikely to be significantly impacted by the loss of a maximum of 0.354 ha of planted overstorey trees.

Golden Sun Moth may occur in mown Chilean Needle-grass adjacent to the SWP connection point and, to a lesser extent, along the roadside of Macgregor Court between Bell Road and Cummins Road which supports regularly mown patches of native wallaby grass and introduced Chilean Needle-grass. Horizontal direction drilling (HDD) between Bell Road and north of Cummins Road would avoid removal of potential habitat for Golden Sun Moth along the roadside of Macgregor Court.

Management and mitigation measures

Retention of planted eucalypt species at the edge of the construction footprint where possible (between School Road and the Corio Native Grassland Reserve) within the paddocks and protection with fencing would minimise removal of marginal Swift Parrot and Grey-headed Flying-fox potential habitat.

Measures to further minimise impacts on potential Golden Sun Moth habitat at Lara City Gate include:

- Fencing the construction footprint to contain disturbance of the ground to within the works area

- Where appropriate, using trenching techniques that minimise disturbance to planted eucalypts
- Minimising the footprint and prioritising placement in areas with little to no Chilean Needle-grass.

Residual impact

Residual impacts on threatened terrestrial species are summarised in Table 3.

Table 3 Summary of EPBC Act-listed threatened species and residual impacts

Value	Residual impact	Significant impact*?
Swift Parrot	Loss of 0.354 ha potential occasional and marginal foraging resource comprised of planted trees.	No
Grey-headed Flying-fox		No
Golden Sun Moth	Loss of 0.48 ha of Chilean Needle-grass habitat around Lara City Gate. Loss of up to 0.001 ha of Plains Grassland (which is not an EPBC-listed ecological community) on the roadside west of Macgregor Court to accommodate HDD drilling.	No

*Significant impact relates to whether a residual impact meets criteria for significant impact in significant impact guidelines (DoE 2013).

The full extent of removal of planted eucalypts within the construction footprint would not be known until the detailed design has been finalised and mitigation measures to be implemented by the project are confirmed. A maximum of 0.354 ha of planted overstorey trees have the potential to be removed. Similar habitat would be retained adjacent to the pipeline route.

Construction of the pipeline at the connection to the SWP at Lara City Gate would remove 0.512 hectares of modified grassland containing a cover of at least 25% Chilean Needle-grass from within the construction footprint. Of this, 0.48 hectares is considered to be potential habitat for Golden Sun Moth. The location of the works area is at the northern edge of the more extensive area of habitat which extends to the south and north within the public recreation reserve. The construction area is the more heavily disturbed portion of the park and aligns with existing access tracks and areas disturbed during installation of Lara City Gate.

As discussed in Section 3.3.3, whilst this area is considered to be low quality habitat for the species, in the absence of targeted assessments and in line with a precautionary approach, Golden Sun Moth has been assumed present.

An assessment of impact on Golden Sun Moth against the significant impact criteria for vulnerable species in *Matters of National Environmental Significance Significant impact guidelines 1.1 - Environment Protection and Biodiversity Conservation Act 1999* (DoE, 2013) is presented in Table 4.

Table 4 Significant impact assessment for Golden Sun Moth

Significant impact criteria for vulnerable species	Criteria met?	Discussion
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	No	The construction footprint west of Shell Parade/Macgregor Court is partly directionally drilled. The impacts are unlikely to result in long-term decline of the species, due to the localised disturbance and the historically modified nature of the area nominated as the construction footprint. Regular slashing of the area of public open space

Significant impact criteria for vulnerable species	Criteria met?	Discussion
		beyond the Lara City Gate is maintaining an open structure of Chilean Needle-grass that would be retained to continue to provide habitat for the species (if present).
Reduce the area of occupancy of an important population	No	The loss of 0.512 ha of Chilean Needle-grass (of which 0.48 ha considered potential habitat) in a more disturbed section of a larger area of habitat is a localised impact and would therefore not reduce the area of occupancy of an important population (if present).
Fragment an existing important population into two or more populations	No	The habitat around Lara City Gate is isolated by Geelong Road (Princes Freeway) and low intensity residential areas. The construction footprint is confined to the northern edge of the broader area of Chilean Needle-grass that extends to the east and south.
Adversely affect habitat critical to the survival of a species	No	The habitat present is not habitat critical to the survival of the species. Chilean Needle-grass is the dominant species, and the area is not native grassland, grassy woodland or derived native grassland.
Disrupt the breeding cycle of an important population	No	Removal of 0.512 ha of Chilean Needle-grass within the construction footprint (of which 0.48 ha considered potential habitat) would not disrupt the breeding cycle of Golden Sun Moth as the more extensive area of habitat retained within the surrounding Hovells Creek Reserve provides this opportunity if the species is present.
Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	This impact is unlikely. The construction footprint is confined to the northern edge of the broader area of Chilean Needle-grass that extends to the east and south and in an area that is less dominated by Chilean Needle-grass and that is subject to current disturbance with access tracks. Loss of 0.512 ha of Chilean Needle-grass habitat (of which 0.48 ha considered potential habitat) is unlikely to contribute to the decline of the species (if present), particularly in the context of extent of habitat that would be retained in the area of public open space.
Result in invasive species that are harmful to a vulnerable species becoming established in the species' habitat	No	Hygiene controls would be employed to mitigate this potential impact. This impact is unlikely.
Introduce disease that may cause the species to decline	No	Hygiene controls would be employed to mitigate this potential impact. This impact is unlikely.
Interfere substantially with the recovery of the species	No	Potential impacts are limited to potential dispersal habitat and unlikely to interfere with the species recovery.

5.2.3 Threatened ecological communities

No EPBC Act listed ecological community would be impacted by the project.

NTGVVP does not occur within the pipeline study area and would not be removed or impacted. Subtropical and Temperate Coastal Saltmarsh occurs within the pipeline study area; however, it occurs outside of the construction footprint on the foreshore reserve and would not be removed or impacted. As a threatened ecological community listed in the vulnerable category, this ecological community it is not considered an MNES for assessment purposes, although it is considered as part of the critical CPS of the Ramsar site.

Management and mitigation measures

No go zones (NGZs) would be defined as areas where works are not permitted. NGZs would protect sites of known significant ecological values including areas adjacent to the Corio Native Grassland Reserve, with particular emphasis on sections adjacent to mapped NTGVVP and in areas where the alignment traverses areas of Western (Basalt) Plains Grassland.

NGZs would form part of the requirements outlined in the Construction Environment Management Plan for the works.

Residual impacts

As there would be no removal of NTGVVP and Subtropical and Temperate Coastal Saltmarsh for the project, no residual impacts on threatened ecological communities are anticipated.

5.3 Migratory species

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.

5.3.1 Migratory shorebirds

Migratory shorebirds are unlikely to be impacted by construction or operation of the onshore pipeline. Marginal habitat occurs for a few of the non-threatened migratory species on the shoreline of Corio Bay adjacent to the existing refinery and adjacent to the pipeline construction footprint. Shorebirds were not observed utilising this shoreline during surveys in 2021 (AECOM, 2021 – Appendix D).

5.3.1.1 Impacts on food resources

As described in Section 5.1.1.1, an increase in turbidity and reduced light availability in the waters around the Refinery Pier during the 8-week dredging program would have minimal effects on seagrass meadows as there is no seagrass in the area to be dredged. The EES studies indicate that the settling of sediments would be significantly below the levels where there would be potential for smothering effects. Dredging is unlikely to have any impact on the availability of food for migratory shorebirds or other waterbirds dredging is predicted to have very limited, short duration effects on primary production (plankton and larvae) in Corio Bay. Conducting the dredging outside of the spring season when primary production is at its peak would further reduce the potential for adverse impacts.

Discharges to the marine environment due to operation of the FSRU are also unlikely to affect seagrass extent and food resources for migratory shorebirds as described in Section 5.1.2.1. No impact on seagrass beds or Ramsar species has been detected due to the existing operational discharges from the Geelong Refinery which have been in place for more than 60 years. This provides confidence that there would be no adverse impacts on marine biota (food sources for Ramsar species) from the project which, through reuse of the FSRU discharge water in the refinery for cooling water, results in a

discharge with the same residual chlorine level and temperatures closer to ambient than the current situation.

Mitigation and management measures

Mitigation and management measures to minimise impacts to seagrass habitat for the dredging phase of works and operation phase are described in Section 5.1.1.1 and 5.1.2.1 respectively.

Residual impact

With the implementation of mitigation measures, no residual impacts on migratory shorebird food resources are anticipated.

5.3.1.2 Noise impacts

Noise can create disturbance to birds and increase predator vigilance which reduces foraging efficiency and therefore food intake. This is of particular concern to migratory shorebirds who need to maximise their energy consumption and stores before they undertaken the long flight back to their breeding grounds.

Construction noise modelling conducted for the EES suggests that airborne noise from the project would likely be minimal at the intertidal areas of Point Abeona, Limeburners Bay and Avalon Beach.

Noise modelling suggests that the construction of the Refinery Pier extension is unlikely to alter airborne noise levels in Limeburners Bay above current levels but would increase noise levels from 39dB(A) to 46 dB(A) in the Avalon area. However, this predicted increase in noise levels in the Avalon area is lower than the >60 dB(A) levels at which responses have been detected in some birds from aircraft noise at Avalon (Weston et al., 1995).

The source of airborne noise during operation of the project would be regular and at a distance from known locations of migratory shorebirds (>1.4 km away from Limeburners Bay and >3 km from the former Avalon Saltworks). The predicted noise levels at these locations are also lower than the >60 dB(A) levels at which responses have been detected in birds.

Mitigation and management measures

Timing the dredging and piling works outside the peak time when migratory shorebirds are present (generally late spring to late summer) would help to reduce potential risks associated with noise during construction. Monitoring of shorebirds at the Western Treatment Plant indicate that numbers of shorebirds gradually increase over spring, peak in late summer (coinciding with the timing of annual summer counts since 1981) and lowest in winter (Loyn et al., 2014). Given that the predicted worst-case scenario noise levels do not exceed current levels in Limeburners Bay, it is not critical that this timing be achieved.

Residual impact

As migratory bird species are unlikely to be affected by construction or operation noise at their known roosting or foraging locations, no residual impacts are anticipated. It is expected that all noise mitigation and management applied to construction activities will minimise the risk of noise emissions within natural areas as far as reasonably practicable. Wildlife is more likely to adapt to sources of noise which are regular, lower in noise level and further away.

5.3.1.3 Lighting impacts

Lighting can cause disorientation of animals accustomed to navigating in a dark environment. Entrapment of species attracted to artificial light and can deter (repulse) wildlife from using habitat subject to light spill for reasons such as lighting making roosting shorebirds more visible to predators (Longcore and Rich, 2004; DoEE, 2020). There is some evidence that lighting could provide greater visual foraging opportunities at night which may benefit some species of shorebird (DoEE, 2020). Tall lighted structures have been shown to cause mortality of migratory birds (Longcore and Rich, 2004).

The project is located in a highly modified port and industrial environment with extensive existing lighting, therefore species utilising habitats in proximity to the facility are likely to be adapted to the existing light pollution in the landscape.

Shorebirds, particularly migratory species, were not recorded on the shoreline of Corio Bay adjacent to the refinery, which is heavily industrialised (AECOM, 2021 – Appendix D). The shoreline in the vicinity of the existing pier is unlikely to be providing a nocturnal roost for shorebirds either as it is already subject to noise and light from the refinery and visitation of the area by people. Migratory shorebirds are unlikely to be reliant on following the shoreline of Corio Bay to move between the south and north of the bay and segments of the Ramsar site to the north-east and south of the Limeburners Bay Point Wilson section as they are capable of long-distance movements over open expanses of water. This suggests that any additional light associated with construction or operation of the project in the existing modified environment is unlikely to affect migratory shorebirds.

Management and mitigation measures

Although light spill would be contained within an environment already subject to artificial lighting, the effect of artificial light on migratory shorebirds is understudied and a precautionary approach should be adopted when managing potential effects from light.

The number, type and layout of lights would be designed to light only the construction or operational area with reference to the National Light Pollution Guidelines for Wildlife including marine turtles, seabirds and migratory shorebirds (DoEE, 2020). The design would:

- Keep lights close to the ground
- Direct and shield lights to avoid light spill beyond the construction area
- Use lowest intensity lighting appropriate for the specific purpose
- Use lights with reduced or filtered blue, violet and ultra-violet wavelengths
- Avoid the use of Light Emitting Diodes (LEDs) if possible.

Residual impacts

No residual impacts of lighting are anticipated on migratory shorebirds.

5.3.2 Migratory marine species

As described in Section 4.2, migratory marine species that may be present in Corio Bay include individuals of Leatherback Turtle and White Shark. If present, these species have the capacity to avoid areas of disturbance or could be habituated to the existing industrial environment and would not be significantly impacted by the project. Given the wide availability of habitat for migratory marine species external to Corio Bay, it is considered that the project is unlikely to have a significant impact on migratory marine species.

6.0 Conclusion

The EES determined that significant impacts to MNES are unlikely.

Dredging at Refinery Pier would have temporary and minor residual impacts on marine ecological values in Corio Bay due to increased turbidity, however, sediment plumes associated with the proposed dredging do not extend to Limeburners Bay. Residual impacts are anticipated to be a localised and short duration reduction in primary productivity of phytoplankton and the loss of infauna (animals living in sediment) in the dredged area until they re-establish, which would not have a significant impact on MNES. There would be no loss of seagrass in the Ramsar site or reduction in available food sources for migratory shorebirds.

Discharges of seawater to the marine environment during the usual open loop operating mode of the FSRU would be via the existing Geelong Refinery seawater outlets. The discharge would be the same volume as at present, with the same residual chlorine level and a temperature closer to ambient than the current refinery discharge reducing the extent of the current temperature plume. Both the temperature plume and the chlorine plume during operation of the project do not extend to Limeburners Bay or the Ramsar site and no adverse impacts on seagrass habitat or marine biota are anticipated. Surveys of the seagrass beds and marine biota under the existing plumes indicate that the refinery discharges over the last 60 years or more have not had a detectible adverse impact on seagrass or marine biota. In fact, seagrass in the vicinity is abundant and healthy, sea urchins, which are

considered to be sensitive to chlorine, are abundant in the current discharge plume, and tests on mussels from the vicinity showed no detectable residual chlorine. It is possible that the seagrass along the north shore of Corio Bay could respond to a change back to a more natural temperature cycle. However, it would still be healthy seagrass, as shown by the condition of nearby seagrass beds. The limiting factor for seagrass growth is more likely to be available light, sediment characteristics and predation.

As the discharge from the project is the same as the current refinery discharge (with an improvement in temperature), some level of confidence can be held that the current healthy condition of the marine environment would be maintained.

Noise, lighting, and increased shipping movements during construction and operation of the project are unlikely to have significant impacts on threatened or migratory fauna species. If present, these species are likely habituated to the existing industrial activities associated with the Port of Geelong and Refinery Pier.

Residual impacts to threatened terrestrial species are comprised of loss of a small area of potential Chilean Needle-grass habitat for Golden Sun Moth which is unlikely to result in a significant impact, and loss of planted trees which are a marginal and widespread foraging resource for Swift Parrot and Grey-headed Flying-fox.

No significant residual impacts are anticipated for MNES protected under the EPBC Act with the implementation of the management and mitigation measures proposed for the project (as summarised in Chapter 14: *Environmental Management Framework*). As such, offsets in accordance with the EPBC Act Environmental Offsets Policy (DSEWPAC, 2012) are not required or proposed for the project.

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