Technical Report J

Landscape and visual impact assessment

Viva Energy Gas Terminal Project

Viva Energy Gas Terminal Project

EES Technical Report for Landscape and Visual Impact Assessment

Prepared by Hansen Partnership - DECEMBER 2021

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EXECUTIVE SUMMARY

This technical report provides a landscape and visual impact assessment conducted to support the Environment Effects Statement (EES) for the Viva Energy Gas Terminal project (the project).

In December 2020, the Victorian Minister for Planning determined that the project requires assessment through an EES under the Environment Effects Act 1978 (Vic). The reasons for the decision were primarily related to the potential for significant adverse effects on the marine environment of Corio Bay and the potential for contributing to greenhouse gas emissions. Secondarily, the EES was required to assess the effects of the project on air quality, noise, land use, Aboriginal and historic heritage, native vegetation, groundwater, traffic, and transport as well as visual amenity.

In January 2021, the project was also determined to require assessment and approval under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) due to the potential for the project to have a significant impact on wetlands of international importance, listed threatened species and communities, and listed migratory bird species. 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.

Overview

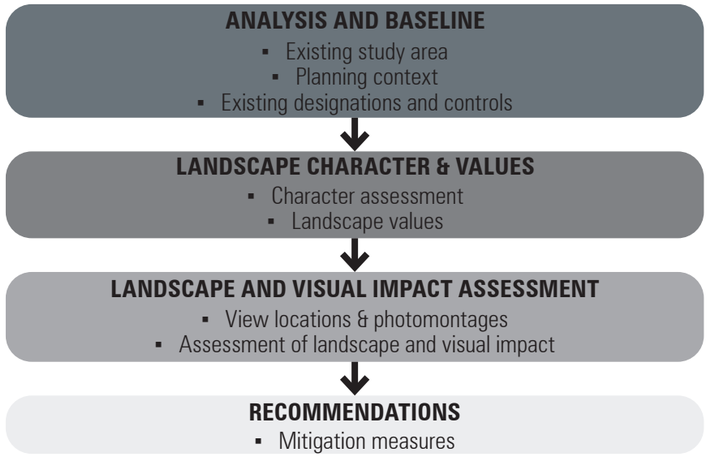
Viva Energy Gas Australia Pty Ltd (Viva Energy) is planning to develop a floating gas terminal using a ship known as a floating storage and regasification unit (FSRU), which would be continuously moored at Refinery Pier in Corio Bay, Geelong. The key objective of the project is to facilitate supply of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

The FSRU would store liquefied natural gas (LNG) received from visiting LNG carriers (that would moor directly adjacent to the FSRU), and regasify the LNG as required to meet industrial, commercial and residential customer demand. A 7 kilometre gas transmission pipeline would transfer the gas from the FSRU to the Victorian Transmission System (VTS) at Lara.

The gas terminal would be located adjacent to, and on, Viva Energy's Geelong Refinery in a heavily industrialised setting and would benefit from Viva Energy's experience and capability as an existing Major Hazard Facility (MHF) operator and potential synergies between the two facilities such as reuse of the FSRU seawater discharge within the refinery operations.

Methodology

This report documents the approach to the Landscape and Visual Impact Assessment (LVIA) undertaken by Hansen Partnership for the assessment of landscape and visual impact.



The LVIA report provides a detailed assessment of the existing landscape character and landscape values within the defined LVIA assessment study area encompassing land typically within 4km of the project footprint. This study area is based upon Zone of Theoretical Visibility (ZTV) mapping described in *Section 4.4* of this report. Baseline assessment is followed by an assessment of the potential impacts upon these values which could occur as a result of the project. Geelong Waterfront, which is located more than 4km from project footprint, was included in the visual assessment due to its high use, and significance within the local area.

The report includes a series of photomontage images as means of demonstrating the visual presence of the proposed Floating Storage Regasification Unity (FSRU), Liquefied Natural Gas carrier (when berthed next to the FSRU) and treatment facility from a series of view locations. This report does not include view location from vantage points within the bay itself as this assessment has been picked up in key views along the foreshore areas looking across the bay. Foreshore areas were chosen as they are more readily accessible to the public and therefore represent a higher sensitivity to the visual impact of the proposed project. View locations 1, 6 and 7 represents this assessment of the visual impact on key views across the bay.

The report subsequently provides recommendations with regard to appropriate mitigation measures to assist in ameliorating any resultant visual impact, where this is considered either necessary or desirable. It is imperative to ground the landscape assessment with a best practice methodology, which is outlined in *Section 4 Methodology.*

Existing Conditions

Landscape Values have been identified within seven Landscape Character Areas within the LVIA study area and their overall relative Landscape Value is as follows:

- Landscape Character Area 1: Coastal Wetland, which has been assessed as 'High' relative Landscape Value.
- Landscape Character Area 2: Flat Farmland, which has been assessed as 'Low' relative Landscape Value.
- Landscape Character Area 3: Suburban, which has been assessed as 'Low' relative Landscape Value.
- Landscape Character Area 4: Geelong Waterfront, which has been assessed as 'High' relative Landscape Value.
- Landscape Character Area 5: Geelong Grammer School, which has been assessed as 'High' relative Landscape Value.
- Landscape Character Area 6: Industrial Buffer, which has been assessed as 'Low' relative Landscape Value.
- Landscape Character Area 7: Industrial Precinct, which has been assessed as 'Low' relative Landscape Value.

These Landscape Character Areas contain landscapes that have statutory significance for their landscape and visual values in the planning scheme, or form part of landscapes that are designated for protection under the Ramsar Convention (Limeburners Burners Lagoon State Nature Reserve and the northern shorelines of Corio Bay).

Stakeholder Engagement

An extensive engagement and consultation program was undertaken to ensure that the community and interested stakeholders were informed, involved and able to actively contribute to the development of the project and preparation of the EES. The selection of viewpoints for this study was informed by concerns raised by stakeholders and the community during engagement sessions.

Construction Impact Assessment

The construction phase would take place over a period of 18 months. Construction works would not result in significant modifications or additions to the existing landscape as the majority of works would occur within the refinery and in the existing port. The pipeline extending north of the refinery would be an underground pipeline and does not cut through any significant vegetation. In addition, the potential visual impacts would be short term and temporary in nature.

Operation Impact Assessment

A Landscape and Visual Impact Assessment of seven sensitive views was undertaken. It was determined that with reference to the criteria for assessment of the view locations the visual impact of the proposed project infrastructure would be negligible to very low for one view, low for two views and moderate for four views. Based on these assessments, mitigation measures are only necessary along School Road adjacent to the treatment facility.

Decommissioning Impact Assessment

The FSRU, which continues to be an ocean-going vessel throughout the operation of the project, would leave Corio Bay on completion of the project life to be used elsewhere.

It is anticipated that the Refinery Pier berth and facilities would be retained for other port related uses. The underground pipeline would likely remain in situ subject to landholder agreements and either decommissioned completely or placed into care and maintenance arrangements. This would have negligible/low visual impact on the surrounding area as all retained elements are consistent within the existing industrial landscape.

Summary of Mitigation Measures

The impact assessment has determined that the potential impacts on the selected sensitive viewpoints range from low/negligible to moderate. Due to the existing industrial context of the proposed infrastructure, mitigation measures were not considered necessary for the majority of sensitive viewpoints with the exception of the treatment facility as this would be visible from School Road. Planting of advanced native trees is recommended at this location to screen the view of the treatment facility from the road.

Abbreviations

Abbreviation	Title
CEMP	Construction Environmental Management Plan
EES	Environment Effects Statement
LCA	Landscape Character Area
LVIA	Landscape and Visual Impact Assessment
TLVE	Theoretical Limit of Viewshed Extent
VLPWA	Visual Landscape and Planning in Western Australia
ZTV	Zone of Theoretical Visibility
FSRU	Floating Storage Regasification Unit
LNG	Liquefied natural gas
LNGC	Liquefied natural gas carrier
SWP	South West Pipeline
VTS	Victorian Transmiossion System

Glossary

The following terms and their definitions have been developed by Hansen Partnership with consideration of relevant LVIA guidance documents, primarily by the *Landscape Institute and Institute of Environmental Management & Assessment, Guidelines for Visual Impact Assessment, Third Edition, 2013* .

Term	Definition
Actual visual sensitivity	The actual visibility of a proposed project infrastructure from a particular view point. It is determined during the visual impact assessment phase and considers all existing features of the landscape - rather than a theoretical based viewshed.
Baseline Assessment	The assessment of existing landscape conditions and statutory designations relevant to the area of landscape within the site study area.
Baseline studies	Work done to determine and describe the environmental conditions against which any future changes can be measured or predicted and assessed.
Development	Any proposal that results in a change to the landscape and/or visual environment
Feature	Particularly prominent or eye-catching elements in the landscape, or a particular element of the Project proposal.
Landscape and Visual Impact Assessment (LVIA)	A tool used to identify and assess the likely significance of the effects of change resulting from development both on the landscape as an environmental resource in its own right and on people's views and visual amenity.
Landscape Character	A distinct, recognisable and consistent pattern of elements that occur in the landscape that make one landscape different from another, rather than better or worse.
Landscape Character Area	Distinct areas of landscape that are relatively homogenous in character and share a combination of geological, hydrological, topographical, drainage, vegetative, land use and settlement layout features.
Landscape Character Assessment	The process of identifying and describing variation in the character of the landscape, and the unique combination of elements and features that make a defined area of land distinctive.
Landscape Significance	The importance of a landscape as designated in statutory documents.
Landscape Value	The value of a landscape based upon its statutory designation and landscape preference indicators, according to the defined criteria for assessment.
Potential visual sensitivity	A designation applied within the LVIA process to land that is potentially visible from a proposed project infrastructure, and conversely, land from which the proposed project infrastructure would be visible. This is based upon the theoretical processes of viewshed mapping and the determination of the theoretical field of visual extents - otherwise referred to as the Zone of Theoretical Visibility.
Sensitive receptor	A receptor that is sensitive either by virtue of significance or exposure to a proposed change in the landscape.
Statutory Landscape Significance	Areas of landscape identified as being of importance at international, national or local levels, either defined by statute or identified in development plans or other documents. Can be interchangeably referred to within this LVIA as 'statutory significance'.
Theoretical Limit of Viewshed Extent (TLVE)	The boundary extent of the study area determined by the point at which the proposed project infrastructure occupies an unnoticeable portion of the field of view (5%).
Viewshed	A theoretical calculation based on 3D terrain modelling that determines areas of land that are potentially visible from a proposed project infrastructure, and conversely, determines land from which the proposed project infrastructure would be visible.
Wireframe photomontage	An accurate presentation of the proposed project infrastructure within an existing view photomontage which is represented as a coloured outline. The image represents the location/position of the proposal as seen from the viewpoint, including behind existing landform, landscape or built elements.
Zone of Theoretical Visibility (ZTV)	The total area of land from which there are potential views of a proposed project infrastructure (i.e. land that is within the assessed Viewshed and Theoretical Extent of Visual Exposure).

1 INTRODUCTION

This technical report provides a landscape and visual impact assessment conducted to support the Environment Effects Statement (EES) for the Viva Energy Gas Terminal project (the project).

Viva Energy Gas Australia Pty Ltd (Viva Energy) is planning to develop a 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 FSRU would store liquefied natural gas (LNG) received from visiting LNG carriers (that would moor directly adjacent to the FSRU) and would convert LNG back into a gaseous state by heating the LNG using seawater (a process known as regasification) as required to meet industrial, commercial, and residential customer demand. A 7 kilometre gas transmission pipeline would transfer the gas from the FSRU to the Victorian Transmission System (VTS) at Lara.

The project would be situated adjacent to, and on, Viva Energy's Geelong Refinery, within a heavily developed port and industrial area on the western shores of Corio Bay between the Geelong suburbs of Corio and North Shore. 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.

In December 2020, the Victorian Minister for Planning determined that the project requires assessment through an EES under the Environment Effects Act 1978 (Vic). The reasons for the decision were primarily related to the potential for significant adverse effects on the marine environment of Corio Bay and the potential for contributing to greenhouse gas emissions. Secondarily, the EES was required to assess the effects of the project on air quality, noise, land use, Aboriginal and historic heritage, native vegetation, groundwater, traffic and transport as well as visual amenity.

In January 2021 the project was also determined to require assessment and approval under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) due to the potential for the project to have a significant impact on the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site (a wetland of international importance), listed threatened species and communities, and listed migratory species. 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 PURPOSE

This landscape and visual impact assessment identifies, assesses and characterises potential environmental impacts on the landscape and visual amenity of the area associated with the construction, operation and decommissioning of the project to inform the preparation of the EES required for the project.

The report identifies and recommends mitigation measures to avoid, minimise and manage potential impacts which would inform the development of an Environmental Management Framework (EMF) for the project. The mitigation measures listed in the EMF would be implemented in the approvals and management plans for the project.

1.2 WHY UNDERSTANDING LANDSCAPE AND VISUAL IMPACT IS IMPORTANT

Planning policy and statutory decisions within Victoria recognise the value of landscapes for their intrinsic qualities, for the quality of life and enjoyment of people, and for the economic benefits they bring. In assessing the impacts of proposed project infrastructure to identified visual and Landscape Values, it is important to consider that[1]:

- Landscape is a shared resource which is important in its own right as a public good
- Landscape is the setting for day to day lives - for living, recreation and working;
- Landscape provides opportunities for scenic enjoyment
- Landscape is a source of memories and associations, and
- Landscape provides economic benefits, directly by providing resources, and indirectly in recreation and tourism.

Understanding the visual character of these landscapes and their recognised scenic and Landscape Values helps to assess the severity of impact resulting from proposed project infrastructure.

1 Landscape Institute and Institute of Environmental Management & Assessment, Guidelines for Visual Impact Assessment, Third Edition, 2013.

1.3 PROJECT AREA

The project would be located adjacent to, and on, the Geelong Refinery and Refinery Pier in the City of Greater Geelong, 75 kilometres (km) south-west of Melbourne. The project area is within a heavily developed port and industrial area on the western shores of Corio Bay between the Geelong suburbs of Corio and North Shore. The Geelong central business district is located approximately 7 km south of the project.

Corio Bay is the largest internal bay in the south-west corner of Port Phillip Bay and is a sheltered, shallow basin at the western end of the Geelong Arm, with an area of 43 square kilometres (km2). 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, approximately one kilometre to the north-east of the project.

The Port of Geelong has been in operation for over 150 years and is the largest industrial bulk cargo port in Victoria, attracting over 600 ship visits and handling more than 14 million tonnes of product annually. Geelong's shipping channels extend 18 nautical miles through Corio Bay from Point Richards through to Refinery Pier. Ports Victoria (formerly Victorian Regional Channels Authority) manages commercial navigation in the port waters in and around Geelong and is responsible for the safe and efficient movement of shipping, and for maintaining shipping channels and navigation aids. The channels are man-made having been deepened and widened through periodic dredging to support port trade development.

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 Geelong Refinery has been operating since 1954 with both the refinery and the co-located Lyondell Bassell plant being licensed Major Hazard Facilities (MHFs). A range of industrial activities are situated in the Port environs including wood fibre processing and chemical, fertiliser and cement manufacturing.

To the north of the Geelong Refinery, along the proposed underground pipeline corridor, the area is predominantly rural. There are several other existing Viva Energy-owned underground pipelines running between the refinery and the connection point to the South West Pipeline (SWP) at Lara. The proposed pipeline route follows already disturbed pipeline corridors, where possible, through a mix of land uses.

The project area is shown in Figure 1.

1.4 PROJECT DESCRIPTION

This section summarises the project as described in Chapter 4 Project Description. Key components of the project include:

- extension of the existing Refinery Pier with an approximately 570 metre (m) long angled pier arm, new berth and ancillary pier infrastructure including high pressure gas marine loading arms (MLAs) and a transfer line connecting the seawater discharge points on the FSRU to the refinery seawater intake
- continuous mooring of an FSRU at the new Refinery Pier berth to store and convert LNG into natural gas. LNG carriers would moor alongside the FSRU and unload the LNG
- construction and operation of approximately 3 km of aboveground gas pipeline on the pier and within the refinery site connecting the FSRU to the new treatment facility
- construction and operation of a treatment facility on refinery premises including injection of nitrogen and odorant (if required)
- construction and operation of an underground gas transmission pipeline, approximately 4km in length, connecting to the SWP at Lara.

The Refinery Pier extension would be located to the north-east of Refinery Pier No. 1. The new pier arm would be positioned to allow for sufficient clearance between an LNG carrier berthed alongside the FSRU and a vessel berthed at the existing Refinery Pier berth No. 1. Dredging of approximately 490,000 cubic metres of seabed sediment would be required to allow for the new berth pocket and swing basin.

The FSRU vessel would be up to 300 m in length and 50 m in breadth, with the capacity to store approximately 170,000 cubic metres (m3) of LNG. The FSRU would receive LNG from visiting LNG carriers and store it onboard in cryogenic storage tanks at about -160°C.

The FSRU would receive up to 140 PJ per annum (approximately 45 LNG carriers) depending on demand. The number of LNG carriers would also depend on their storage capacity, which could vary from 140,000 to 170,000 m3.

When gas is needed, the FSRU would convert the LNG back into a gaseous state by heating the LNG using seawater (a process known as regasification). The natural gas would then be transferred through the 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 adjusted (diluted) to meet local specifications. Odorant is added as a safety requirement so that the normally odourless

gas can be smelt when in use. From the treatment facility, the underground section of the pipeline would transfer the natural gas to the tie-in point to the SWP at Lara.

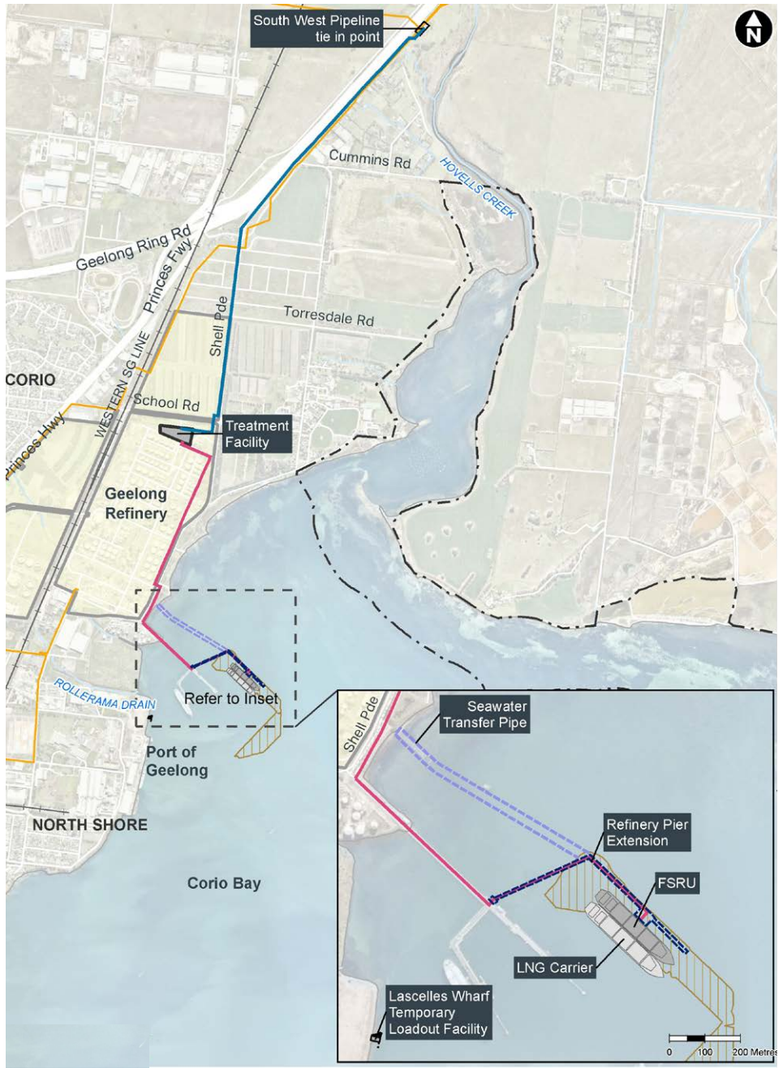


figure 1 *LVIA Relevant Project Components Map*
EES Chapter 4: Project Description (NTS) (Source: AECOM Australia Pty. Ltd.)

1.4.1 KEY CONSTRUCTION ACTIVITIES

Construction of the project would occur over a period of up to 18 months. The key construction activities relate to:

- localised dredging of seabed sediments to enable the FSRU and LNG carriers to berth at Refinery Pier and excavation of a shallow trench for the seawater transfer pipe
- construction of a temporary load-out facility at Lascelles Wharf
- construction of the new pier arm and berthing infrastructure, and aboveground pipeline along Refinery Pier and through the refinery
- construction of the treatment facility on a laydown area at the northern boundary of the refinery site
- construction of the buried pipeline
- construction at the tie-in point to the SWP at Lara

There are no construction activities required for the FSRU component of the project. The vessel would be built, commissioned and all production and safety systems verified prior to being brought to site.

An estimated 490,000 cubic metres (m3) of dredging would be required over an area of approximately 12 hectares (ha) adjacent to the existing shipping channel to provide sufficient water depth at the new berth and within the swing basin for visiting LNG carriers to turn. Dredging within the new berth would be undertaken to a depth of 13.1 metres and the swing basin would be dredged to a depth of 12.7 metres. It is planned to deposit the dredged material within the existing dredged material ground (DMG) in Port Phillip Bay to the east of Point Wilson, approximately 26 km from Refinery Pier.

The temporary load-out facility at Lascelles Wharf would be the first construction activity to take place in order to facilitate the Refinery Pier extension. This would involve installation of 10 piles using hydraulic hammers

Construction of the pier arm would be carried out once dredging was complete, primarily from the water using barge-mounted cranes. Steel piles would be driven into the seabed by cranes mounted on floating barges and pre-cast concrete and pre-fabricated steel components would be transported to site by barge and lifted into position. The installation of pier infrastructure such as the marine loading arms (MLAs), piping from the FSRU to the existing refinery seawater intake (SWI) and aboveground pipeline would also be undertaken from the water using barge-mounted cranes and construction support boats.

Installation of the 3km above ground pipeline along the pier and through the refinery is anticipated to take 3.5 months to complete. The above ground pipeline would run along the pier to the existing pipe track east of Shell Parade within the pier foreshore compound. It would then pass through a road under-crossing to the existing refinery pipe track. The pipeline would then run north along the existing refinery pipe track to an existing laydown area where the treatment facility would be located.

The treatment facility would be located within an existing laydown area in the refinery site and cover an area of approximately 80m x 120m. Construction of the treatment facility would take approximately 18 months and would be undertaken by specialist crews across distinct phases of work. These would include initial earthworks and civil construction, mechanical installation and electrical and instrumentation works.

The 4km underground pipeline would be installed in stages over an approximate 4 month period within a corridor which has been selected so as to avoid watercourses or other environmental sensitivities, where possible. Firstly, a construction right of way (ROW) would be established, clearly identified and fenced off where required. Typically, this would be between 15 and 20m wide, and minimised where possible to reduce disturbance. Once the construction ROW is established, vegetation would be removed, and a trench excavated to a maximum depth of 2m and a maximum width of 1m for the pipeline to be placed. Following the placement of the pipeline, the construction ROW would be rehabilitated to its pre-existing condition as far as reasonably practicable for the purposes for which it was used immediately before the construction of that part of the pipeline.

Trenchless construction (including thrust boring or horizontal directional drilling (HDD)) would be used to install the underground pipeline in areas that are not suited to open trenching techniques, such as at intersections with major roads. Trenchless construction would involve boring or drilling a hole beneath the ground surface at a shallow angle and then pushing or pulling a welded length of pipe through the hole without disturbing the surface. It is anticipated that the maximum depth of the trenchless section would be 25m.

The anticipated trenching, HDD and thrust bore segment locations are presented in *figure 2*. It is possible that along the northern section of MacGregor Court the pipeline would also be constructed using HDD and this would be confirmed during detailed design.

Construction at the tie-in point to the SWP at Lara would be undertaken by specialist crews across the distinct phases of works, as with the treatment facility.

As the construction phase would occur over a period of 18 months and as no construction equipment would exceed the size of the FSRU which would be berthed at the proposed location for the next 20 years, the potential visual impacts associated with the operational phase of the project would represent the 'worst-case' visual scenario. Any potential visual impacts from the construction phase would be of a lesser magnitude and would be short-term and temporary in duration.

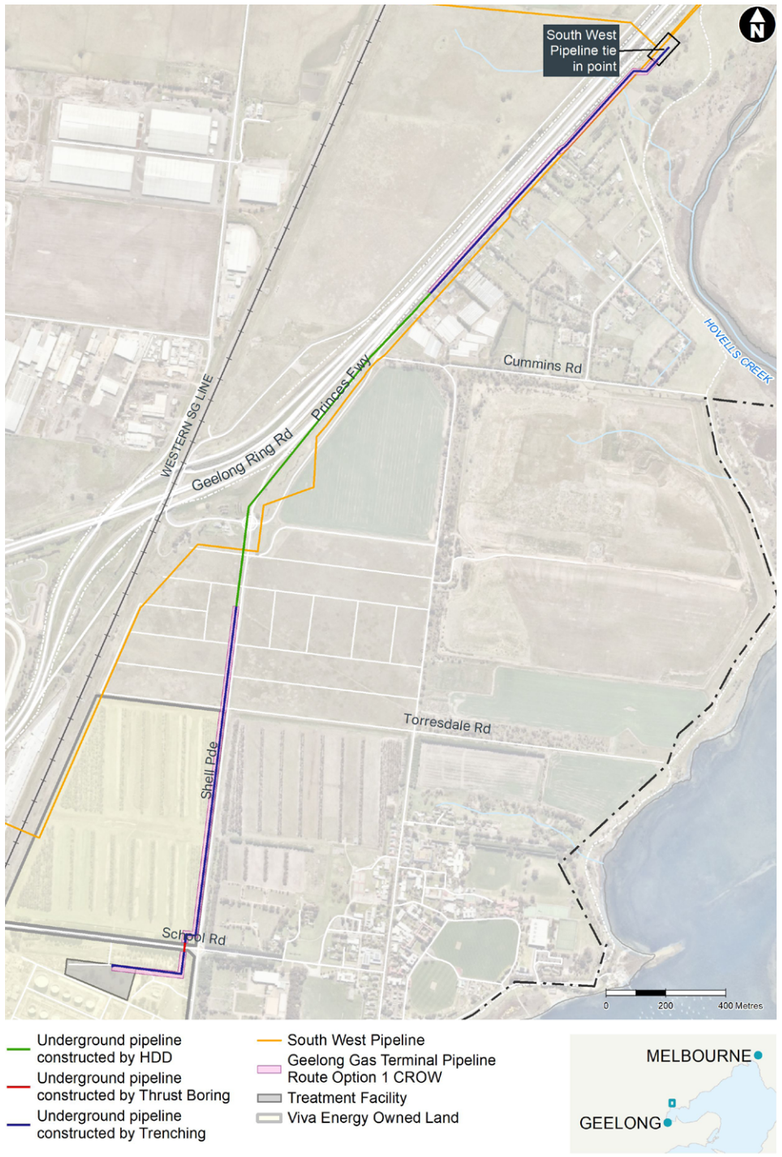


figure 2 *Construction Trenching Map: Proposed location of trenching construction techniques for the underground pipeline including open trenching, HDD and thrust boring*

1.4.2 KEY OPERATIONAL ACTIVITIES

The project is expected to be in operation for approximately 20 years. Key activities relating to project operation include:

- Receipt of up to 45 LNG carriers each year at Refinery Pier – the number and frequency of LNG carriers arriving each year would depend on their storage capacity and gas demand
- Regasification of LNG onboard the FSRU using seawater as a heat source, which would then be reused within the refinery as cooling water
- Injection of nitrogen and odorant into the gas prior to distribution via the VTS
- Monitoring and maintenance of the pipeline easement.

1.4.3 KEY DECOMMISSIONING ACTIVITIES

The FSRU, which continues to be an ocean-going vessel throughout the operation of the project, would leave Corio Bay on completion of the project life to be used elsewhere.

It is anticipated that the Refinery Pier berth and facilities would be retained for other port related uses. The underground pipeline would likely remain in situ subject to landholder agreements and either decommissioned completely or placed into care and maintenance arrangements.

Decommissioning activities may be subject to change, subject to legislative requirements at the time and potential re-purposing of the infrastructure at the end of the project.

1.5 STAKEHOLDER ENGAGEMENT

An extensive engagement and consultation program was undertaken to ensure that the community and interested stakeholders were informed, involved and able to actively contribute to the development of the project and preparation of the EES. The following issues related to landscape and visual amenity were raised by stakeholders and the community:

- The size of the floating storage regasification unit and its visibility from the surrounding shorelines to the north and west of Corio Bay, and the Geelong Waterfront precinct
- The visibility of the treatment facility and how it would look from various public viewpoints
- Concerns around how the project infrastructure would look like from Geelong Grammar School

The selection of viewpoints for this study was informed by concerns raised by stakeholders and the community during engagement sessions.

Representatives from Geelong Grammar School were also present during the site investigation for View 5 within the school premises.

Legend

- FSRU/LNG carrier
- Pier extension
- Treatment facility
- Aboveground pipeline
- Underground pipeline

0 1 2 3 4 km

figure 3 *Viva Energy Gas Terminal Project Overview Map (Source: AECOM Australia Pty. Ltd.)*

Viva Energy Gas Terminal LVIA

Site Work

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Project Ref:	**21.0224**
Dwg No.:	**LVIA-2**
Scale	**1:50,000**
Date:	**12/12/2021**
Revision:	**A**

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2 SCOPING REQUIREMENTS

2.1 EES EVALUATION OBJECTIVES

The scoping requirements for the EES set out the specific environmental matters to be investigated in the EES. The scoping requirements include a set of evaluation objectives. These objectives identify the desired outcomes to be achieved in managing the potential impacts of constructing and operating the project.

The following evaluation objective is relevant to the LVIA assessment:

Social, economic, amenity and land use - to minimise potential adverse social, economic, amenity and land use effects at local and regional scales

2.2 EES SCOPING REQUIREMENTS

The aspects from the Scoping Requirements relevant to the LVIA evaluation objective as well as the locations indicating where these items have been addressed in this report is shown in the table below.

Aspect	Scoping Requirement	Section Addressed
Key issues	*Potential for adverse impacts on visual or Landscape Values.*	Section 5: Existing Conditions
Existing environment	*Identify visual and Landscape Values near the project, including public and private vantage points from which elements of the project may be visible.*	Section 6: Impact Assessment Section 7: Environmental Management and Monitoring
Likely effects	*Assess likely noise, vibration, traffic, lighting and visual impacts at sensitive receptors adjacent to the project during project construction and operation (both with and in the absence of the proposed mitigation measures), relative to standards.*	Section 6: Impact Assessment Section 7: Environmental Management and Monitoring
Mitigation measures	*Identify options for mitigating or managing visual or landscape impacts of the project.*	Section 8: Conclusion
Performance objectives	*Describe any further measures that are proposed to enhance social outcomes, and either manage risks to landscape and recreational values, or enhance visual amenity outcomes both for existing land uses, residents living near the project and for visitors to the locality, to form part of the EMF.*	Section 8: Conclusion

3 LEGISLATION, POLICY, GUIDELINES AND CRITERIA

3.1 LEGISLATION

3.1.1 COMMONWEALTH LEGISLATION

Environment Protection and Biodiversity Conservation 1999 Act (EPBC Act).

The EPBC Act is the Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage matters of National Environmental Significance (MNES) including, but not limited to, World Heritage Properties, National Heritage Places, Ramsar sites, nationally listed threatened species and ecological communities and listed migratory species. The EPBC Act states that 'controlled' actions i.e. actions that are determined as likely to have a significant impact on a MNES are subject to assessment and approval under the EPBC Act.

The objectives of the EPBC Act are to:

- Provide for the protection of the environment, especially matters of national environmental significance
- Conserve Australian biodiversity
- Provide a streamlined national environmental assessment and approvals process
- Enhance the protection and management of important natural and cultural places
- Control the international movement of plants and animals (wildlife), wildlife specimens and products made or derived from wildlife
- Promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources
- Recognise the role of indigenous people in the conservation and ecologically sustainable use of Australia's biodiversity
- Promote the use of indigenous peoples' knowledge of biodiversity with the involvement of, and in cooperation with, the owners of the knowledge.

3.1.2 VICTORIAN STATE LEGISLATION

The Marine and Coastal Act 2018

The Marine and Coastal Act (the Act) covers the planning and management of the marine and coastal environments in Victoria. The objectives of the act which are relevant to visual and Landscape Values are:

- to protect and enhance the marine and coastal environment
- to promote a diversity of experiences in the marine and coastal environment
- to promote the ecologically sustainable use and development of the marine and coastal, and environment and its resources in appropriate areas.

The recently released Marine and Coastal Policy 2020 (the M&C Policy) sets objectives and guiding principles for the planning and management of the state's marine and coastal environment. The M&C Policy would be accompanied by a Marine and Coastal Strategy, which would outline priority actions to achieve the objectives of the M&C Policy.

The Planning and Environment Act 1987

The purpose of this Act is to establish a framework for planning the use, development and protection of land in Victoria in the present and long term interests of all Victorians.

3.2 VICTORIAN PLANNING PROVISIONS

3.2.1 STATE PLANNING POLICY FRAMEWORK

12.02-1L Protection of Coastal Areas

The objective of this clause is to recognise the value of coastal areas to the community, conserve and enhance coastal areas, and ensure sustainable use of natural coastal resources.

Of relevance to the visual values of the coast, the clause seeks to ensure development is sensitively sited and designed, and respects the character of coastal settlements.

12.02-1S Protection of Coastal Areas

This clause recognises the importance of coastal areas to the local community and outlines objectives and strategies to ensure a sustainable use of its coastal resources.

This clause outlines the following principles for the planning and management of the coastal areas:

- Principle 1 - Ensure the protection of significant environmental and cultural values.
- Principle 2 - Undertake integrated planning and provide clear direction for the future.
- Principle 3 - Ensure the sustainable use of natural coastal resources.
- Principle 4 - Ensure development on the coast is located in existing modified and resilient environments where the demand for development is evident and any impacts can be managed sustainably.

12.05-1S Environmentally Sensitive Areas

This clause outlines protection and conservation of environmentally sensitive areas with significant conservation or recreational values. Coastal landscapes within the Port Phillip Bay areas have been identified.

12.05-2S Landscapes

This clause outlines the objective for protection, and for the enhancement of landscapes and open spaces that contribute to character, identity and sustainable environments.

Strategies are as follow:

- Ensure significant landscape areas such as forests, the bays and coastlines are protected.
- Ensure development does not detract from the natural qualities of significant landscape areas.
- Improve the landscape qualities, open space linkages and environmental performance in significant landscape and open spaces, including green edges, conservation areas and non-urban areas.
- Recognise the natural landscape for its aesthetic value as fulling functioning system.
- Ensure important natural features are protected and enhanced.

3.2.2 LOCAL PLANNING POLICY FRAMEWORK

21.04 Municipal Framework Plan

The framework plan identifies key settlement areas within the municipality and identifies increased housing diversity within Corio, as well as nominating Northern Geelong and Western Geelong as future growth areas.

21.05 Natural Environment

This clause conservatively estimates the remnant vegetation to be approximately 5% of that which existed pre European settlement. The clause outlines the significance of protecting this remnant landscape, especially within the urban and rural growth areas.

A series of objectives and strategies are outlined to maintain and protect the existing remnant ecologies including restrictions on future developments which may impede access and connections to these sites.

The landscape character areas identified as high value natural landscapes are identified within ESO4, and ESO2 as part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. The Ramsar site is recognised wetland of international significance, and accommodates public recreational use within its natural ecology:

- Limeburners Lagoon State Nature Reserve
- Avalon Coastal Park

21.12 Geelong Port

This clause identifies the economic importance of the port area, and outlines objectives and strategies for continued operation of the port area whilst balancing its impact within the surrounding context.

Key relevant objectives include:

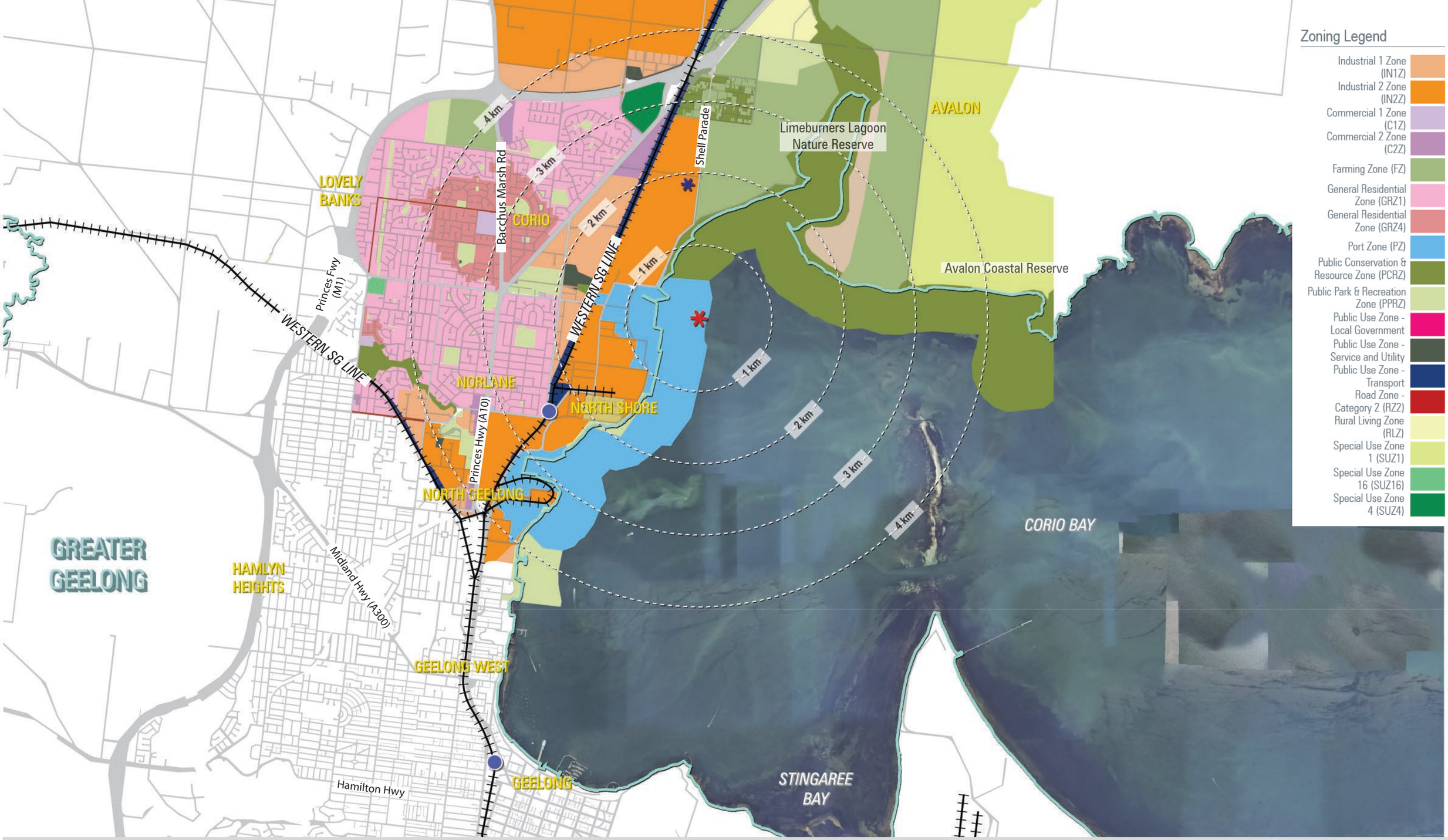
- Providing continued growth and development within the Geelong Port
- Ensuring the development of the port area is environmentally sustainable

3.3 PLANNING FRAMEWORK ZONES:

The types of uses that may occur within the study area are determined by the following zones:

- IN1Z - Industrial 1 Zone
- IN2Z - Industrial 2 Zone
- C1Z - Commercial 1 Zone
- C2Z - Commercial 2 Zone
- FZ - Farming Zone
- GR1Z - General Residential 1 Zone
- GR4Z - General Residential 4 Zone
- PZ - Port Zone
- PCRZ - Public Conservation & Resource Zone
- PPRZ - Public Park & Recreation Zone
- RZ2 - Road Zone Category 2
- RLZ - Rural Living Zone
- SUZ1 - Special Use Zone 1
- SUZ4 - Special Use Zone 4
- SUZ16 - Special Use Zone 16
- Public Use Zone - Local Government
- Public Use Zone - Service and Utility
- Public Use Zone - Transport

Due to the coastal location of the Project site, the LVIA study area spans across numerous zoning areas around the site, as well as to key coastal areas to the east and south with visual access across the water.



Legend

- FSRU
- Treatment facilities
- Train line
- Train station
- Roads
- Municipal boundary

0 1 2 3 4 km

figure 4 *Planning Zones Map*

Viva Energy Gas Terminal LVIA

Planning Scheme Zoning
Greater Geelong Planning Scheme

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Project Ref:	**21.0224**
Dwg No.:	**LVIA-3**
Scale	**1:50,000**
Date:	**12/12/2021**
Revision:	**A**

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3.4 PLANNING FRAMEWORK OVERLAYS:

42.01 Environmental Significance Overlay (ESO1) - Schedule 1: Areas of flora and fauna habitat and of geological and natural interest

An area to the east of Limeburners Lagoon State Nature Reserve is covered by the ESO1 which has identified significant flora and fauna habitat. This area is surrounded by Limeburners Bay and the paddocks along Avalon Road. This overlay outlines objectives to conserve areas of habitat and geological interests by minimising development impact within these areas. This overlay also limits the building works permitted on this area to ensure the environmental integrity is preserved.

42.01 Environmental Significance Overlay (ESO2) - Schedule 2: High value wetlands and associated habitat protection

A significant area within the eastern LVIA study area is covered by the ESO2 overlay which recognises these areas as wetlands of significance at regional, state, national or international level. This area, extending from Limeburners Lagoon State Nature Reserve to Point Cook through the Avalon Coastal Reserve, falls within the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site as marked by the Convention on Wetlands (Ramsar, Iran, 1971).

The relevant objectives of the overlay are to:

- Maintain the ecological character of Ramsar wetlands
- Protect the visual amenity

42.01 Environmental Significance Overlay (ESO4) - Schedule 4: Grasslands within the Werribee Plains Hinterland

An area to the west of Limeburners Lagoon State Nature Reserve is covered by the ESO4 which has identified significant flora and fauna habitat. This is a discrete area consisting of two vacant and undeveloped paddocks between Torresdale and Bell Roads on both sides of Shell parade known as the Corio Native Grassland Reserve. This overlay outlines objectives to conserve native vegetation and native fauna habitat of the Victorian Volcanic Plain by minimising development impact within these areas. This overlay also limits the building works permitted on this area to ensure the environmental integrity is preserved.

43.01 Heritage Overlay

The purpose of this overlay is to:

- To implement the Municipal Planning Strategy and the Planning Policy Framework.
- To conserve and enhance heritage places of natural or cultural significance.
- To conserve and enhance those elements which contribute to the significance of heritage places.
- To ensure that development does not adversely affect the significance of heritage places.
- To conserve specified heritage places by allowing a use that would otherwise be prohibited if this will demonstrably assist with the conservation of the significance of the heritage place.

The two key heritage overlays within the study area are Avalon Homestead and Geelong Grammar School.

Avalon Homestead (HO26, HO.59) outlines the settlement of James and Thomas Austin in 1835. The ownership of this site later transferred to Geelong Grammar School, and was leased to Avalon College as a residential English language school. The Statement of Significance does not mention any landscape visual elements that contributed to the heritage significance of the site.

Geelong Grammar School (HO.142) references the heritage significance of the original 1912-13 building complex within the school precinct. The statement of significance outlines the architectural history and form contributing to the significance of the building complex, and does not reference any landscape visual elements contributing to this heritage status.

43.02 Design and Development Overlay – Schedule 20 (DDO20) - Industrial Zone 1,2, and 3 Zones

The refinery site and significant areas to the west and south falls within DDO20 as zoned industrial areas. The overlay outlines objectives to improve the visual appearance and image of industrial areas through well designed site responsive developments, including a high level of amenity for the worker and visitors within the industrial areas.

The overlay outlines requirements a series of relevant design guidelines as follow:

- Visually permeable fencing where appropriate
- Structures to be set back from road reserve
- Retention of existing vegetation where possible
- Landscaping provided around the boundaries which adjoin sensitive land use or environmental features, or where the site is visually prominent
- The quality and quality of landscaping should reflect the scale of the building and the car park area in order to address screening and softening of visual bulk.

3.5 REFERENCE DOCUMENTS

Port Phillip Bay (Western Shoreline) & Bellarine Peninsula Ramsar Site - Strategic Management Plan (2003)

The primary purpose of this document is to identify the management framework for Victorian Ramsar sites and assist in the maintenance of their ecological character. This applies to Limeburners Lagoon State Nature Reserve and the coastal extension to Point Wilson across the Avalon Coastal Reserve.

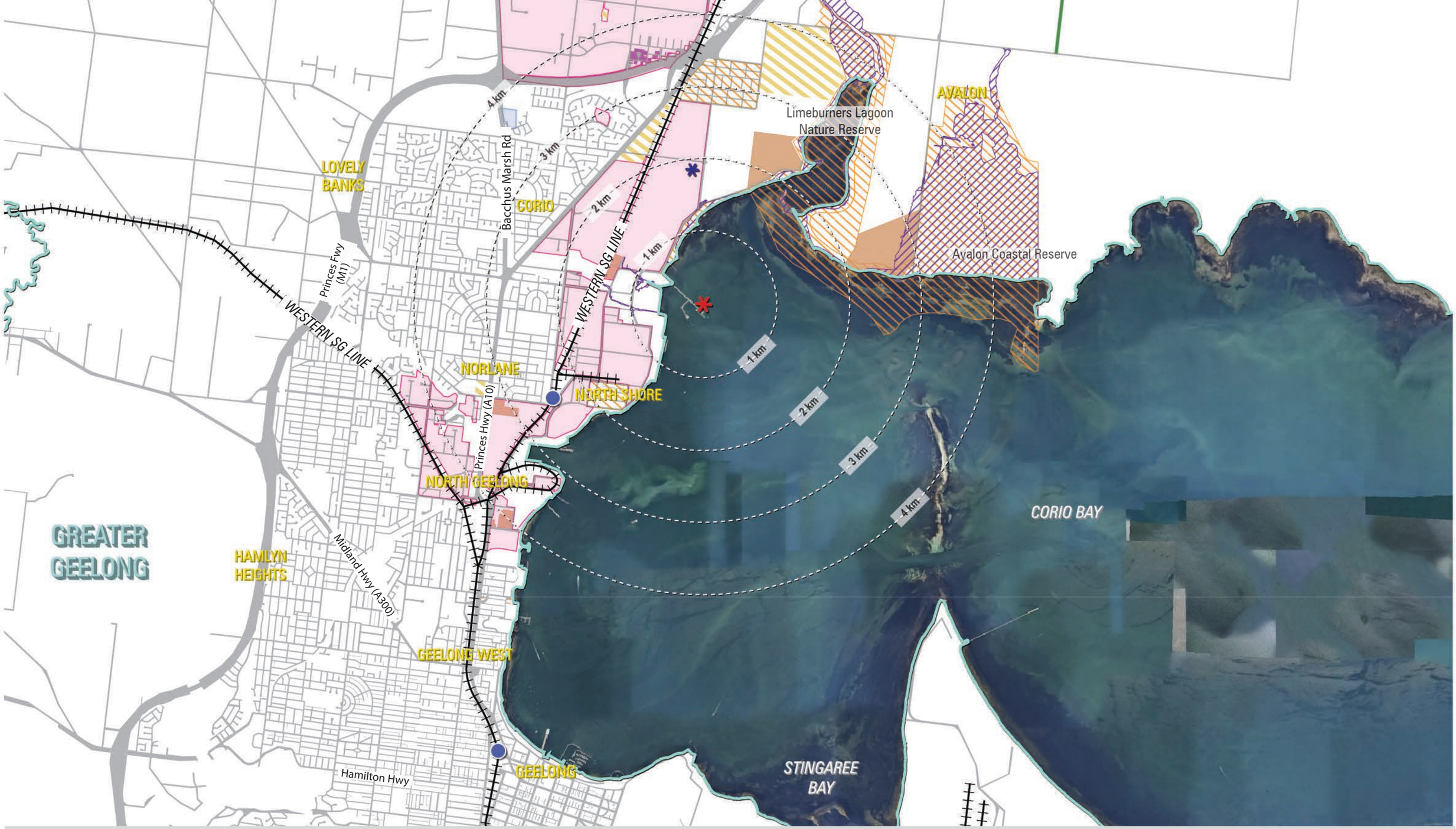
The management plan predominantly addresses the ecological character through the assessment of local ecological qualities, but acknowledges the importance of scenic values within the Ramsar sites.

Geelong Port Structure Plan (2007)

The Geelong Port Structure Plan is a strategic framework for developments within the Geelong Port area and its surrounding land with respect to uses related to the port area. This includes freight, storage and future expansion opportunities.

The structure plan acknowledges the visual impact of the heavily industrialised area and provide advice on the importance of amenity buffers between the industrial areas and its surrounding landscape. Improvements to the visual landscape qualities through the planting of native vegetation has been noted as a key implementation technique to address this issue.

This document also outlines the importance of preserving the visual amenity of the Princes Highway. Given this is the major road into Geelong, the visual quality of this space should be considered so as to detract from the residential precincts along its boundary.



Legend

- FSRU
- Treatment facilities
- Train line
- Train station
- Roads
- Municipal boundary
- Design and Development Overlay (DDO)
- Development Plan Overlay (DPO)
- Environmental Audit Overlay(EAO)
- Environmental Significance Overlay (ESO)
- Heritage Overlay (HO)
- Land Subject to Inundation Overlays (LSIO)
- Public Acquisition Overlay (PAO)

0 1 2 3 4km

figure 5 *Overlays Map*

Viva Energy Gas Terminal LVIA

Planning Scheme Overlays
Greater Geelong Planning Scheme

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Dwg No.:	**LVIA-4**
Scale	**1:50,000**
Date:	**11/11/2021**
Revision:	**P2**

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4 METHODOLOGY

This section describes how the Landscape Visual Impact Assessment was conducted in order to understand the potential visual impacts of the project on within the study area. The following sections outline the study methodology.

4.1 EXISTING CONDITIONS ASSESSMENT METHOD

4.1.1 STUDY AREA

The Study Area is determined through Zone of Theoretical Visibility (ZTV) assessment, which includes:

- Viewshed Mapping
- The Theoretical Limit of Viewshed Extent (TLVE)

It is important to emphasise that the ZTV assessment process undertaken relies on viewshed mapping informed by topographical data only, which is a 'virtual' exercise that is explained further below. In this regard, it presents what can be described as a 'worst case scenario'. As such, the ZTV assessment should not be relied upon as a definitive representation of the visibility (or otherwise) of a proposed project infrastructure, but rather should be used to guide the subsequent identification of view locations for the preparation of photomontage images, which can be relied upon as definitive representations of visibility and visual impact.

The calculation resulted in a study area of 4km radius around the FSRU berth location. *Refer to Section 4.4.*

4.2 RISK SCREENING METHOD

A risk-based screening approach has been used for the EES assessment in accordance with the requirements outlined in the 'Ministerial guidelines for assessment of Environmental Effects under the Environment Effects Act 1978' (page 14). The risk screening is undertaken to ensure that the level of investigation conducted in each technical study is adequate to inform an assessment of the significance and acceptability of the project's potential environmental impacts.

An environmental, social and economic issues risk screening tool has been used to prioritise and focus the proposed investigations, assessments and approaches to avoiding, minimising or managing potential impacts. The issue screening process involved an evaluation of the potential environmental, social and economic issues associated with the project based on the information collected through a series of initial assessments undertaken into the potential effects of the project.

A risk workshop convened by a qualified risk practitioner and comprising technical specialists from the proponent, project design team and EES team conducted the initial risk screening. The risk screening process utilised knowledge of the project infrastructure and design, existing environment and land use setting to assess potential risks based on the specialised knowledge of the technical experts.

The purpose of the issues screening approach was to assist in identifying:

- Significant issues, uncertainties and/or potential impacts that require more detailed characterisation and/or assessment within the EES
- Matters or potential impacts considered to be already well understood or less significant.

A high, medium, or low screening value was assigned to potential issues to determine the level of assessment required to identify and investigate impacts.

Each potential issue was given a score (1, 2 or 3) against the categories of:

- Community and stakeholder interest
- Significance of assets, values and uses
- Potential impact (spatial, temporal and severity).

The scores were added together, or the highest score across the three contributing categories was used, to give a 'screening value' of high, medium or low, which gives an indication of the level of impact assessment that is required. Issues that were assigned a screening value of high or medium required detailed assessment in the EES at a level commensurate with them being considered primary level issues.

Issues that were assigned a screening value of low were proposed to be documented and managed with some investigation and assessment in the EES at a level commensurate with them being considered secondary level issues.

4.2.1 Criteria and consequence ratings

Risks, issues, and potential impact pathways were identified for both construction and operation of the project. Table 4.1 defines the criteria and consequence ratings for each of the three categories that have been used to inform the issues screening. The sum of the scores against each of the three categories or the highest rating across any of the three contributing categories gives the 'screening value'.

Rating	Community and stakeholder interest	Significance of assets, values and uses	Potential impact (spatial, temporal and severity)
1	*Low interest and perceived impact*	Locally significant asset, value or use	Potential for localised, temporary impact
2	*Some interest and targeted perceived impacts*	Regionally significant asset, value or use	Potential for significant temporary, or localised permanent impact
3	*Broad community and stakeholder interest or impacts*	State or nationally significant asset, value or use	Potential for significant permanent impact

Table 4.1 - Issues screening criteria and consequence rating

The screening values are then used to determine the level of assessment required as shown in Table 4.2.

Screening score	Screening Value	Potential consequences	Complexity of mitigation	Level of assessment
7, 8 or 9 or the highest rating across any one of the three contributing categories is 3	*High*	Potential for elevated, longer term impacts, significant assets or values may be affected with enduring changes. Considers both impacts and benefits, or Issue may not be well defined and insufficient information is available for the impact assessment, or High level of community interest.	Stringent management measures may be required	Detailed assessment required
4, 5 or 6 or the highest rating across any one of the three contributing categories is 2	*Medium*	Potential for moderate level impacts, significant assets or values may be affected over an extended time frame with some resultant changes. Considers both impacts and benefits, or Issue may be moderately understood, and some information is available, however more is required for the impact assessment, or Medium level of community interest.	Standard management measures are available that can be adopted with some modification	Moderate assessment required
3 or the highest rating across any one of the three contributing categories is 1	*Low*	Potential for short term and localised impact. Asset or values may be temporarily affected but recovery expected, or Issue is well understood and there is enough information available for the impact assessment, or Low level of community interest.	Standard management measures are available.	Some assessment required

Table 4.2 - Issue investigation categories

Further information about the risk screening process is detailed in Chapter 7 Assessment framework.

Outcomes from the risk screening process are outlined in Section 4.2.2 below.

4.2.2 Risk screening results

Table 4.3 provides the key potential issues related to landscape character and visual amenity identified as part of the risk screening process for the project and presents the screening value for each issue.

Aspect	Issue	Community & stakeholder perceived impacts	Significance of assets, values & uses	Potential impact (spatial, temporal & severity)	Screening Score	Screening Value
Construction						
Landscape character and visual amenity	*Potential impacts on landscape or visual values from construction activities and plant*	1	1	1	3	Low
Operation						
Landscape character and visual amenity	*Potential impacts on landscape character and visual amenity at local and regional scales*	2	1	2	5	Medium
Landscape character and visual amenity	*Impact of light emissions from the gas terminal on community*	2	1	2	5	Medium

Table 4.3 - Issues screening results for landscape character and visual amenity

4.3 IMPACT ASSESSMENT METHOD

The report documents the approach to the Landscape and Visual Impact Assessment (LVIA) undertaken by Hansen Partnership and has been based on industry best practice as articulated by key reference documents, including *Guidelines for Landscape and Visual Impact Assessment, Visual Landscape and Planning in Western Australia, and a Manual for Evaluation, Assessment, Siting and Design*[1].[2] The Western Australian Guidelines is considered the most relevant LVIA guideline to the local context in the absence of a Victorian document. The UK published Manual is broadly accepted as the basis for LVIA theory and terminology.

A brief overview of the Hansen Partnership LVIA Methodology is outlined in *Figure 5*. The following sections describe the process undertaken for the impact assessment in more detail.

1 Department for Planning and Infrastructure, *Visual Landscape and Planning in Western Australia, a Manual for Evaluation, Assessment, Siting and Design*, November 2007

2 Landscape Institute and Institute of Environmental Management & Assessment, *Guidelines for Landscape and Visual Impact Assessment*, Third Edition, 2013.

The methodology for the Project is divided into the following phases:

Phase 1 - Inception

- Description of the site location and context
- Acquisition of base data, information and briefings to identify main features of the proposal and any assumptions
- Establish study area based on 'Theoretical Limit of Viewshed Extent' (TLVE) calculations
- Collation of mapping data

Phase 2 - Baseline Assessment

- Analysis of physical landscape features including:
  - Elevation and Topography
  - Vegetation
  - Urban built form and land use patterns
- Review of relevant landscape and visual reports / citations / planning controls and assessments

Phase 3 - Landscape Character and Values Assessment:

- Describe and map the Landscape Character Areas within the study area.
- Assign landscape typologies and identification of landscape character feature preferences.
- Identify Landscape Significance where articulated within existing planning controls
- Determine relative Landscape Value of each landscape character

Phase 4 - Visual Sensitivity Assessment

- Determine potential visual sensitivity:
  - Undertake viewshed mapping within the study area extents to identify areas of theoretical visibility (the Zone of Theoretical Visibility)
  - Identify sensitive receptors within the Zone of Theoretical Visibility

Phase 5 - Visual Impact Assessment

- Field investigations to verify visual sensitivity
- Preparation and review of photomontage images at selected view locations
- Assessment of visual impact
- Discussion of mitigation measures and production of photomontage images for the basis of visual impact assessment where appropriate

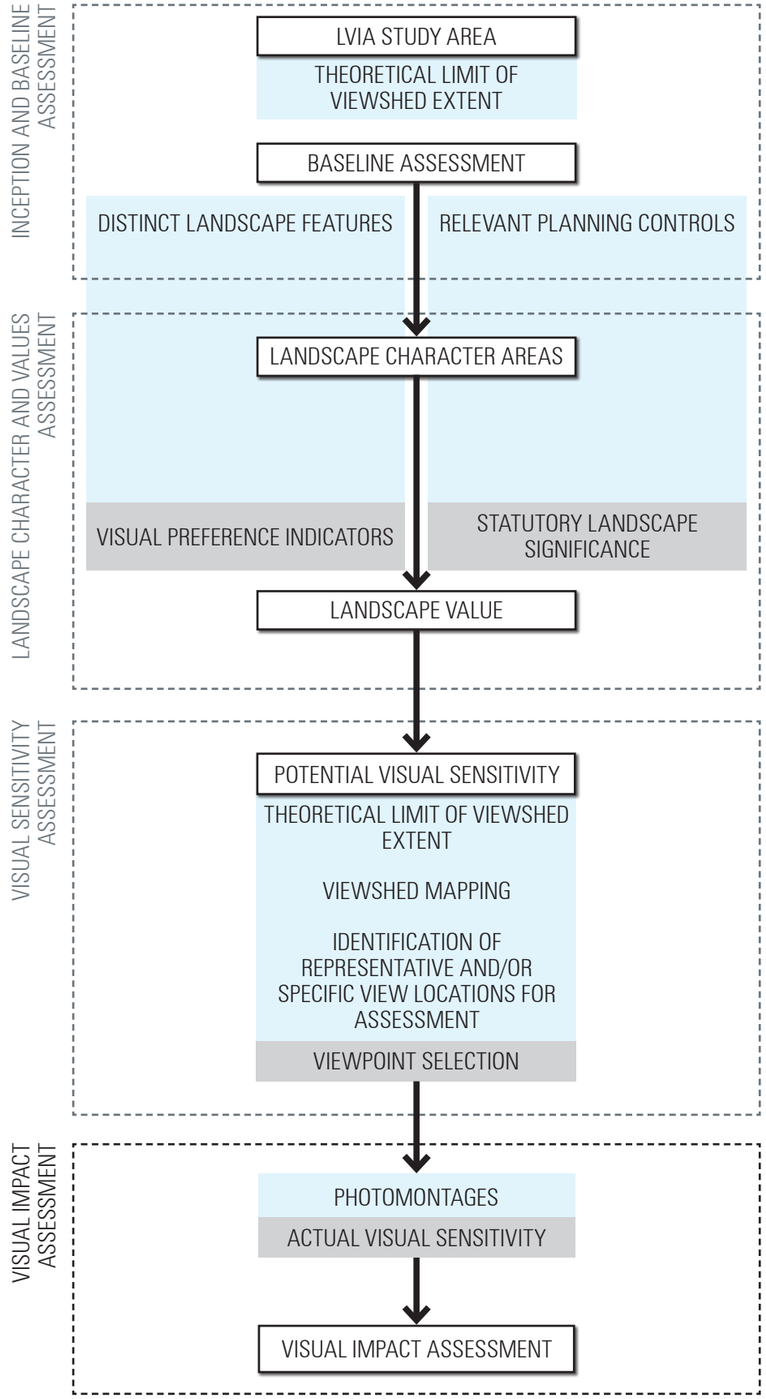


figure 6 *Hansen Partnership Pty. Ltd. LVIA Methodology*

4.4 ZONE OF THEORETICAL VISION

4.4.1 VIEWSHED MAPPING

The following describes the viewshed assessment methodology used to develop the 'Viewshed' mapping, as represented in *Figure 27*. This mapping is a digitally-produced graphic representation of areas surrounding the project from which the proposed project infrastructure is potentially visible. This assessment is subsequently used to guide the selection of photomontage view locations.

It is important to emphasise that the viewshed mapping process undertaken is a 'virtual' exercise, which utilises only topographical data to generate viewshed assessment mapping. It does not take into account 'real world' obstacles such as buildings and vegetation, which obstruct or reduce views. In this regard, it presents what can be described as a 'worst case scenario', as the presence of existing buildings and vegetation almost always results in a 'real' viewshed being less extensive than a virtual viewshed, for any given point.

A viewshed is defined as the surface area or terrain visible from a given view location. It is also the area from which that view location or series of view locations may be seen. This is referred to as the 'intervisibility' relation. The visibility between two points depends on the presence of on-ground obstacles, such as vegetation and buildings along the sight-line which connects the two points. Such obstacles may obstruct or reduce the reciprocal vision of the same two points.

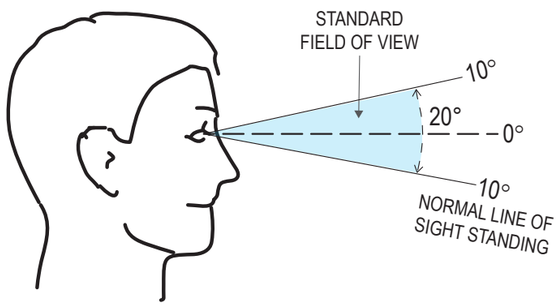
Viewshed mapping involves the use of computer software packages to translate topographical data (i.e. contour lines) into a 3-dimensional digital terrain model. The Project was modelled using DEM map data, 3DS Max 2019 software, Rhino, and 3D models provided by AECOM. This information was subsequently used to guide the identification of view locations for which photomontages were generated as a means of demonstrating the visual impact of the Project, and the degree to which mitigation of visual impact is required.

The limitation of this process and resultant assumption with respect to the geographical extent of DEM data on which this assessment was based is outlined in *Section 4.7 Limitations and Assumptions.*

4.4.2 THEORETICAL LIMIT OF VIEWSHED EXTENT

The boundary extent of the Study Area is determined by the Theoretical Limit of Viewshed Extent (TLVE). This is a standard measure that determines the distance from a proposed project infrastructure at which the vertical height of the proposed project infrastructure occupies a specified percentage of the vertical field of view.

'Human Factors in Design' (Dreyfuss, 1960)[3] provides guidance with respect to the field of view of the human eye, and describes a normal horizontal and vertical field of view as comprising approximately 60 degrees (horizontal) and 20 degrees (vertical).



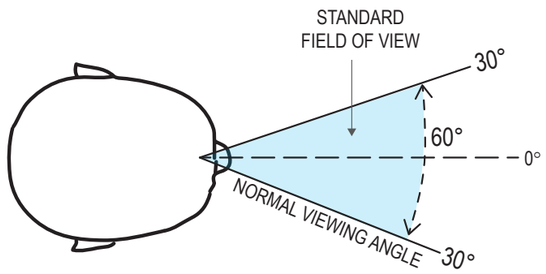


figure 7 *Field of View diagram*

Noting the ZTV description in the previous section, in the absence of intervening topographical features which would otherwise limit the extent of a particular viewshed, it is theoretically possible for a viewshed to have an infinite extent. To address this, in circumstances where topography does not provide a limit to viewshed extent, a limitation can be applied on the basis of the known characteristics of the human eye field of view.

For this LVIA, an assumption has been made that any object which occupies less than 5% of the human eye vertical field of view (equivalent to 1 degree) is unlikely to result in an unacceptably-high visual impact, due to the relatively small proportion of the total field of view it would occupy.

A 1-degree vertical angle measured from an origin point to a horizontal distance of 1km yields a height at that distance of 17m above the level of the origin point. Conversely, an object of that height, at a distance of 1km from an origin point (or viewing point) would occupy a vertical field of view not greater than 1 degree (or 5% of the vertical field of view).

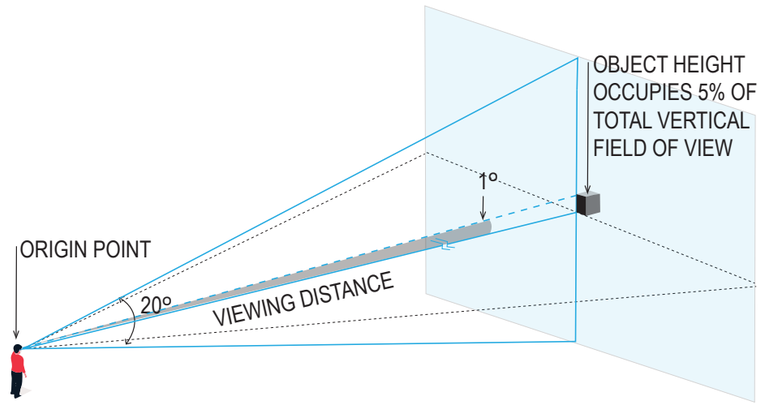


figure 8 *Theoretical limit of viewshed extent diagram*

This relationship can hence be applied to any structure with a vertical height and used to determine an appropriate viewshed extent. For the purposes of this LVIA, the TLVE has been calculated based on the maximum draught of the FSRU at 55m above sea level. This resulted in an TLVE extent of 3.25km, which has been extended to 4km for completeness (*refer to figure 2*).

The Geelong Waterfront, which is roughly 7km away from the proposed project infrastructure has been included in the visual assessment as a high value site.

3 'Human Factors in Design', Dreyfuss 1960

4.5 EXISTING CONDITIONS ASSESSMENT

4.5.1 BASELINE ASSESSMENT

The existing conditions are identified in the baseline analysis phase of the LVIA assessment process. This phase establishes the baseline for the existing landscape and visual conditions, and their recognition. The information collected would, when reviewed alongside the description of the proposed project infrastructure, form the basis for the identification and description of the changes that would result from the Project.

The baseline analysis is conducted in two parts:

- Review of legislation, policy, and guidelines *(refer to Section 3 of this report*)
- Existing conditions: landscape features *(refer to Section 4 of this report)*

4.5.2 LANDSCAPE CHARACTER ASSESSMENT

Landscape Character Assessment is a key tool for understanding the overall character of the landscape in the Study Area, including distinctions between landscape character types based on the particular combinations of elements and perceptual aspects that make each area distinctive. Landscape Character Areas are mapped in Section 5 *(Fig. 20)*

This section of the report focuses on describing the landscape character of the LVIA Study Area by identifying the primary landscape features that make a defined geographical area distinctive. This was undertaken to understand, through fieldwork, whether there are any further landscape or visual amenity values which are of significance within the LVIA Study Area, in addition to those identified in the desktop baseline work undertaken.

The LVIA Study Area has been assessed to identify the landscape character precincts which can be described as areas of similar patterns or elements in the landscape such as landform, vegetation, water-bodies and land use as well as individual features.

Separating the LVIA Study Area into landscape character precincts is the initial step in identifying areas of relative significance. This is an essential part of the landscape assessment, and leads into determining Landscape Values.

Where existing character assessments have been undertaken and applied to land within the LVIA Study Area, they can contribute to the formation of the LVIA landscape character types. Existing landscape character assessments are reviewed as part of the LVIA process to ensure that the intent, scale, relevance to existing conditions and quality are suitable for adaptation.

4.5.3 Landscape Value

This section of the assessment aims to assess the existing relative Landscape Value of the Project site and surrounding landscapes in an objective manner. This is to be achieved through the baseline analysis work and the fieldwork undertaken. Guidance is taken from benchmarking documents, primarily *Visual Landscape and Planning in Western Australia, a Manual for Evaluation, Assessment, Siting and Design. November 2007.* In this manual Landscape Values are broadly defined as:

The value placed on a landscape feature by the community based primarily on its perceived visual quality.[1]

It is important to note that the assigned Landscape Values derived from this assessment are relative to the context of the proposed project infrastructure site and the surrounding landscapes. Part of this is context is to acknowledge the existing statutory designations of some landscapes within the LVIA Study Area and the context of landscape as identified in review of legislation, policy, and guidelines *(refer to Section 3 of this report).*

The Landscape Values assessment utilised the following methodology:

- Reviewing benchmarking documents, and objective criteria to assess existing Landscape Value.
- The relative value of the different landscape character precincts were identified through the evaluation of these criteria.

1 Visual Landscape and Planning in Western Australia, a Manual for Evaluation, Assessment, Siting and Design. November 2007, Page 33

4.4.3 CRITERIA FOR THE ASSESSMENT OF LANDSCAPE CHARACTER VALUES

For the purposes of this study a set of broad Landscape Value assessment criteria have been developed through professional assessments by Hansen Partnership, based on landscape character preference indicators identified in the *Visual Landscape and Planning*

in Western Australia, a Manual for Evaluation, Assessment, Siting and Design. November 2007 (VLPWA Manual) .

Statutory controls which impact the LVIA study area have been used to guide the criteria for the assessment of Landscape Values. This includes the relatively higher level of value placed on the landscapes regarded significant for their landscape and visual values within the State Planning Policy Framework, national or state parks, and landscapes with designations such as World Heritage, Ramsar, National Trust, and Australia ICOMOS sites, or sites. These values have been integrated into the criteria identified from the *VLPWA Manual*.

It is intended that the landscape character preference indicators be used to assess Landscape Value of the site, where statutory designations are not applicable, in a manner that is as objective as possible. In order to achieve this the *VLPWA Manual* has been reviewed along with the baseline analysis work to formulate the landscape character preference indicators outlined in *Section 6.3* of this report.

To ensure that the methodology for this Landscape Values assessment is grounded by a best practice approach, it has been based on the methodology outlined in the guidelines provided by the *VLPWA Manual*.

It is acknowledged that the nature of Landscape Values inherently varies from person to person, or is subjective. Therefore it is largely based on the perceptions of individuals taking into account a variety of factors, such as cultural backgrounds, education and economic circumstances. While this is evident, the methodology above enables Landscape Values to be assessed in a professional and objective manner.

Relative Landscape Value would be assigned have been assigned as either *high*, *moderate* or *low* base on the following criteria:

High

- Prevalence of preferred landscape features, with minimal presence of non-preferred landscape features.

Moderate

- Some presence of preferred landscape features, with these being more prevalent than non-preferred landscape features.

Low

- Minor presence of preferred landscape features, and/or a prevalence of non-preferred landscape features.

4.4.4 VLPWA MANUAL

The *VLPWA Manual* aims to provide a valuable resource for undertaking visual assessments of the landscape in lieu of often non-existent formal local or state planning policy. The *VLPWA Manual* has been used for this assessment as there is an absence of any similar Victorian State Government publication. The Landscape Values assessment conducted for this site specifically referred to: *Part Two, Section 2, Identify and assess what is valued in the visual landscape (p32-33)* and *Appendix 7, Visual landscape character preference indicators (75-177)* within the *VLPWA Manual*.

The landscape character preference indicators identified in the *VLPWA Manual* have been developed using community preference research and subsequently list landscape features as being either most preferred or least preferred in a generalised landscape typology. These landscape typologies are categorised broadly as being natural, rural or built.

The preference indicators of the landscape elements have been outlined in *Section 5.3* of this report, and have been used as a basis for deriving the Landscape Values of each landscape character area.

4.6 IMPACT ASSESSMENT

The impact assessment methodology for operation phase components is detailed in *Section 7 Impact Assessment* of this report. It should be noted that the impact assessment is made independent of the period of time in which the proposed project component would be present.

4.6.1 CRITERIA FOR THE ASSESSMENT OF LANDSCAPE AND VISUAL IMPACT

The Visual Impact Criteria for assessment is detailed in *Section 6 Operation Impact Assessment* of this report. The criteria has been developed by Hansen Partnership and is based upon the UK standard *Guidelines for Visual Impact Assessment, Third Edition, 2013*.

The assessment criteria determines whether or not a proposed change in the landscape is acceptable on the basis of visual change, and if the impact can and should be mitigated. The assessment varies dependant on the sensitivity of the viewer; Private views are considered generally more sensitive to change than representative views.

4.6.2 RATIONALE

The Hansen Partnership LVIA Methodology is based upon guidance from benchmarking documents, primarily the *Visual Landscape and Planning in Western Australia, a Manual for Evaluation, Assessment, Siting and Design. November 2007, and the Landscape Institute and Institute of Environmental Management & Assessment, Guidelines for Visual Impact Assessment, Third Edition, 2013*. The influence of these guides is further detailed in Section 5 Methodology of this report.

4.6.3 CONSTRUCTION IMPACT

As the construction phase would occur over a period of 18 months, and as no construction equipment would exceed the size of the FSRU which would be berthed at the proposed location for the next 20 years, the potential visual impacts associated with the operational phase of the project would represent the 'worst-case' visual scenario.

The pipeline extending north of the refinery would be an underground pipeline running along Shell Parade and Princes Freeway. The underground pipeline would be installed over a period of 4 months, and would only involve typical construction vehicles. This pipeline would be constructed in sections to minimise visual impact by limiting works to each segment of the pipeline as they are installed. The finished sections would be returned to the existing condition, before construction start on the next segment of pipeline.

Therefore, any potential visual impacts from the construction phase would be of a lesser magnitude than the operation of the project, and the temporary duration would result in negligible visual impact.

4.6.4 LNG CARRIER

The LNG carrier would be using the existing shipping channels to enter Corio Bay during the operation of the proposed facilities. The shipping channel is currently used by more than 600 ships each year to reach Refinery Pier, so it is anticipated the visual impact of the LNG carrier in transit would be minimal and will not deviate from the current day-to-day operations within Corio Bay.

Thus the visual impact of the LNG carriers in transit has not been assessed as part of this report.

4.7 LIMITATIONS AND ASSUMPTIONS

Several technical limitations and assumptions have been relied upon in order to assess the impact of this proposal. These are detailed below:

Existing conditions

The existing conditions on which a baseline assessment was formed and the location of proposed structures is reliant on information obtained from the following sources:

- Existing terrain is based upon a combination of Data Victoria and 3D model data provided by AECOM. This data is assumed to be a current representation of existing conditions.

Viewshed Extents

- Viewshed extents are determined based upon the geographical extent of LiDAR data provided by AECOM. Where the geographical area of extents of this data is limited and is also within the determined LVIA study area, a 'worst-case scenario' approach has been adopted and these areas are assumed to fall within the viewshed extents i.e. assumed to be 'potentially visible'.

Representation of FSRU and LNG carrier in Photomontages

Assessment of the FSRU and LNG carrier is based upon the 3D modelled layout showing both vessels berthed adjacent to the existing refinary pier, as provided by AECOM.

The assessment considers the overall extent of the new infrastructure within the context of the existing industrial precinct and its maximum draught at the highest astronomical tide of 1.24m as noted in the *VIC Tide 2021, Edition 5, Victorian Regional Channel Authority*.

Treatment Facility

Assessment of the Treatment Facility is based upon 3D modelled layout within the existing Geelong Refinery as provided by AECOM. A assessment considers the overall extent of the new facility within the context of the existing refinery area and the existing screening mechanisms found along the perimeter of the refinery boundary.

Decommissioning

Decommissioning activities have been detailed in *Section 1.4.4 Key Decommissioning Activities*.

4.8 STAKEHOLDER AND COMMUNITY ENGAGEMENT

Stakeholders and the community were consulted to support the preparation of the project's EES and to inform the development of the project and understanding of its potential impacts.

For the landscape and visual impact assessment, feedback from community sessions around the visibility of the project from the Geelong waterfront and the new Spirit of Tasmania terminal was considered.

In addition, the selection of viewpoints for this study was informed by concerns raised by stakeholders and the community during engagement sessions.

5 EXISTING CONDITIONS

5.1 BASELINE ASSESSMENT: LANDSCAPE FEATURES

5.1.1 SURROUNDING LANDSCAPE CONTEXT

The proposed project site is situated within Corio Bay, along Shell Parade, next to the Viva Energy Geelong Refinery.

The project site is situated at the edge of an industrial area stretching south along Corio Bay towards Geelong CBD, with residential suburbs to the west such as Norlane and Corio, separated by the rail corridor. A pocket of residential area cuts through this industrial precinct in North Shore and extends to the western shoreline of Corio Bay, south of the proposed project infrastructure.

Open paddocks are found to the north of the project site extending to and beyond the Princes Freeway. These paddocks are separated from the project site with native screen tree planting oriented in rows from north to south.

Geelong Grammar School is situated to the east of the project site directly across Shell Parade. The school ground covers the majority of the land stretching from Shell Parade east to the Limeburner's Bay.

5.1.2 EXISTING LAND USE

Within the LVIA study area, the land use varies across different agricultural and industrial uses, residential living, and recreational land use.

The proposed project site is located within an existing industrial area on the western shoreline of Corio Bay. To its north and north east are predominately agriculture and public reserve land including Avalon Coastal Reserve and Limeburners Lagoon Nature Reserve. Geelong Grammar School is also located within this area situated at the intersection of Limeburners and Corio Bay.

To the west of the proposed project site along the waterfront of Corio Bay is the existing industrial precinct extending from the Princes Freeway to Rippleside. The industrial precinct is mostly concentrated along the existing rail line resulting in a thin but long stretch of industry along Corio Bay.

Beyond the industrial precinct to the west consists predominately of residential suburbs including Norlane and Corio. These residential suburbs contain some large commercial precincts such as service stations and shopping centre, but are mostly single and double storey detached dwellings.

5.1.3 INFRASTRUCTURE

The proposed project site is situated within an established port area of numerous wharfs, piers, including the existing Refinery Pier which would house certain components of the project infrastructure.

A rail corridor extends in a north/south direction cutting through the study area and is located within a close proximity to the marine infrastructure as mentioned above.

The Princes Freeway runs east/west across the north of the study area with Princes Highway branching off and similarly running north/south along the rail corridor but extending much further inland through the various residential suburbs.

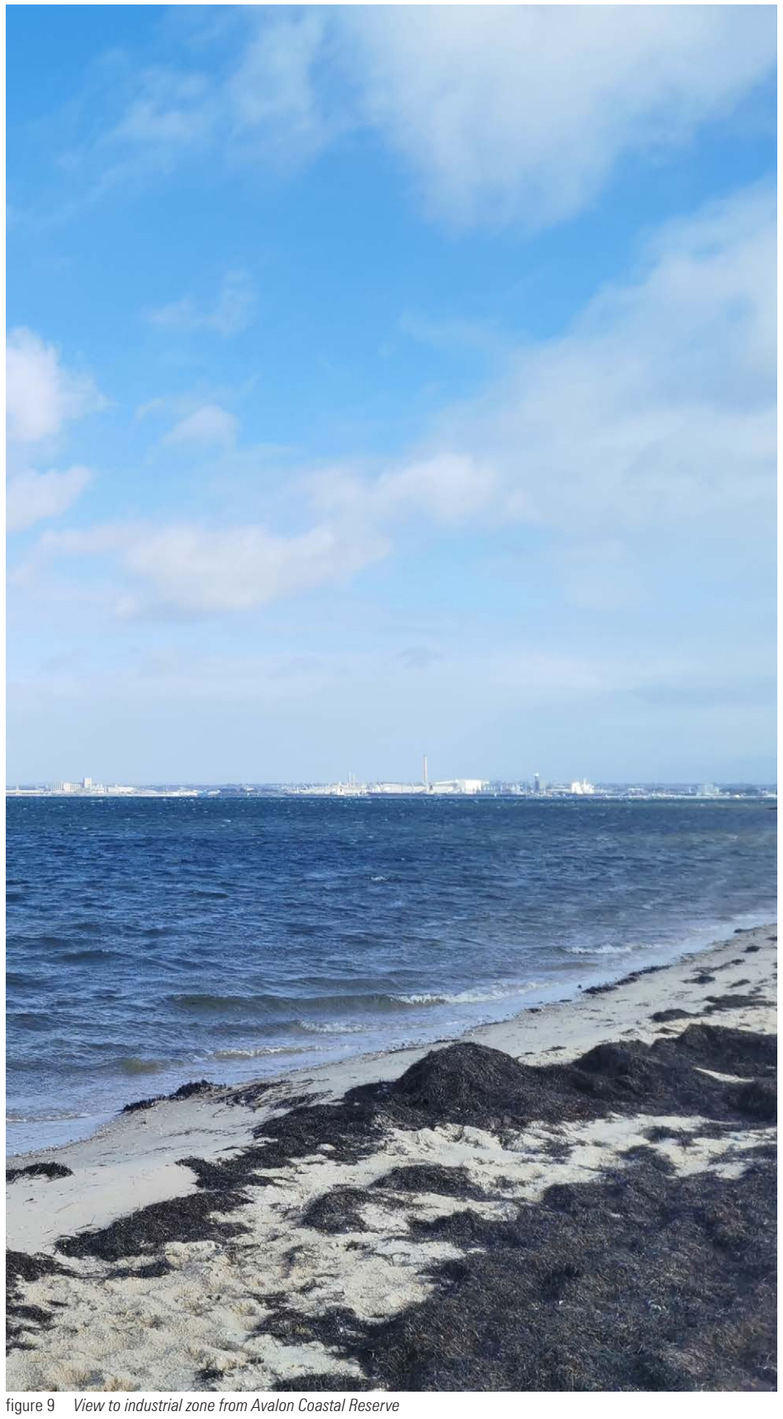
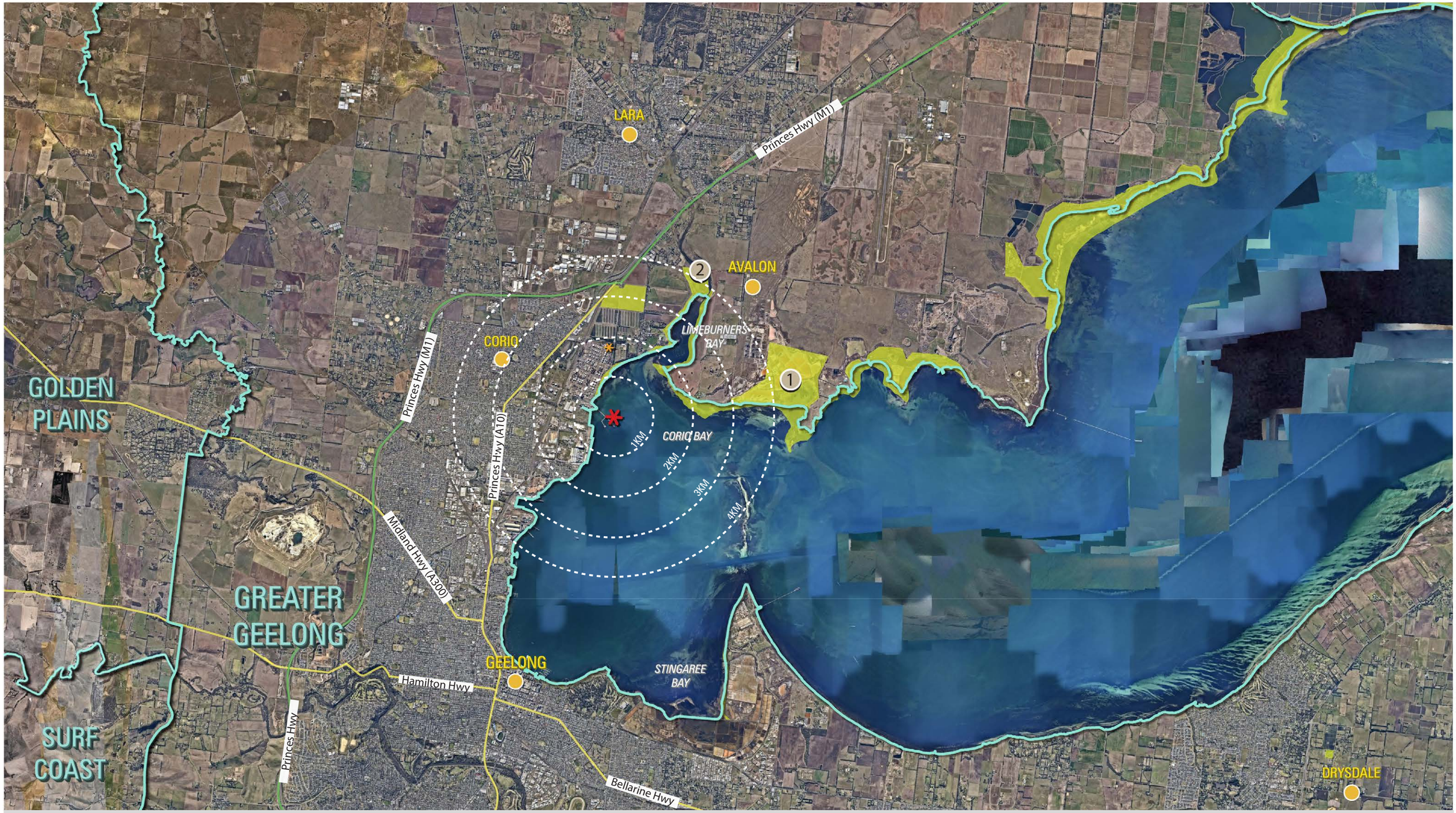


figure 9 *View to industrial zone from Avalon Coastal Reserve*



Legend

- FSRU
- Treatment Facilities
- Major Towns
- Freeway
- Highway
- Municipal Boundary
- Nature Reserve
- Avalon Coastal Reserve (1)
- Limeburners Lagoon Nature Reserve (2)

0 1 2 3 4 5 km

figure 10 *Greater Geelong - Regional Context Map*

Viva Energy Gas Terminal LVIA

Regional Context Map

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5.1.4 ELEVATION AND HYDROLOGY

The land within the study area is typically flat, with subtle undulations. There is a general rise in elevation to the south around Geelong.

Coastal reserves and intertidal zones are associated with low elevations, and are located toward the eastern area of the LVIA study extents.

Hovells and Cowies Creek enters the Corio Bay within the LVIA study area to the north of the Project site.

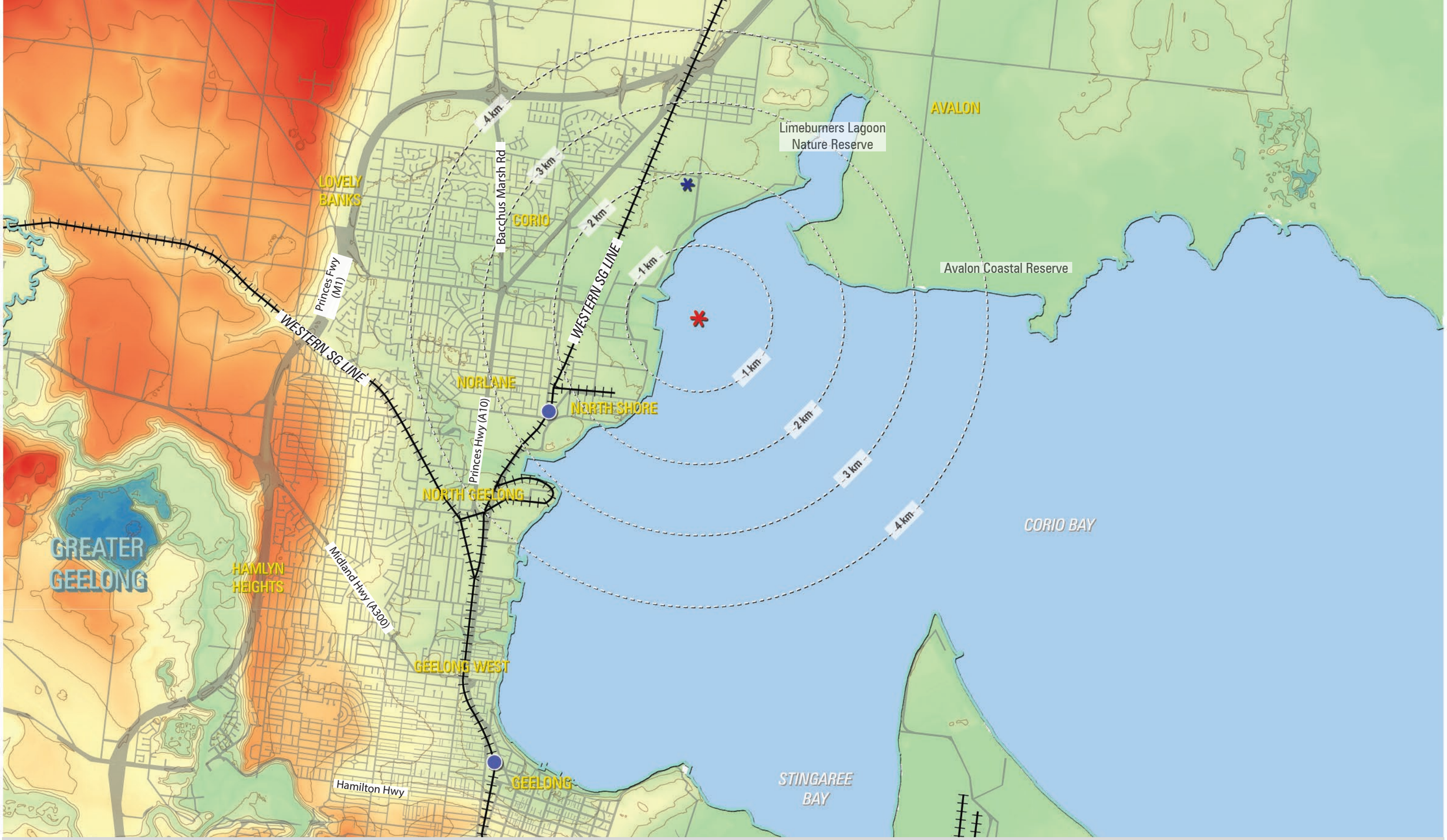
The proposed pier extension would be built from the existing Refinery Pier located in Corio Bay. The treatment facility would be situated within the existing footprint of the Geelong Refinery.

The relative flatness of the general elevation within the study area, in combination with the built form and street trees significantly limit views to the surrounding landscape, with the exception of the roads running along the shorelines of Corio Bay.

figure 11 *Open flat paddocks typical of areas to the north of the LVIA study area*

figure 12 *Typical unsealed road within Avalon Coastal Reserve*

figure 13 *View to existing refinery from Foreshore Road*



Legend

- FSRU
- Treatment facilities
- Train line
- Train station
- Existing contours (10m intervals)
- Roads
- Municipal boundary

Elevation Colour Range Classification:

92.9m

0m

- 30.5m

0 1 2 3 4 km

figure 14 *Greater Geelong - Elevation Plan*

Viva Energy Gas Terminal LVIA

Elevation Map

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5.1.5 VEGETATION

Noting the the majority of land within the study area is heavily urbanised, the existing vegetation resides in a heavily modified landscape. The existing vegetation within the vicinity of the project site can be categorised as follow:

- Coastal heath vegetation
- Formal screen planting of trees and large shrubs around the Geelong Refinery
- Pasture and cropping grasses with scattered native trees along agricultural property boundaries
- Roadside vegetation consisting of shrubs, grasses, and native trees
- Avenues of windbreak vegetation along roads and parcel boundaries
- Native and exotic formal tree planting along urban streets
- Native and exotic trees, shrubs and groundcover planting in public recreational areas
- Wetland planting along local creeks

5.1.6 SUMMARY OF LANDSCAPE FEATURES

A large portion of the landscape within the LVIA study extents has been modified by human activity directly by the nearby residential, agricultural, commercial and industrial land uses.

The urban precincts are defined with more formalised planting and more presence of exotic species, with the non urbanised areas displaying a predominately native plant palette. Vegetation from the indigenous ecologies are located mainly along the creek corridors, and along the Corio Bay shorelines.

The natural landscape is visually dominant to the east of the study area, however, this quickly changes moving west. The abundance of large trees along streets and roadways, in combination with the urban built form and the generally flush landscape, creates a compelling visual barrier for people within these spaces, and drastically reduce their visual accessibility into surrounding landscapes. The exception to this is the shorelines of Corio Bay which provides unimpeded views across the water.

figure 15 *Coastal heath vegetation - Avalon Coastal Reserve*

figure 16 *Exotic street trees - Corio*

figure 17 *Screen/windbreaker planting with paddocks - Shell Parade*

figure 18 *Screening/windbreaker planting along road edge - Foreshore Road*

figure 19 *Exotic trees along Geelong waterfront - Geelong*

figure 20 *Intertidal vegetation - Foreshore Road*

5.2 LANDSCAPE CHARACTER AREA ASSESSMENT

5.2.1 INTRODUCTION

This section of the report focuses on describing the landscape character of the LVIA study area by identifying the main characteristics of the landscape. This was undertaken to understand, through fieldwork, whether there are any further landscape character or visual amenity values which are of significance within the LVIA study area, in addition to those identified in the desktop baseline work undertaken.

The LVIA study area has been assessed to identify the Landscape Character Areas (LCAs) which can be described as areas of similar patterns or elements in the landscape such as landform, vegetation, waterbodies and land use as well as individual features.

Separating the LVIA study area into LCAs is the initial step in identifying areas of relative significance. This is an essential part of the landscape assessment, and leads into determining Landscape Values.

5.2.2 LANDSCAPE CHARACTER AREAS

As identified through the baseline assessment, the LVIA study area is divided into seven landscape character areas that differ from one another, each with a distinct, recognisable and consistent pattern of elements that occur in the landscape. The landscape character areas are identified as:

1. Coastal Wetland
2. Flat Farmland
3. Suburban
4. Geelong Waterfront
5. Geelong Grammar School
6. Industrial Buffer
7. Industrial Precinct

The landscape character areas determined through this assessment are shown graphically in *Figure 20*.

5.2.3 LANDSCAPE CHARACTER AREA 1: COASTAL WETLAND

The 'Coastal Wetland' landscape character area refers to a large portion of the land within the eastern section of the LVIA study area spanning the northern coast of Corio Bay from Limeburners Lagoon State Nature Reserve to Avalon Coastal Reserve.

Landscape topography: Generally flat with areas of natural wetland and remnant evaporation ponds from old salt works.

Use: Ramsar wetlands with publicly accessible areas for recreational use.

Vegetation: Low coastal heath and intertidal vegetation.

Built form: Minimal built up areas along Avalon Foreshore Road with public car park, toilet block, pier, and single storey residential dwellings. Roads within the landscape character site are unpaved with a mixture of dirt tracks and crushed rock. Public car park is sealed with asphalt.

Visible utilities: Overhead power line along Avalon Foreshore Road.

Visual accessibility: Expansive and open. The low vegetation typical of this character site provides high levels of visual accessibility to the surrounding area. The residential dwelling along the Avalon Foreshore Road are typically spaced out with minimal fencing to reduce visual intrusion on the landscape.

Landscape typology: Natural.

5.2.4 LANDSCAPE CHARACTER AREA 2: FLAT FARMLAND

The 'Flat Farmland' landscape character area refers to areas of the land to the eastern section of the LVIA study area surrounding the coastal wetlands. These areas border Limeburners Bay and extends west to the Princes Freeway to the north of the project site.

Landscape topography: Generally flat.

Use: Private farming pastures and estates.

Vegetation: Sparse screening shrub and tree plantings along private boundary interfaces with public roads. Formal planting of screening and avenue trees within the private land. Some street tree planting.

Built form: Buildings within these areas are single storey dwelling, homesteads and barns. Public road to the east of Limeburners Bay consist of a crushed rock finish, whilst road to the west of Limeburners Bay are sealed with asphalt.

Visible utilities: Overhead power line along all of the public roads.

Visual accessibility: Generally expansive and open. The screening vegetation, whilst present, are generally spaced out and consists of mostly native species with high and open canopies.

Landscape typology: Rural.

5.2.5 LANDSCAPE CHARACTER AREA 3: SUBURBAN

The 'Suburban' landscape character area consists of the suburbs to the west and south of the Project site.

Landscape topography: Generally flat.

Use: Largely urban residential areas with commercial and public use precincts.

Vegetation: Largely formal landscape with a mixture of native and exotic planting. Planting consists predominately of formal street trees and more naturalistic planting in parks, reserves and along Cowies Creek. Screening and garden bed planting can also be found within most private lots consisting of trees, small shrubs and groundcovers.

Built form: Residential buildings within this area are mostly single storey dwellings with a small portion of double storey dwellings. Building with large floor plates can be found within recreational, commercial and education precincts such as schools, pools, and shopping centres. These large floor plate buildings are all kept to single storey height. All roads are sealed with asphalt.

Visible utilities: Overhead power line along streets. Street lights. Rail corridor. Power substation.

Visual accessibility: Even with the general flatness of the site. The urban built form creates extensive visual barriers within the site as well as to its surrounding areas.

Landscape typology: Built.

5.2.6 LANDSCAPE CHARACTER AREA 4: GEELONG WATERFRONT

The 'Geelong Waterfront' landscape character area expands across the south of Corio Bay directly south of the Project site.

This area consists of the Geelong Central Business District (CBD) and its waterfront. This area is heavily urbanised with varies commercial and residential high rises, and public recreational areas including a foreshore walking trail, skate park, playground, theme rides, multi-use lawn, wharf, parks, beaches and pool.

Landscape topography: Generally flat incline from west to east. Visually higher elevations can be observed east of Bellerine Street including large areas within Eastern Park.

Use: Geelong CBD has a predominately commercial and public use, with some low density residential areas to the east. Housing types within this area includes apartment units, and single and double storey detached dwellings. This area also include Eastern Park which is the largest public open park land in Geelong, and houses a botanic garden. The waterfront consists mostly of public recreational open space, as well as a skate park, playground, Eastern Beach, and a public pool.

Vegetation: Largely formal landscape with a mixture of native and exotic planting. Planting consists predominately of formal street tree and garden planting, and more naturalistic planting along the waterfront open space and Eastern Park. Screening and garden bed planting can also be found within most private lots consisting of trees, small shrubs and groundcovers.

Built form: Building within this area consists of large floor plate multi-storey buildings such as residential high-rise, mix use and commercial towers, multi-storey shopping centre, and multi-storey university building. Smaller single and double storey residential dwelling can be found in the low density area, as well as some single storey commercial buildings along the waterfront. A large pier protrudes into the harbour north of the CBD and terminate at a restaurant/event space. Smaller piers can be found to its east and west housing private boats. Numerous open area and multi-storey car park can be found across this area.

Visible utilities: Overhead power line along streets. Street lights. Rail corridor.

Visual accessibility: Even with the general flatness of the site. The urban built form creates extensive visual barriers within the site as well as to its surrounding areas. Area opens up along the waterfront with allows for visual accessibility across the harbour.

Landscape typology: Built.

5.2.7 LANDSCAPE CHARACTER AREA 5: GEELONG GRAMMAR SCHOOL

The 'Geelong Grammar School' character area consists of various Geelong Grammar School buildings, housing, activity grounds, the eastern extent of the Foreshore Road and its associated waterfront public open space, and the area Lagoon Boat Club.

Landscape topography: Generally flat with elevation raising gradually towards the east whilst dropping down again at the boat club.

Use: The Geelong Grammar School, a private boarding school, covers the majority of this character area. The school includes activity precincts for the education, housing and recreation areas for its students, as well as maintenance and storage areas to service these activity precincts.

Foreshore Road runs to the south of the school along the Corio Bay waterfront. This area consists of public open space and a small pier.

The Lagoon Boat Club is a private docking area with public car park connecting into a walking trail to its north.

Vegetation: This character area consist largely of formal planting of trees, shrubs and garden beds, as well as open lawn areas. Natural heath vegetations can be found sparsely scattered along the Foreshore Road waterfront, whilst still predominately covered with lawn.

Planting of large screening trees can be found to the west of the this character area along Shell Parade, as well as to the south of the Geelong Grammar School along Foreshore Road.

Built form: This character area consist largely of buildings within the Geelong Grammar School. Various single storey building can be found around the Lagoon Boat Club serving as maintenance, storage and amenity facilities for the Club. Two boat ramps and two piers can be found to the south of the character area extending into Corio Bay. A public car park is located to the north of the boat club with a public pavilion.

A separate public car park area can be found to the south of the school servicing one of the boat ramp.

All road surfaces within the character area are sealed.

The Geelong Grammar School boundaries are marked out with a series of fencing including post and wire, grated mesh, timber pickets, and timber paling fence. The fencing type varies from low permeable fencing to high impermeable fencing.

Visible utilities: Overhead power line along streets.

Visual accessibility: Visual accessibility within this character area is limited with the exception of the waterfront areas. Large screen planting can be found in abundance around this area which limits view particularly to and from the school. The level change at the boat club also creates obstructions from the eastern edge of this character area towards the west.

Landscape typology: Built.

5.2.8 LANDSCAPE CHARACTER AREA 6: INDUSTRIAL BUFFER

The 'Industrial Buffer' character area consists of paddocks to the north and west of Geelong Refinery. These areas are zoned as industrial use and consists of formal screen planting of trees in consistent row formations.

Landscape topography: Flat.

Use: Formal planting of medium to large trees as visual screening for the industrial area.

Vegetation: Medium to large native trees planted in formal groups and rows.

Built form: This character area consist largely of planted vegetation. The only built element consist of the post and wire fencing surrounding the boundary of this character area, which prevents public access.

Visible utilities: There are no visible utilities within this character area.

Visual accessibility: This character area has a flat typology, but the screen planting limits visibility to a north-south direction.

Landscape typology: Built.

5.2.9 LANDSCAPE CHARACTER AREA 7: INDUSTRIAL PRECINCT

The 'Industrial Precinct' character area consists large industrial structures and complexes including the Geelong Refinery. This area is zoned for industrial use with minimal public amenity such as footpaths.

Landscape topography: Flat.

Use: Heavy industrial.

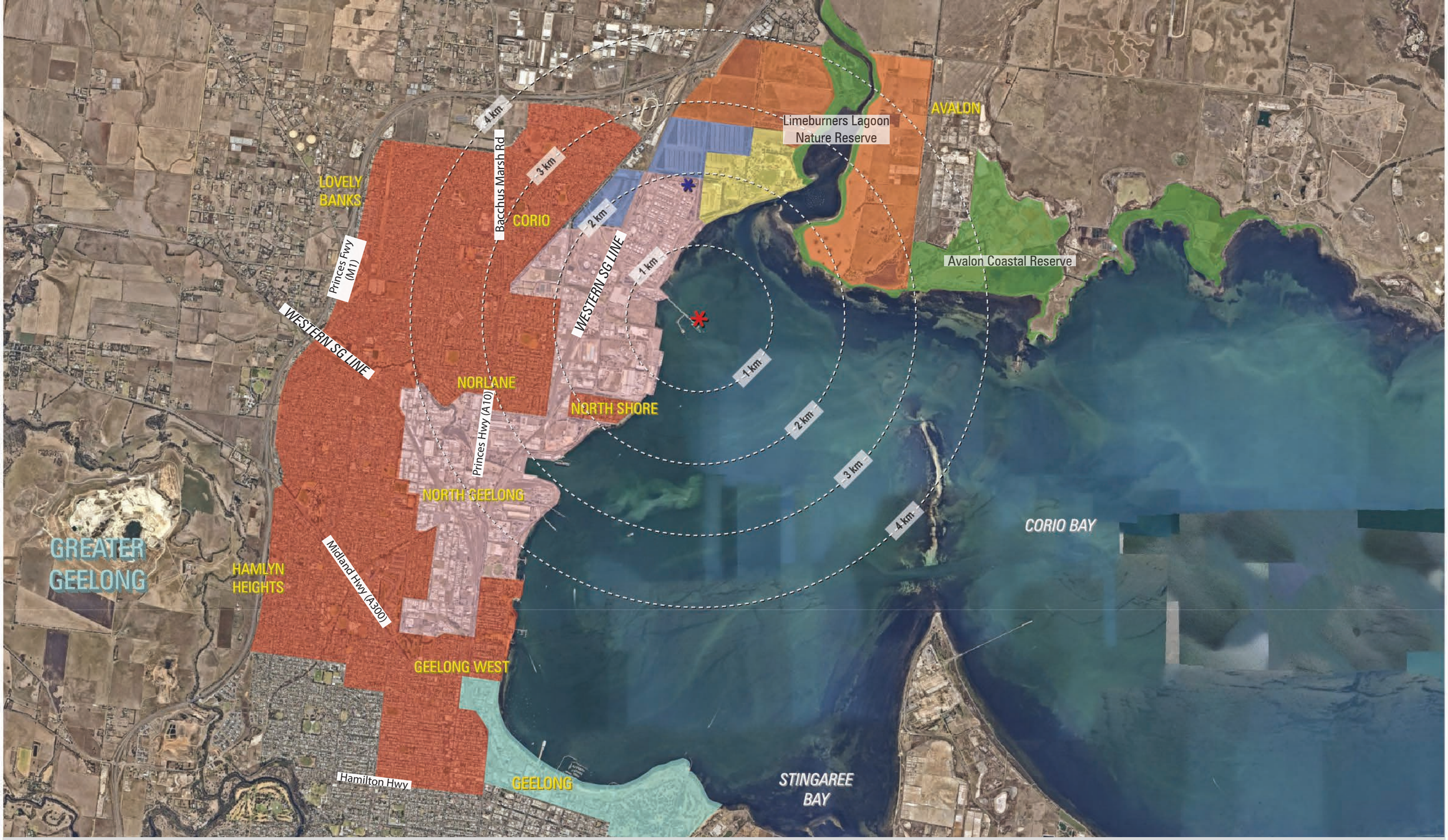
Vegetation: Medium to large native trees planted in formal groups and rows.

Built form: Various industrial structures and complexes ranging from single storey sheds to multi-storey structures. Property boundaries within this precinct are generally lined with chain mesh fencing topped with barb wire.

Visible utilities: Overhead power line along streets.

Visual accessibility: This character area has a flat typology, but the screen planting and large structures create visual barriers to the surrounding landscape.

Landscape typology: Built.



Legend

FSRU		Geelong Waterfront	
Treatment facility		Geelong Grammar School	
Coastal wetland		Industrial buffer	
Flat farmland		Industrial precinct	
Suburban			

0 1 2 3 4km

figure 21 *Landscape Character Area Map*

Viva Energy Gas Terminal LVIA

Landscape Character Map

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5.3 LANDSCAPE VALUE

5.3.1 INTRODUCTION

This section of the assessment aims to assess the existing relative Landscape Value of the study area in an objective manner. This is to be achieved through the baseline analysis work and the fieldwork undertaken. Guidance is taken from benchmarking documents, primarily *Visual Landscape and Planning in Western Australia, a Manual for Evaluation, Assessment, Siting and Design. November 2007.* In this manual Landscape Values are broadly defined as:

"the value placed on a landscape feature by the community based primarily on its perceived visual quality[1]*."*

Statutory controls which impact the LVIA study area have been used to guide the criteria for the assessment of Landscape Values. This includes the relatively higher level of value placed on the landscapes regarded significant for their landscape and visual values within the State Planning Policy Framework, national or state parks, and landscapes with designations such as World Heritage, Ramsar, National Trust, and Australia ICOMOS sites, or sites. These values have been integrated into the criteria identified from the *VLPWA Manual*.

Landscape character preference indicators have been used to assess Landscape Value of the site, where statutory designations are not applicable, in a manner that is as objective as possible.

Relative Landscape Value have been assigned as either *high*, *moderate* or *low* based on consideration of 'Statutory Landscape Significance' identified in *Section 4* of this report, and the identified landscape character preferences for each Landscape Character Area. Relative Landscape Value is assigned based on the following criteria:

High

- Prevalence of preferred landscape features, with minimal presence of non-preferred landscape features.

Moderate

- Some presence of preferred landscape features, with these being more prevalent than non-preferred landscape features.

Low

- Minor presence of preferred landscape features, and/or a prevalence of non-preferred landscape features.

5.3.2 BUILT CHARACTER PREFERENCE INDICATORS

PREFERRED LANDSCAPE FEATURES

Most preferred landscape features for this landscape typology include:

- Presence of trees, greenery, parks and gardens, street trees, canopied streets, median strip vegetation;
- Complementary building styles in neighbourhoods;
- Diverse building styles in neighbourhoods;
- Built developments that do not impinge on dominant natural features;
- Coherence of industrial buildings in one area;
- Elevated landforms and undulating terrain;
- Presence of water bodies;
- Presence of natural rock features
- Historic features including land uses that strengthen the local urban character;
- Well maintained gardens;
- Incorporation of significant cultural and environmental features into urban design;
- Urban water management (water bodies that are well maintained, and open drains with a complementary appearance to the surrounding built form);
- Development sites supporting and enhancing the urban context in which they are located;
- Development sites designed so they strengthen local character and promoted a sense of community;
- Design which takes account of landscape features, vegetation and landform;
- Services being underground to reduce cabling and severance of street trees;
- Unobtrusive mobile phone towers and other utility towers;
- Unobtrusive advertising;
- Presence of community artworks;
- Multi-storey buildings that maintain the CBD character (graduated skyline and gaps between clusters of buildings to allow views).

LEAST PREFERRED LANDSCAPE FEATURES

Least preferred landscape features for this landscape typology include:

- Derelict industrial areas (junkyard);
- Large carparks without trees;
- Run-down residential areas (dead grass, bare sand, dead vegetation, derelict housing and/or buildings, abandoned and/or trashed cars);
- Graffiti;
- Intrusive billboards (particularly along roads and railway reserves);
- Buildings which contrast sharply from surrounding built character (large isolated shopping centres, apartments, hotel);
- Arterial highways with strip commercial and light industrial developments, lacking trees and other vegetation;
- Utilities (tower, transmission lines, overhead powerlines);
- Severed or badly pruned street trees;
- Lack of vegetation;
- Degraded areas prone to depreciative uses and unregulated vehicle activities;
- Poorly maintained waterways and drains prone to stagnation, pollution and littering;
- Extensive areas of urban sprawl lacking vegetation or public open space;
- Extensive retaining walls which result in concrete canyon effects on roadways;
- Buildings that create a solid wall effect (no gaps to allow views between buildings).

5.3.4 RURAL CHARACTER PREFERENCE INDICATORS

PREFERRED LANDSCAPE FEATURES

Most preferred landscape features for this landscape typology include:

- Agricultural patterns, colours and textures that complement natural features; Presence of native avenue trees along roadsides;
- Areas or sites frequently prone to ephemeral features (presence of fauna, distinctive crop rotations, water conditions and climatic conditions);
- Distinctive remnant vegetation located along waterbodies, roadsides and in paddocks;
- Large mature feature trees;
- Established and consistent wind break planting or the presence of native or exotic avenue trees along property driveway entrances;
- Low density built developments that do not impinge on dominant natural features;
- Elevated landforms and undulating terrain;
- Uninterrupted vistas of natural horizons;
- Presence of natural water bodies and associated riparian vegetation;
- Presence of natural rock features;
- Historic features including that strengthen the local rural character;
- Well maintained gardens (native and exotic);
- Unobtrusive mobile phone towers and other utility towers;
- Unobtrusive advertising;

LEAST PREFERRED LANDSCAPE FEATURES

Least preferred landscape features for this landscape typology include:

- Industrial areas (junkyards) or large carparks;
- Utilities that contrast significantly from natural landscape characteristics, including utility towers and high voltage transmission lines;
- Run-down residential areas (dead grass, bare sand, dead vegetation, derelict housing and/or buildings, abandoned and/or trashed cars);
- Obtrusive Advertising signage or buildings which contrast sharply from the surrounding natural character (large, isolated shopping centres, apartments, hotels);
- Arterial highways with strip commercial and light industrial developments, lacking trees and other vegetation;
- Utilities (towers, transmission lines, overhead power-lines);
- Presence of agricultural equipment and machinery, and associated large footprint structures
- Lack of vegetation and degraded areas prone to depreciative uses and unregulated vehicle activities;
- Poorly maintained waterways and drains prone to stagnation, pollution and littering;
- Extensive areas of urban sprawl lacking vegetation or public open space;

5.3.3 NATURAL LANDSCAPE CHARACTER PREFERENCE INDICATORS

PREFERRED LANDSCAPE FEATURES

Most preferred landscape features for this landscape typology include:

- Unusual diversity in agricultural landscapes (colour and contrast or species diversity of cropping);
- Agricultural patterns, colours and textures that complement natural features;
- Gradual transition zones between agricultural land and natural landscape;
- Topographic variety and ruggedness;
- Presence of water bodies (dams, lakes, inundated areas) that borrow location, shape, scale and edge configuration from natural elements;
- Areas or sites frequently prone to ephemeral features (presence of fauna, distinctive crop rotations, water conditions and climatic conditions);
- Significant landscape features (trees and tree stands, historic relics, some windmills and areas of unusual topographic variation);
- Settlement patterns and individual structures that strengthen the local rural character (silos, windmills, water tanks, historic buildings, bridges, hay bales and dams);
- Historic features and land use patterns that strengthen the local rural character (historic farm machinery, old shearing sheds, windmills and historic buildings), and
- Distinctive remnant vegetation located along natural waterbodies, roadsides and in paddocks, or Big Old Trees

LEAST PREFERRED LANDSCAPE FEATURES

Least preferred landscape features for this landscape typology include:

- Areas of soil salinity/ salt scalds or dead, dying or diseased vegetation;
- Areas of extensive weed infestation;
- Eroded areas;
- Tips, dumps and landfill areas;
- Recently harvested areas (stumps, debris, abandoned off-cuts);
- Land use areas that contrast significantly from natural landscape characteristics (can include plantations, mines, rural settlement and/or housing, utility towers, roads and fencing;
- Abandoned structures in a state of disrepair or destruction;
- Unmanaged roads and access tracks;
- Farm structures and buildings in a state of disrepair;
- Eutrophied dams, lakes and water bodies.

5.4 LANDSCAPE VALUE ASSESSMENT

5.4.1 LANDSCAPE CHARACTER AREA 1: COASTAL WETLAND

Landscape Typology

Natural

Statutory Landscape Significance

- Ramsar wetland site
- Environmental Significance Overlay - Schedule 2 (Wetlands)

Preferred Landscape Features

- Topographic variety of natural heath landscape, natural intertidal wetlands and modified wetlands
- Presence of water bodies at the Limeburners Bay and Corio Bay
- Housing of migratory birds
- Spare building of low visual intrusiveness with simple designs, natural material, and muted and light colours
- Location of the all salt work evaporation ponds
- Distinctive coastal heath and intertidal vegetations

Least Preferred Landscape Features

- Overhead powerlines

Overall Relative Landscape Value

HIGH

The 'Coastal Wetland' character area is a generally well established area with a consistent natural coastal landscape. The landscape varies across coastal heath and intertidal vegetation with minimal intrusion of built elements. The landscape offers a wide vista of visual connection within and across its surrounding areas. The 'Coastal Wetland' character site has also been identified as a Ramsar site.

figure 22 *Typical view coastal heath vegetation along Avalon Coastal Park*

5.4.2 LANDSCAPE CHARACTER AREA 2: FLAT FARMLAND

Landscape Typology

Rural

Statutory Landscape Significance

- None applicable

Preferred Landscape Features

- Large mature trees
- Two homestead along the Avalon Coastal Reserve has been identified as historically significant
- Low density built developments that do not impinge on dominant natural features
- Unobstructed views to its surrounding areas

Least Preferred Landscape Features

- Overhead powerlines

Overall Relative Landscape Value

LOW

The 'Flat Farmland' character area is a generally open and expansive area of farmlands and private estates. This is a modified landscape consisting of formal screening trees and avenue trees along driveways, and large open pastures for animal grazing. This character area has a high visual accessibility with predominately large native trees planted at generous offsets with high, open canopies.

figure 23 *Typical view from Avalon Road*

5.4.3 LANDSCAPE CHARACTER AREA 3: SUBURBAN

Landscape Typology

Built

Statutory Landscape Significance

- None applicable

Preferred Landscape Features

- Presence of trees, greenery, parks and gardens, street trees, canopied streets, median strip vegetation
- Complementary building styles in neighbourhood
- Presence of water bodies
- Urban water management

Least Preferred Landscape Features

- Large carparks without trees
- Graffiti
- Intrusive billboards
- Overhead powerlines, and electrical substation
- Badly pruned street trees
- Arterial highway with large commericial and light industrial developments
- Large shopping centre precincts
- Buildings that create a solid wall effect

Overall Relative Landscape Value

LOW

The 'Suburban' landscape character area consists of low density housing, formal street tree planting, and parks with large open lawn. This landscape character area has a low visual connectivity to its surrounding due to the general flatness of the typology, and the visual barrier created by buildings, fences and street trees.

figure 24 *Typical view of residential suburb to the west of the study area*

5.4.4 LANDSCAPE CHARACTER AREA 4: GEELONG WATERFRONT

Landscape Typology

Built

Statutory Landscape Significance

- None applicable

Preferred Landscape Features

- Presence of trees, greenery, parks and gardens, street trees, canopied streets, median strip vegetation
- Complementary building styles in neighbourhood
- Built developments that do not impinge on dominant natural features
- Presence of water bodies
- Historic features including land uses that strengthen the local urban character
- Well maintained gardens
- Urban water management
- Development sites designed so they strengthen local character and promoted a sense of community
- Unobtrusive advertising
- Presence of community artworks
- Multi-storey buildings that maintain the CBD character

Least Preferred Landscape Features

- Large carparks without trees
- Graffiti
- Intrusive billboards
- Overhead powerlines
- Buildings that create a solid wall effect

Overall Relative Landscape Value

HIGH

This character area is the main commercial, educational and recreational hub of the Greater Geelong Municipality, and as such attracts high volume of daily visitors. The landscape is typically formal in nature, but are well maintained, particularly along the waterfront. The combination of the character area's central location, key amenities, and an existing high quality landscape makes this a high Landscape Value area.

figure 25 *Typical view from Geelong waterfront towards proposed project site*

5.4.5 LANDSCAPE CHARACTER AREA 5: GEELONG GRAMMAR SCHOOL

Landscape Typology

Built

Statutory Landscape Significance

- None applicable

Preferred Landscape Features

- Presence of trees, greenery, parks and gardens, street trees, canopied streets, median strip vegetation
- Complementary building styles in neighbourhood
- Presence of water bodies
- Historic features including land uses that strengthen the local urban character
- Well maintained gardens
- Diverse building styles in neighbourhoods
- Presence of community artworks

Least Preferred Landscape Features

- Overhead powerlines
- Buildings that create a solid wall effect

Overall Relative Landscape Value

HIGH

This character site consists of a private school complex with a series of traditional and contemporary buildings set within a largely formal landscape. The site is located on private land with no public access. The numerous buildings, and mature trees and shrubs create abundant screening and limit visual accessibility into the surrounding areas. Due to the historical significance of the site, a high Landscape Value has been assigned to this character area.

figure 26 *Typical view Geelong Grammar School (Photo by Geelong Grammar School)*

5.4.6 LANDSCAPE CHARACTER AREA 6: INDUSTRIAL BUFFER

Landscape Typology

Built

Statutory Landscape Significance

- None applicable

Preferred Landscape Features

- Presence of trees, greenery, parks and gardens, street trees, canopied streets, median strip vegetation

Least Preferred Landscape Features

- Overhead powerlines

Overall Relative Landscape Value

LOW

This character site consists of formal screen planting of trees in row formation. This character site are all located on private land with no public access, and the density and screening nature of the tree planting heavily limits visual access in, and out of the character area. Hence, a low Landscape Value has been assigned to this character area.

figure 27 *Typical view of screening trees*

5.4.7 LANDSCAPE CHARACTER AREA 7: INDUSTRIAL PRECINCT

Landscape Typology

Built

Statutory Landscape Significance

- None applicable

Preferred Landscape Features

- Presence of trees

Least Preferred Landscape Features

- Derelict industrial areas;
- Large carparks without trees;
- Graffiti;
- Intrusive billboards (particularly along roads and railway reserves);
- Utilities (tower, transmission lines, overhead powerlines);
- Severed or badly pruned street trees;
- Lack of vegetation;
- Degraded areas prone to depreciative uses and unregulated vehicle activities;
- Buildings that create a solid wall effect (no gaps to allow views between buildings).

Overall Relative Landscape Value

LOW

This character site is heavily industrialised with minimal public amenities such as footpaths. The industrial structures greatly limit visual access into the surrounding areas and detach from the limited views where available.

figure 28 *Typical view of large industrial complex within the precinct*

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6 OPERATION IMPACT ASSESSMENT

6.1 INTRODUCTION

This section of the assessment aims to determine the visual impact of the Project on the surrounding landscape, through the process of undertaking the following:

- Determination of the Zone of Theoretical Visibility of the Project as a means of identifying all areas of the existing landscape within a defined distance of the relevant project components from which the development would potentially be visible;
- Identifying and describing a series of representative view locations and non-stakeholder residential view locations from which the development would be visible; and
- Preparing a series of computer-generated photomontage images as a means of demonstrating the anticipated visual presence of the development from each of the view locations. The proposed project infrastructure would be 3D models imposed onto photographs taken from each view location using geo-referenced coordinates and reference points (wireframe view), and;
- Consideration of the landscape character attributes and Landscape Values described in earlier sections of this report, and using the photomontage images as points of reference, a level of magnitude of visual impact would be described for each representative view location.

The assessment of visual impact (level of magnitude) for each view location would discuss the need for mitigation of the visual impact in each instance, and would outline and describe appropriate measures to achieve an appropriate level of mitigation.

Mitigation measures are deemed necessary for any visual impact assessed as High or above. Visual impact assessed as Moderate would be reviewed on a case by case basis within the context of the existing conditions and land use to determine whether any mitigation measures are necessary.

6.2 CRITERIA FOR ASSESSMENT OF VISUAL IMPACT ON REPRESENTATIVE VIEWS

In adopting a series of criteria for assessing the visual impact of representative view locations, it is important to define a range of terms which provide some indication of the extent to which a view location may be impacted upon visually by the Project, and when mitigation measures are considered necessary.

In determining this range a grading system of visual impact categories is described below. Consideration of mitigation measures is desirable for any visual impact at representative view location which is assessed as 'Negligible/Very Low' or higher.

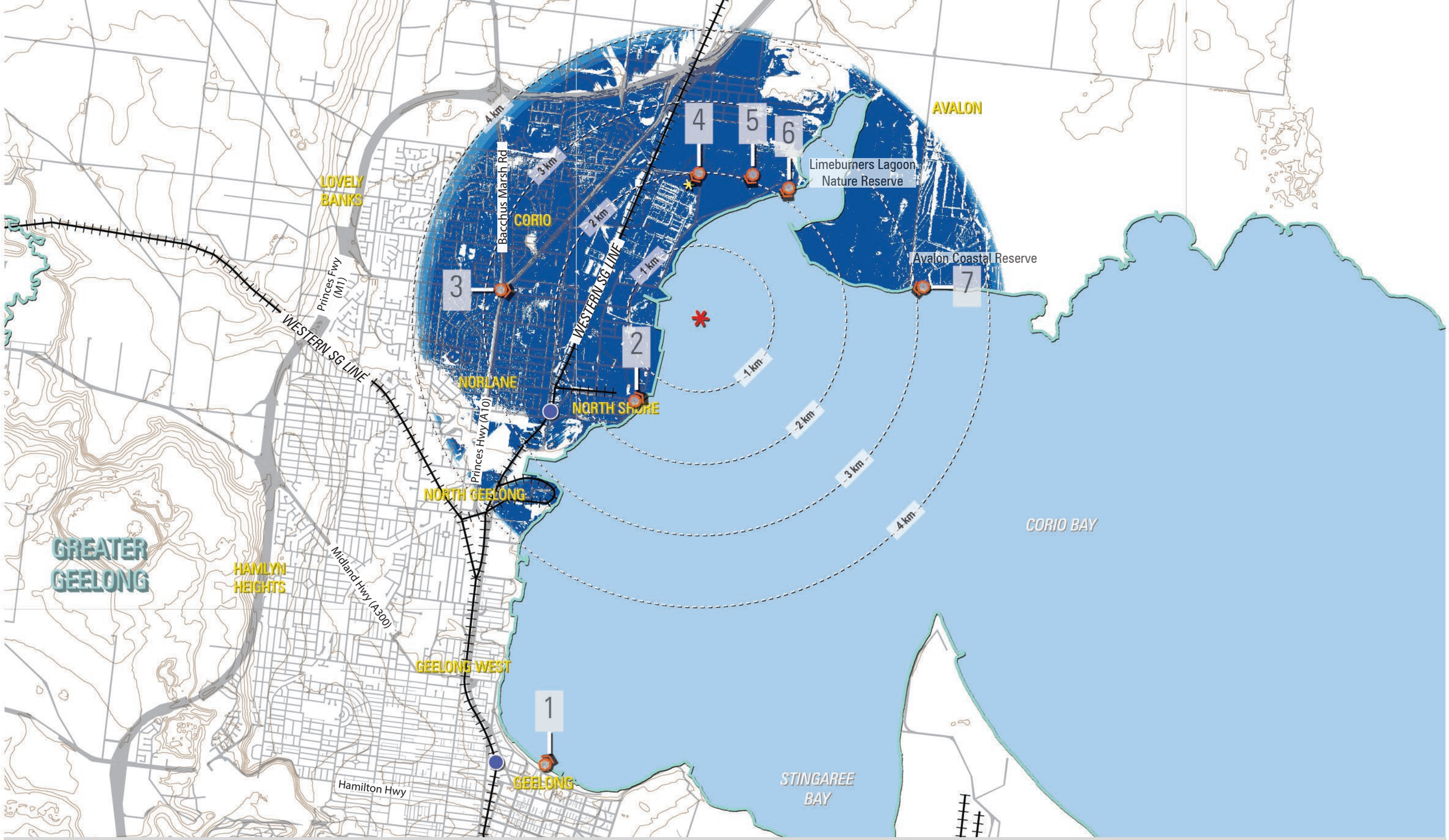
Very High: entailing close proximity in an exposed location incapable of effective mitigation, where in principle the proposed structures would impact unacceptably on visual amenity, with limited opportunity for the implementation of mitigation measures.

High: where impacts would be substantial, with the proposed structures forming a major element in the view. There would be a tendency for proposed structures to be more dominant than other landscape elements. Consideration of the feasibility and appropriateness of mitigation measures would determine whether or not the development results in unacceptable impacts on visual amenity.

Moderate: proposed structures would typically be visible, sometimes obviously so. Notwithstanding this, the generally greater distances involved, together with the contribution to visual screening typically provided by topography or vegetation, results in situations where proposed structures would not be a dominant element in the view. Mitigations measures are generally not necessary.

Low: proposed structures are visible but form only minor elements in available views as a result of distance and/or screening by vegetation and/or topography. Mitigation measures are considered unnecessary.

Negligible/Very Low: proposed structures are visible in clear conditions and may be recognisable, but conversely may sometimes not even be noticed. Mitigation measures are considered unnecessary.



Legend

- Highest points of proposed project infrastructure (55m AHD)
- Treatment facility
- View location
- Train line
- Train station
- Roads
- Existing contour (10m interval)

Potential Visual Exposure

- Very high visibility
- High visibility
- Moderate visibility
- Low visibility
- No visible area

0 1 2 3 4 km

figure 29 *Viewshed Analysis Mapping*

Viva Energy Gas Terminal LVIA

Viewshed Analysis (Viewpoint at FSRU top level at RL 55m AHD)
(Generate from 10m DEM NASA map)

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Project Ref:	**21.0224**
Dwg No.:	**LVIA-6**
Scale	**1:50,000**
Date:	**12/12/2021**
Revision:	**A**

hansen

6.2.1 IMPACT ASSESSMENT: VIEW LOCATION 1

Location

View location 1 is located at the edge of the waterfront along Geelong CBD on the foreshore path east of The Carousel. This location is approximately 7km from the proposed FSRU/LNG carrier docking location.

Project Description

The FSRU would be permanently berthed at the new pier extension with periodic visits from LNG carriers (up to 45 per annum) to unload liquefied natural gas.

The treatment facility would be located further north of the FSRU within the existing Refinery grounds

Landscape Value

The view is located within the 'Geelong Waterfront' Landscape Character Area, of which the relative Landscape Value is 'High'.

Visual Character

As represented in the photomontage: 'Existing view' *(refer to Fig 28)*, the view expands into open water offering direct visual access to the proposed FSRU/LNG carrier docking location.

The foreground of the view is situated on the pedestrian walkway along the Geelong foreshore. The view looks north towards the project site with a timber pier to its left.

The mid-ground is filled with the expanse of Corio Bay which accommodates regular traffic of large commercial ships that dock in the various harbours and piers.

The view concludes with the industrial developments along the west of Corio Bay and Avalon to the north, including a view to The You Yangs. However, The You Yangs is partially obstructed by the existing industrial infrastructure including numerous chimneys that break the horizon.

The features around this view are consistent with the 'built' typology of the 'Geelong Waterfront' Landscape Character Area.

Rationale for selection

This view location was selected based on the high profile of the Geelong CBD and waterfront areas which accommodates high use on a daily basis. The view location is 7km from the project footprint which exceeds the assessment range as determined in *Section 7.2*, but was included to demonstrate and assess any potential visual impact within this high use area.

Anticipated visual impact

The photomontage: 'Wireframe view' *(refer to Fig 29)* illustrates the visibility of the proposed FSRU which would be minimal within this view.

The FRSU would be berthed within a existing heavily industrialised area of Corio bay, adjacent an extension of the existing Refinery Pier. Up to a maximum of 45 LNG carriers per annum would be temporarily berthed next to the FSRU to unload liquefied natural gas.

The proposed project infrastructure does not obstruct the existing view of the water, nor does it further impede views to the You Yangs.

The pier extension and pipeline is only partially visible from this view sitting slightly above the water line in the background. It does not obstruct the view to any existing landscape features.

The treatment facility would not be visible from this view point.

Therefore, with reference to the criteria for assessment of view locations described in *Section 6.2*, the visual impact of the proposed project at view location 1 - as represented by the photomontage image - is considered to be 'Low'.

Recommended mitigation measures

With consideration of the minimal visual impact of the proposed FSRU, LNG carriers (when berthed next to the FSRU) and the treatment facility at view location 1, mitigation measures are not considered necessary.

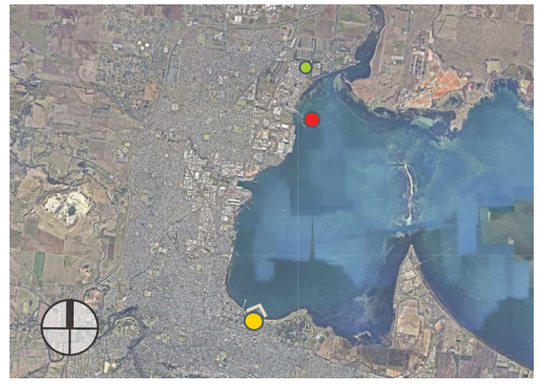
View location 1 - from Geelong waterfront facing north towards proposed FSRU/LNG carrier and treatment facility

Photograph taken:
11:21 am on the 15/07/21
Photo taken at:
170cm above ground level

View location :
e: 268931.4990
n: 5774958.1660
rl: 1.55

Approx. distance to FSRU/LNG Carrier :
7.0km

Photomontage created by:
ZJ - B.LA
Images created using:
Rhino 6, V-Ray5.0 for Rhino, autocad 2019, adobe photoshop, indesign cc 2021
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 15/07/21
Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM



Camera location
FSRU/LNG Carrier
Treatment facility

figure 30 *View Location 1: Existing view*

figure 31 *View Location 1: Wireframe view - without LNG carrier*

figure 32 *View Location 1: Wireframe view - with LNG carrier*

6.2.2 IMPACT ASSESSMENT: VIEW LOCATION 2

Location

View location 2 is located adjacent to The Esplanade in North Shore along the Bay Walk trail south of Sea Breeze Parade. This location is approximately 1.5km from the proposed FSRU/LNG carrier docking location.

Project Description

The FSRU would be permanently berthed at the new pier extension with periodic visits from LNG carriers (up to 45 per annum) to unload liquefied natural gas.

The treatment facility would be located further north of the FSRU within the existing Refinery grounds

Landscape Value

The view is located within the 'Suburban' Landscape Character Area, of which the relative Landscape Value is 'Low'.

Visual Character

As represented in the photomontage: 'Existing view' *(refer to Fig 31)*, the view expands into open water offering direct visual access to the proposed FSRU/LNG carrier docking location behind the large industrial complex.

The foreground of the existing view includes the termination point of the Bay Walk (south) trail concluding at an access driveway into the industrial precinct. There are presence of native coastal heath vegetation scattered along the embankment and walking trail.

The mid-ground includes a large industrial complex and various industrial infrastructure that creates substantial visual barrier for views looking north. View to Corio Bay could be seen adjacent to the industrial complex, but is heavily obstructed by the existing building complex and vegetation.

The coastal of Avalon could be seen in the background.

This view was taken at the eastern edge of the North Shore residential area, which has a typical 'built' typology of the 'Suburban' Landscape Character Area.

Rationale for selection

This view location was selected based on its proximity to the proposed project site. The view is located in to the east of the residential area in North Shore in order to understand the visual impact of the proposed project infrastructure on the residents in this area.

This view location is also the highest point directly between the proposed project infrastructure and the future Spirit of Tasmania Terminal. The visual assessment of this view location would inform the 'worst-case scenario' on the future terminal.

Anticipated visual impact

The photomontage: 'Wireframe view' *(refer to Fig 32)* illustrates the visibility of the proposed FSRU would be minimal within this view.

The FSRU would be partially visible in the background from above the roof of the existing industrial complex. The FSRU would not obstruct the views to the water or the Avalon coastal line. There would be also be no obstruction to the vegetation in the foreground.

The pier extension and pipeline is only partially visible from this view sitting slightly above the water line in the background. It does not obstruct any features within this view.

The treatment facility would not be visible from this view point.

Therefore, with reference to the criteria for assessment of view locations described in *Section 6.2*, the visual impact of the proposed project at view location 2 - as represented by the photomontage image - is considered to be 'Low'.

The future Spirit of Tasmania Terminal will be located to the south-west of this view location at a lower elevation. This means the existing landform and industrial structures would further increase the visual screening of the FSRU and LNG carriers (when berthed next to the FSRU) from the new terminal location. As a result, the visual impact for the future Spirit of Tasmania Terminal would be lower than the result assessed in this view.

Recommended mitigation measures

With consideration of the minimal visual impact of the proposed FSRU, LNG carriers (when berthed next to the FSRU) and the treatment facility at view location 2, mitigation measures are not considered necessary.

View location 2 - from The Esplanade (North Shore) facing north-east towards proposed FSRU/LNG carrier and treatment facility

Photograph taken:
12:06 pm on the 15/07/21
Photo taken at:
170cm above ground level

View location :
e: 270153.7280
n: 5779957.7640
rl: 10.56

Approx. distance to FSRU/LNG Carrier :
1.5km

Photomontage created by:
ZJ - B.LA
Images created using:
Rhino 6, V-Ray5.0 for Rhino, autocad 2019, adobe photoshop, indesign cc 2021
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 15/07/21
Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

figure 33 *View Location 2: Existing view*

figure 34 *View Location 2: Wireframe view - without LNG carrier*

figure 35 *View Location 2: Wireframe view - with LNG carrier*

6.2.3 IMPACT ASSESSMENT: VIEW LOCATION 3

Location

View location 3 is located on St George's Road, at the Boston Street intersection facing east. This location is approximately 1.7km from the proposed FSRU/LNG carrier docking location.

Project Description

The FSRU would be permanently berthed at the new pier extension with periodic visits from LNG carriers (up to 45 per annum) to unload liquefied natural gas.

The treatment facility would be located further north of the FSRU within the existing Refinery grounds

Landscape Value

The view is located within the 'Suburban' Landscape Character Area, of which the relative Landscape Value is 'Low'.

Visual Character

As represented in the photomontage: 'Existing view' *(refer to Fig 34)*, the view predominantly contain service infrastructures including numerous overhead powerlines, street lights and the rail barrier extending consistently from the foreground to the background. The naturestrip along St Georges Road is heavily eroded with extensive die back of turf, and no street tree planting.

Some native trees can be seen in the mid-ground of the view, but are heavily obstructed by the overhead powerlines situated in the foreground.

A large industrial complex can be seen in the background, with the view terminating a row of native trees used for screening industrial infrastructures.

This view was taken at the eastern edge of the Corio and Norlane, which has the typical 'built' typology of the 'Suburban' Landscape Character Area.

Rationale for selection

This view location was selected at the eastern edge of Norlane, closest to the proposed project infrastructure. The view was selected to determine the maximum visual impact of the proposed project infrastructure on the residential suburbs to the west.

Anticipated visual impact

The photomontage: 'Wireframe view' *(refer to Fig 35)* illustrates the visibility of the proposed FSRU in the background of this view which can be seen above the screening vegetation.

The view of the FSRU would be partially obstructed by the existing industrial complex and the numerous powerlines and street lights.

Whilst extending above the existing screening vegetation, the proposed FSRU does not protrude above the existing powerlines and light poles which breaks up the horizon.

The pier extension and pipeline would not be seen within this view.

The treatment facility is not visible from this view point.

Therefore, with reference to the criteria for assessment of view locations described in *Section 6.2*, the visual impact of the proposed project at view location 3 - as represented by the photomontage image - is considered to be 'Moderate'.

Recommended mitigation measures

Whilst the visual impact of the proposed FSRU and the LNG carrier (when berthed next to the FSRU) is moderate on the existing view. The context of the view demonstrates a highly industrialised site with minimal existing visual and public amenity. Substantial existing service infrastructure create obstructions to its visual accessibility and further reduces the landscape value of this area. Therefore, mitigation measures are not considered necessary.

View location 3 - from St George Road facing east towards proposed FSRU/LNG carrier

Photograph taken:
12:20 pm on the 15/07/21
Photo taken at:
170cm above ground level

View location :
e: 269250.2190
n: 5781434.8930
rl: 8.26

Approx. distance to FSRU/LNG Carrier :
1.7km

Photomontage created by:
ZJ - B.LA
Images created using:
Rhino 6, V-Ray5.0 for Rhino, autocad 2019, adobe photoshop, indesign cc 2021
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 15/07/21
Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

figure 36 *View Location 3: Existing view*

70° 80° 90° 100° 100°

figure 37 *View Location 3: Wireframe view - without LNG carrier*

E

figure 38 *View Location 3: Wireframe view - with LNG carrier*

6.2.4 IMPACT ASSESSMENT: VIEW LOCATION 4

Location

View location 4 is located at the northern nature strip of School Road looking south at Geelong Refinery. This location is roughly 0.05km from the proposed treatment facility.

Project Description

The FSRU would be permanently berthed at the new pier extension with periodic visits from LNG carriers (up to 45 per annum) to unload liquefied natural gas.

The treatment facility would be located further north of the FSRU within the existing Refinery grounds

Landscape Value

The view location is situated within the 'Industrial Buffer' Landscape Character Area, of which the relative Landscape Value is 'Low'.

Visual Character

As represented in the photomontage: 'Existing view' *(refer to Fig 37)*, the view distance from this location is limited. The view looks across School Road directly at the location of the new treatment facility.

The foreground of the view consists of School Road and the property boundary of Geelong Refinery as denoted by a post and wire fence. An open grass area extends from the foreground into the mid-ground denoted by another row of post and wire fencings. A few mature native trees can be seen providing partial screening to the industrial structures in the background.

The industrial structures include a series of large storage tanks and a refinery structure to the left, with a chimney extending above the existing trees in the mid-ground. This chimney is the highest element within this view.

The features around this view are consistent with the 'built' typology of the 'Industrial Buffer' Landscape Character Area.

Rationale for selection

This view location was selected based on the proximity to the treatment facility from Geelong Grammar School along School Road. This road is a key access road for the School from the surrounding arterial roads, western suburbs and Geelong. This would be the location where the treatment facility would have the maximum visibility, and would be ideal for demonstrating the maximum visual impact of the treatment facility on the surrounding landscape.

This is also one of the closest location from which the treatment facility can be viewed.

Anticipated visual impact

The photomontage: 'Wireframe view' *(refer to Fig 38)* illustrates the treatment facility would highly visible from this location as there is no existing vegetation to provide screening for the proposed treatment facility from School Road.

The treatment facility would be located in the mid-ground of the view and would contain various elements extending across the extent of this view. The highest element of the proposed treatment facility is shown to be much lower than the existing chimney structure. The proposed treatment facility would be situated within an existing industrial complex and would not detract from the existing visual character of this view. The existing native trees in the mid ground would be removed as a result of the new treatment facility. This removes the limited natural screening on the industrial structures which create more visual emphasis on these structures, increasing their prominence within this view.

The FSRU would not be visible from this view point.

The pier extension and pipeline would not be visible from this view point.

Therefore, with reference to the criteria for assessment of view locations described in *Section 6.2*, the visual impact of the proposed project at view location 4 - as represented by the photomontage image - is considered to be 'Moderate'.

Recommended mitigation measures

As the proposed treatment facility would be visible from School Road, screen planting of large native trees along the School Road boundary is recommended to screen the view of the treatment facility from the road.

View location 4 - from School Road/ Shell Parade facing south-west towards proposed treatment facility

Photograph taken:
11:12 am on the 04/10/21
Photo taken at:
170cm above ground level

View location :
e: 270795.6770
n: 5783197.8410
rl: 11.933

Approx. distance to treatment facility :
0.05km

Photomontage created by:
ZJ - B.LA
Images created using:
Rhino 6, V-Ray5.0 for Rhino, autocad 2019, adobe photoshop, indesign cc 2021
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 15/07/21
Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Camera location
FSRU/LNG Carrier
Treatment facility

200° 210° 220° SW 230°

figure 39 *View Location 4: Existing view*

200° 210° 220° SW 230°

figure 40 *View Location 4: Wireframe view - with treatment facility*

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6.2.5 IMPACT ASSESSMENT: VIEW LOCATION 5

Location

View location 5 is located at the south of Geelong Grammar School looking south at the Geelong Refinery. This location is roughly 1.6km from the proposed FSRU/LNG carrier docking location.

Project Description

The FSRU would be permanently berthed at the new pier extension with periodic visits from LNG carriers (up to 45 per annum) to unload liquefied natural gas.

The treatment facility would be located further north of the FSRU within the existing Refinery grounds

Landscape Value

The view is located within the 'Geelong Grammar School' Landscape Character Area, of which the relative Landscape Value is 'High'.

Visual Character

As represented in the photomontage: 'Existing view' *(refer to Fig 39)*, the view represents a coastal view looking south across Foreshore Road and into Corio Bay.

The view is largely exposed with gravel access road and open lawn filling the foreground to mid-ground, with the mid-ground consisting partly of Foreshore Road and the grass naturestrip. The foreground also contains a number of timber bollards and a timber post and wire fencing.

The mid-ground end with clumps of coastal heath vegetation including a number of medium to large sized shrubs, as well as powerpole and overhead lines which breaks up the horizon. The mid-ground creates a natural screening of Corio Bay allowing limited visual access to the water.

The background consist mostly of Corio Bay as well as the existing industrial area and limited views to Geelong East to the left of the view.

The features around this view are consistent with the 'built' typology of the 'Geelong Grammar School' Landscape Character Area.

Rationale for selection

This view location was nominated by Geelong Grammar School. Concerns were raised about the visual impact of the proposed project from this location due to its proximity to the student dormitory. The view location was selected at the most exposed location near the dormitory in order to demonstrate the maximum visual impact of the FSRU and LNG carrier (when berthed next to the FSRU) on this Landscape Character Area.

The view location is situated within a service driveway in the school ground. A representatives of the school was present during the site investigation fieldwork at this view location.

Anticipated visual impact

The photomontage: 'Wireframe view' *(refer to Fig 40)* illustrates that the FSRU would be largely screened by the existing coastal vegetation along Shell Parade.

A limited portion of the FSRU would be visible above the existing shrubs adjacent to the power pole. The outline of the proposed FSRU also demonstrate it only sits slightly higher than the existing industrial complexes but remain lower than the existing chimneys at a similar height to the visible cranes.

The pier extension and pipeline sits above the waterline in the background along the industrial precinct and does not provide obstruction to any view.

The treatment facility would not be visible from this view location.

Therefore, with reference to the criteria for assessment of view locations described in *Section 6.2*, the visual impact of the proposed project at view location 6 - as represented by the photomontage image - is considered to be 'Negligible/Very Low'.

In the event that the vegetation is removed from Foreshore Road in the future, the visual impact of the proposed FSRU at view location 6 - as represented by the photomontage image - would be escalated to 'Moderate'.

Assessment of the visual impact to the school ground was only taken from this one location as nominated by the school representative. The proposed project infrastructure may be more visible in other areas of the school ground, but it is anticipated that the visual impact would be comparable to the assessment of this location.

Recommended mitigation measures

With consideration of the minimal visual impact of the proposed FSRU, LNG carrier (when berthed next to the FSRU) and pier extension at view location 5, mitigation measures are not considered necessary.

View location 5 - from Geelong Grammar facing south-west towards proposed FSRU/LNG Carrier

Photograph taken:
10:08 am on the 04/10/2021
Photo taken at:
170cm above ground level

View location :
e: 271712.9316
n: 5782860.9758
rl: 9.050

Approx. distance to FSRU/LNG carrier:
1.6km

Photomontage created by:
ZJ - B.LA
Images created using:
Rhino 6, V-Ray5.0 for Rhino, autocad 2019, adobe photoshop, indesign cc 2021
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the xx
Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Camera location
FSRU/LNG Carrier
Treatment facility

figure 41 *View Location 5: Existing view*

figure 42 *View Location 5: Wireframe view - without LNG carrier*

figure 43 *View Location 5: Wireframe view - with LNG carrier*

6.2.6 IMPACT ASSESSMENT: VIEW LOCATION 6

Location

View location 6 is located in the public car park adjacent to the Lagoon Boat Club in Limeburners Bay. This location is approximately 2.1km from the proposed FSRU/LNG carrier docking location.

Project Description

The FSRU would be permanently berthed at the new pier extension with periodic visits from LNG carriers (up to 45 per annum) to unload liquefied natural gas.

The treatment facility would be located further north of the FSRU within the existing Refinery grounds

Landscape Value

The view is located within the 'Geelong Grammar School' Landscape Character Area, of which the relative Landscape Value is 'High'.

Visual Character

As represented in the photomontage: 'Existing view' *(refer to Fig 42)*, the view expands into open water offering direct visual access to the proposed berth location of the FSRU/LNG carrier.

The foreground of the view is situated within a public car park with an unsealed surface, and native coastal vegetation growing along the embankment leading down to the water.

The mid-ground of the view consist of Corio Bay which accommodates traffic of large ships docking at the existing piers along the industrial precinct.

The view ends at the industrial precinct along the western banks of Corio Bay including the existing Geelong Refinery and terminal. Partial view of the Herne Hill can be seen beyond the industrial development. The horizon is broken up with various chimneys, silos, and cranes within the existing industrial precinct.

The features around this view are consistent with the 'built' typology of the 'Geelong Grammar School' Landscape Character Area.

Rationale for selection

This view location was selected to understand the visual impact of the proposed project infrastructure on the Geelong Grammar School and Lagoon Boat Club as it offers a unimpeded view to the proposed project infrastructure from a site on which people gather.

Anticipated visual impact

The photomontage: 'Wireframe view' *(refer to Fig 43)* illustrates the FSRU would be visible with the background of this view. The FSRU would be obstruct the view to Herne Hill, which is visible behind the industrial precinct.

The FSRU sits slightly higher than the existing industrial complexes but remain lower than the existing chimneys at a similar height to the silos and cranes.

The pier extension and pipeline sits above the waterline in the background along the industrial precinct and does not provide obstruction to any view.

The treatment facility would not be visible from this view location.

Therefore, with reference to the criteria for assessment of view locations described in *Section 6.2*, the visual impact of the proposed project at view location 6 - as represented by the photomontage image - is considered to be 'Moderate'.

Recommended mitigation measures

Considering the view of Corio Bay is not obstructed by the proposed project infrastructure, and the context of the industrial precinct, mitigation measures are not considered necessary.

View location 6 - from Lagoon Boat Club facing south-west towards proposed FSRU/LNG Carrier

Photograph taken:
12:54 pm on the 15/07/21
Photo taken at:
170cm above ground level

View location :
e: 272363.0450
n: 5783038.6050
rl: 5.8

Approx. distance to FSRU/LNG carrier:
2.1km

Photomontage created by:
ZJ - B.LA
Images created using:
Rhino 6, V-Ray5.0 for Rhino, autocad 2019, adobe photoshop, indesign cc 2021
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 15/07/21
Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Camera location
FSRU/LNG Carrier
Treatment facility

figure 44 *View Location 6: Existing view*

figure 45 *View Location 6: Wireframe view - without LNG carrier*

figure 46 *View Location 6: Wireframe view - with LNG carrier*

6.2.7 IMPACT ASSESSMENT: VIEW LOCATION 7

Location

View location 7 is located at the Avalon Beach car park near the Avalon Beach Boat Ramp. The view looks west towards the existing industrial precinct and proposed project site. This location is approximately 3.1km from the proposed FSRU/LNG carrier docking location.

Project Description

The FSRU would be permanently berthed at the new pier extension with periodic visits from LNG carriers (up to 45 per annum) to unload liquefied natural gas..

The treatment facility would be located further north of the FSRU within the existing Refinery grounds

Landscape Value

The view is located within the 'Coastal Wetland' Landscape Character Area, of which the relative Landscape Value is 'High'.

Visual Character

As represented in the photomontage: 'Existing view' *(refer to Fig 45)*, the view looks west towards the existing industrial precinct.

The foreground of the view contains native coastal heath vegetation extending into the mid-ground.

Corio Bay is visible in the mid-ground extending into the background where the view terminates at the existing industrial precinct. Partial view to the landscape beyond the industrial precinct are visible.

The horizon is broken up with powerlines in the mid-ground and chimneys, silos and cranes in the background.

The features around this view are consistent with the 'natural' typology of the 'Coastal Wetland' Landscape Character Area.

Rationale for selection

This view location was selected based on its unique natural landscape habitat and status as a Ramsar Wetland, and its use as a public recreational space.

Anticipated visual impact

The photomontage: 'Wireframe view' *(refer to Fig 46)* illustrates the visibility of the proposed FSRU within the background of this view.

The FRSU would be docked within a existing industrialised area in Corio bay, adjacent an extension of the existing Refinery Pier.

The FSRU obstructs views to the landscape beyond the existing industrial precinct, but generally sits along the existing horizon line of that landscape beyond.

The FSRU sits lower than the chinmeys and powerlines which break up the horizon, and does not obstruct views to Corio Bay or the vegetation along the Avalon coastline.

The pier extension and pipeline sits just above the water, and is partially obstructed by the existing vegetation in the mid-ground.

The treatment facility would not be visible from this view location.

Therefore, with reference to the criteria for assessment of view locations described in *Section 6.2*, the visual impact of the proposed project at view location 7 - as represented by the photomontage image - is considered to be 'Moderate'.

Recommended mitigation measures

Given the FSRU is proposed within an established industrial context whilst, and does not obstruct the higher value views of the coastal vegetation and Corio Bay, mitigation measures are not considered necessary.

View location 7 - from Avalon Coastal Park facing west towards proposed FSRU/LNG Carrier

Photograph taken:
13:22 pm on the 15/07/21
Photo taken at:
170cm above ground level

View location :
e: 274167.6160
n: 5781651.3660
rl: 1.48

Approx. distance to FSRU/LNG carrier:
3.1km

Photomontage created by:
ZJ - B.LA
Images created using:
Rhino 6, V-Ray5.0 for Rhino, autocad 2019, adobe photoshop, indesign cc 2021
Method used to collect relevant data:
Photo locations obtained on site by Geocomp Consulting pty ltd on the 15/07/21
Camera:
Canon EOS 5Ds Digital SLR
Camera lens:
Canon EF 50mm f/1.8 USM

Camera location
FSRU/LNG Carrier
Treatment facility

figure 47 *View Location 7: Existing view*

figure 48 *View Location 7: Wireframe view - without LNG carrier*

figure 49 *View Location 7: Wireframe view - with LNG carrier*

7 ENVIRONMENTAL MANAGEMENT AND MONITORING

7.1 MEASURES TO BE UNDERTAKEN TO MINIMISE IMPACT

On the basis of the visual impact criteria described in *Section 6*, and in accordance with the LVIA assessment methodology, limited mitigation measures are recommended within the study area on the basis that the proposed project infrastructure is located within an established heavily industrialised area. The proposed project infrastructure generally sits lower than many of the existing elements as seen from each of the assessed views, and does not obstruct the higher value views of the water or the native vegetations.

Therefore, the Visual Impact Assessment concludes that mitigation measures are only necessary for the proposed treatment facility along School Road, as nominated in the assessment of view location four. No mitigation measures are considered necessary for the proposed pier extension and FSRU and LNG carrier (when berthed next to the FSRU).

It is noted that the assessment of this report is based on the day time operation of the proposed works and does not include night time operations. Assessment of the proposed lighting scope would be conducted as a separate study by Aecom in the *'Light Spill Impact Assessment'* report. The light spill report has been included in *Appendix A* of this report.

7.2 RESIDUAL IMPACT ASSESSMENT/REVIEW

The residual impact at view location 4 would be 'low' following the planting of advanced screening trees along the School Road boundary for sufficient visual screening of the treatment facility. A residual impact assessment has not been conducted on the other view locations as no mitigation measures have been recommended for these locations.

8 CONCLUSION

8.1 EXISTING CONDITIONS

Analysis of the existing conditions and review of relevant statutory documents was relied upon to determine the relative Landscape Value for the following identified Landscape Character Areas:

1. Coastal Wetland; Landscape Value is 'High'
2. Flat Farmland; Landscape Value is 'Low'
3. Suburban; Landscape Value is 'Low'
4. Geelong Waterfront; Landscape Value is 'High'
5. Geelong Grammar School; Landscape Value is 'High'
6. Industrial Buffer; Landscape Value is 'Low'
7. Industrial Precinct; Landscape Value is 'Low'

The Landscape Value forms the baseline for the LVIA impact assessment.

8.2 IMPACT ASSESSMENT

The Zone of Theoretical Vision was determined for each of the following project components and sensitive receptors identified within these extents to determine the potential for visual impact:

- Extension of the existing Refinery Pier; no potential impact
- Continuous docking of FSRU; moderate potential impact which does not obstruct any existing high value views
- Construction and operation of a treatment facility on refinery premise; screen tree planting required along School Road as mitigation for the proposed treatment facility.
- Construction and operation of approximately 3km of aboveground gas pipeline on the pier and within the refinery site connecting the FSRU to the new treatment facility; no potential impact

Based on the above findings, project components identified as having a potential impact have been assessed further to determine the extent of visual impact from identified sensitive representative and private view locations.

The effects of the pier extension and aboveground pipelines have been determined not to have a 'potential visual impact' on the basis that they do not provide any obstruction to the existing view lines and would be constructed within an established heavily industrialised precinct.

The treatment facility was found to have a moderate impact even though it doesn't obstruct any view lines and is constructed in the refinery.

The continuous docking of the FSRU and visiting LNGCs have been determined to have a 'moderate visual impact' on the basis of their size and visual presence within the landscape assessed in *section 6*.

Seven view locations were assessed in the consideration of operation impacts. The locations of these views and their visual impact assessment are:

- View location 1, located at Geelong waterfront, approximately 7km from the proposed FSRU; Visual impact is 'Low'.
- View location 2, located at The Esplanade in North Shore along the Bay Walk trail, approximately 1.5km from the proposed FSRU; Visual impact is 'Low'.
- View location 3, located on St George's Road, at the Boston Street intersection, approximately 1.7km from the proposed FSRU; Visual impact is 'Moderate'.
- View location 4, located at the northern naturestrip of the School Road, located approximately 0.05km from the proposed treatment facility; Visual impact is 'Moderate'.
- View location 5, located at Geelong Grammar School, approximately 2.5km from the proposed FSRU; Visual impact is 'Negligible/Very Low'.
- View location 6, located in the public car park adjacent to the Lagoon Boat Club, approximately 2.1km from the proposed FSRU; Visual impact is 'Moderate'.
- View location 7, located at the Avalon Beach car park, approximately 3.1km from the proposed FSRU; Visual impact is 'Moderate'.

The following recommendations are made with respect to each relevant project component on the basis of the report findings:

- Extension of the existing Refinery Pier; acceptable impacts - mitigation measures are not considered necessary.
- Continuous docking of FSRU and visiting LNGCs; acceptable impacts - mitigation measures are not considered necessary.
- Construction and operation of a treatment facility on refinery premise; acceptable impacts - screen planting of large native Eucalyptus recommended along the School Road boundary in character with existing trees on site.
- Construction and operation of approximately 3km of aboveground gas pipeline on the pier and within the refinery site connecting the FSRU to the new treatment facility; acceptable impacts - mitigation measures are not considered necessary.

8.3 REFERENCES

Visual Representation of Development Proposals,Technical Guide Note 06/19, Landscape Institute, 2013 .

Landscape Institute and Institute of Environmental Management & Assessment, Guidelines for Visual Impact Assessment, Third Edition, Landscape Institute, 2013 .

Visual Landscape and Planning in Western Australia, a Manual for Evaluation, Assessment, Siting and Design, 2007.

Human Factors in Design, Dreyfuss, 1960.

APPENDIX A - *Light Spill Impact Assessment - Aecom*

Appendix A: Light Spill Impact Assessment

Viva Energy Gas Terminal Project Environment Effects Statement

25-Feb-2022
Viva Energy Gas Terminal Project

Appendix A: Light Spill Impact Assessment

Viva Energy Gas Terminal Project Environment Effects Statement

Client: Viva Energy Gas Australia Pty Ltd

ABN: N/A

Prepared by

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25-Feb-2022

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 and ISO45001.

Table of Contents

Executive summary

This technical report provides a light spill impact assessment conducted to support the Environment Effects Statement (EES) for the Viva Energy Gas Terminal Project (the project).

In December 2020, the Victorian Minister for Planning determined that the project requires assessment through an EES under the *Environment Effects Act 1978 (Vic)*. The reasons for the decision were primarily related to the potential for significant adverse effects on the marine environment of Corio Bay and the potential for contributing to greenhouse gas emissions. Secondarily, the EES was required to assess the effects of the project on air quality, noise, land use, Aboriginal and historic heritage, native vegetation, groundwater, traffic and transport as well as visual amenity.

In January 2021, the project was also determined to require assessment and approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999 (Cth)* ('EPBC Act') due to the potential for the project to have a significant impact on wetlands of international importance, listed threatened species and communities, and listed migratory species. 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.

Overview

Viva Energy Gas Australia Pty Ltd (Viva Energy) is planning to develop a 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 FSRU would store liquefied natural gas (LNG) received from visiting LNG carriers (that would moor directly adjacent to the FSRU), and regasify the LNG as required to meet industrial, commercial and residential customer demand. A 7-kilometre gas transmission pipeline would transfer the gas from the FSRU to the Victorian Transmission System (VTS) at Lara.

The gas terminal would be located adjacent to, and on, Viva Energy's Geelong Refinery in a heavily industrialised setting and would benefit from Viva Energy's experience and capability as an existing Major Hazard Facility (MHF) operator and potential synergies between the two facilities such as reuse of the FSRU seawater discharge within the refinery operations.

Methodology

The methodology for this assessment comprised a combination of two independent night-time site visits and light spill modelling using industry standard best practice software.

The site visits were organised to record the existing view and lighting conditions from various site marker locations – either as a proposed site location or a viewpoint to a primary site location.

The software used for modelling enables best practice simulation of the lighting to be modelled for physical and geographical locations and measure the potential impact for any light spill. The modelling was executed using singular and combined light source entities to provide different resultant scenarios and provide adequate data for the impact assessment. A total entity light model could not be achieved due to the complexity of physical shapes and various light sources: however, this does not have an impact on the overall assessment of light spill.

Existing conditions

The existing conditions assessment method involved night-time lighting observations with photos recorded from a number of markers locations surrounding the project area. The site visits were coordinated with the berthing schedule for vessels visiting the existing Refinery Pier to ensure that current ship lighting conditions were considered in the assessment.

Clear weather conditions were observed during both site visits, with no local atmospheric conditions hindering the line of sight to the pier structure, vessels or land zones.

The data collected during the site visits indicate that the industrial and port area within and around the project area already contains extensive lighting.

Construction impact assessment

Lighting on vessels used during dredging, temporary lighting for the pipeline HDD construction compounds (near the Rennie Street - Shell Parade roundabout adjacent to the Princes Freeway off ramp, and potentially also along Macgregor Court) and temporary lighting for the construction compound at the treatment facility could potentially result in light spill impacts on sensitive receptors.

Lighting during construction should be compliant with work, health and safety (WHS) standards and requirements and should be in accordance with various lighting guidelines and standards to avoid and minimise potential light spill impacts. Lighting at construction compounds and workspaces would be safety and task-focused and would not result in light spill reaching residential properties.

Overall, the residual light spill impacts from construction of the project are considered to be minor due to the industrial port setting of the project which has a considerable amount of existing lighting, the temporary nature of the construction compounds and workspaces, and the significant distance between the offshore dredging activities that would occur on a 24 hour basis and potential land-based receptors.

Operation impact assessment

Light spill impacts could occur during operation of the project as a result of lighting from project infrastructure including the pier extension, FSRU, LNG carrier and treatment facility.

The extent of existing light spill from Refinery Pier is 20 m from the edge of the pier. Modelling indicates that light spill from the proposed pier extension would be localised and contained within the immediate vicinity of the pier extension in the offshore environment and would not reach onshore locations. Viewpoints to the north and west, including sensitive receptors located approximately 1.8 km north of the pier extension, along Foreshore Road would not experience light spill from the pier extension, as light levels would fall to 0.1 lux after approximately 100 m.

The extent of light spill from the FSRU and an LNG carrier moored adjacent to the FSRU is 400 m from the edge of the vessels. The light spill would be contained within the offshore environment and would not reach surrounding land-based receptors.

The proposed treatment facility would be located within the existing refinery boundary at Nerita Gardens, towards its northern extent. Light spill from the treatment facility would only be observed from locations adjacent to the facility and within the existing boundary of the refinery. Viewpoints beyond the boundary of the refinery would be screened by vegetation and the existing luminance of the refinery itself would have higher visibility over the proposed treatment facility in the immediate area. Given the low potential for luminance from the treatment facility to be visible in surrounding areas, the potential light spill impact of the treatment facility is considered to be low.

Decommissioning impact assessment

It is not anticipated that there would be any new residual decommissioning impact as the FSRU would leave the port post-project, the Refinery Pier extension would remain in-situ for other purposes. In the event that the treatment facility was decommissioned, no change to lighting impacts is anticipated due to its location within the existing, brightly lit refinery complex.

Summary of mitigation measures and residual impacts

Mitigation measures have been recommended as part of this assessment to avoid, minimise and manage potential impacts related to light spill. These include lighting in accordance with the following standards and guidelines:

- AS 4282: 2019 Control of the Obtrusive Effects of Outdoor Lighting
- AS/NZS 1680.5 Interior and workplace lighting: Outdoor workplace lighting
- National Light Pollution Guidelines for Wildlife Including marine turtles, seabirds and migratory shorebirds January 2020 Version 1.0.

Abbreviations and glossary of terms

Abbreviation/Term	Definition
AS/NZS	Australian New Zealand Standards
BHD	Backhoe Dredging
DELWP	Department of Environment Land Water Planning
DMG	Dredged Material Ground
EES	Environment Effects Statement
EMF	Environmental Management Framework
EPBC	Environment Protection and Biodiversity Conservation
FSRU	Floating storage and regasification unit
HDD	Horizontal Directional Drilling
ICA	Independent Commissioning Agent
IESNA	Illuminating Engineering Society of North America
LED	Light Emitting Diode
LNG	Liquified natural gas
MHF	Major Hazard Facility
MLA	Marine Loading Arm
ROW	Right of way
SHP	Split Hopper Barge
SWI	Seawater Intake
SWP	South West Pipeline
TRG	Technical Reference Group
VTS	Victorian Transmission System
WHS	Work, health safety

1.0 Introduction

This technical report provides a light spill impact assessment conducted to support the Environment Effects Statement (EES) for the Viva Energy Gas Terminal Project (the project).

Viva Energy Gas Australia Pty Ltd (Viva Energy) is planning to develop a 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 FSRU would store liquefied natural gas (LNG) received from visiting LNG carriers (that would moor directly adjacent to the FSRU) and would convert LNG back into a gaseous state by heating the LNG using seawater (a process known as regasification) as required to meet industrial, commercial, and residential customer demand. A 7 kilometre (km) gas transmission pipeline would transfer the gas from the FSRU to the Victorian Transmission System (VTS) at Lara.

The project would be situated adjacent to, and on, Viva Energy's Geelong Refinery, within a heavily developed port and industrial area on the western shores of Corio Bay between the Geelong suburbs of Corio and North Shore. 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.

In December 2020, the Victorian Minister for Planning determined that the project requires assessment through an EES under the *Environment Effects Act 1978* (Vic). The reasons for the decision were primarily related to the potential for significant adverse effects on the marine environment of Corio Bay and the potential for contributing to greenhouse gas emissions. Secondarily, the EES was required to assess the effects of the project on air quality, noise, land use, Aboriginal and historic heritage, native vegetation, groundwater, traffic and transport as well as visual amenity.

In January 2021 the project was also determined to require assessment and approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999 (Cth)* ('EPBC Act') due to the potential for the project to have a significant impact on the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site (a wetland of international importance), listed threatened species and communities, and listed migratory species. 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 Purpose

This light spill impact assessment identifies, assesses and characterises potential environmental impacts related to light spill associated with the construction, operation and decommissioning of the project to inform the preparation of the EES required for the project.

The report identifies and recommends mitigation measures to avoid, minimise and manage potential impacts which will inform the development of an Environmental Management Framework (EMF) for the project. The mitigation measures listed in the EMF would be implemented in the approvals and management plans for the project.

1.2 Why understanding light spill is important

The Australian Government (Dept. Of Environment and Energy) provides light pollution guidelines for the natural environment. The 'National Light Pollution Guidelines for Wildlife' January 2020 provides a succinct statement for understanding the importance of light spill assessment. The guidelines quote:

"Natural darkness has a conservation value and should be protected through good quality lighting design and management for the benefit of all living things. To that end, all infrastructure that has outdoor artificial lighting or internal lighting that is externally visible should incorporate best practice lighting design.

Incorporating best practice lighting design into all infrastructure will not only have benefits for wildlife but will also save energy and provide an economic benefit for light owners and managers."

Light emitted from night time construction and operation of the project forms part of its overall presence in the local landscape. Light spill considers the lighting used during construction and operation of the project, its extent and its potential impact to visual amenity and the disruption it may cause to nearby sensitive receptors and marine and terrestrial fauna.

1.3 Project area

The project would be located adjacent to, and on, the Geelong Refinery and Refinery Pier in the City of Greater Geelong, 75 km south-west of Melbourne. The project area is within a heavily developed port and industrial area on the western shores of Corio Bay between the Geelong suburbs of Corio and North Shore. The Geelong central business district is located approximately 7 km south of the project.

Corio Bay is the largest internal bay in the south-west corner of Port Phillip Bay and is a sheltered, shallow basin at the western end of the Geelong Arm, with an area of 43 square kilometres (km^2). 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, approximately one kilometre to the north-east of the project.

The Port of Geelong has been in operation for over 150 years and is the largest industrial bulk cargo port in Victoria, attracting over 600 ship visits and handling more than 14 million tonnes of product annually. Geelong's shipping channels extend 18 nautical miles through Corio Bay from Point Richards through to Refinery Pier. Ports Victoria (formerly Victorian Regional Channels Authority) manages commercial navigation in the port waters in and around Geelong and is responsible for the safe and efficient movement of shipping, and for maintaining shipping channels and navigation aids. The channels are man-made having been deepened and widened through periodic dredging to support port trade development.

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 Geelong Refinery has been operating since 1954 with both the refinery and the co-located LyondellBasell plant being licensed Major Hazard Facilities (MHFs). A range of industrial activities are situated in the Port environs including wood fibre processing and chemical, fertiliser and cement manufacturing.

To the north of the Geelong Refinery, along the proposed underground pipeline corridor, the area is predominantly rural. There are several other existing Viva Energy-owned underground pipelines running between the refinery and the connection point to the South West Pipeline (SWP) at Lara. The proposed pipeline route follows already disturbed pipeline corridors, where possible, through a mix of land uses.

The project area is shown in Figure 1-1.

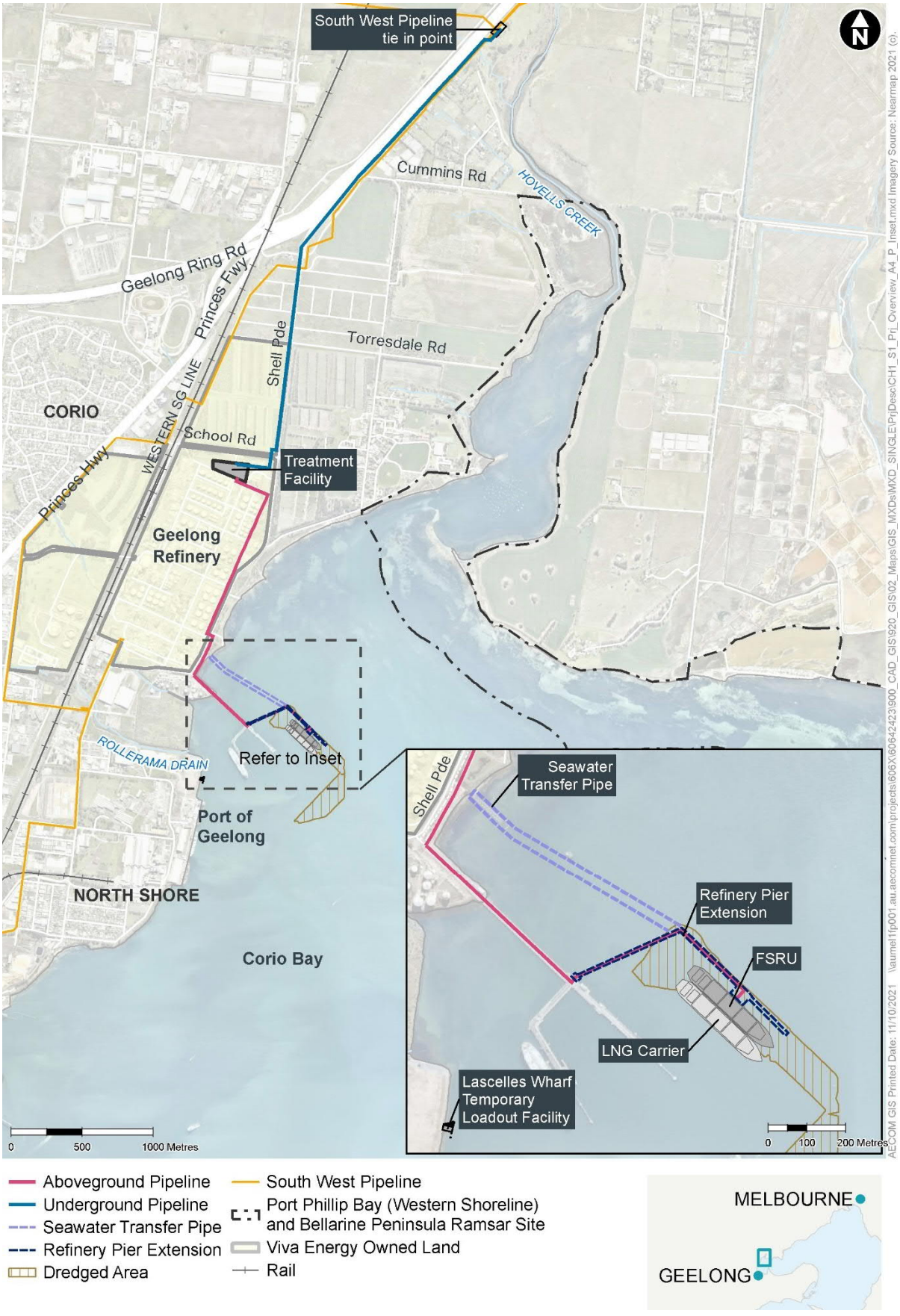

Figure 1-1: Project overview

1.4 Project description

This section summarises the project as described in Chapter 4: *Project description*. Key components of the project include:

- extension of the existing Refinery Pier with an approximately 570 metre (m) long angled pier arm, new berth and ancillary pier infrastructure including high pressure gas marine loading arms (MLAs) and a transfer line connecting the seawater discharge points on the FSRU to the refinery seawater intake
- continuous mooring of an FSRU at the new Refinery Pier berth to store and convert LNG into natural gas. LNG carriers would moor alongside the FSRU and unload the LNG
- construction and operation of approximately 3 km of aboveground gas pipeline on the pier and within the refinery site connecting the FSRU to the new treatment facility
- construction and operation of a treatment facility on refinery premises including injection of nitrogen and odorant (if required)
- construction and operation of an underground gas transmission pipeline, approximately 4km in length, connecting to the SWP at Lara.

The Refinery Pier extension would be located to the north-east of Refinery Pier No. 1. The new pier arm would be positioned to allow for sufficient clearance between an LNG carrier berthed alongside the FSRU and a vessel berthed at the existing Refinery Pier berth No. 1. Dredging of approximately 490,000 cubic metres of seabed sediment would be required to allow for the new berth pocket and swing basin.

The FSRU vessel would be up to 300 m in length and 50 m in breadth, with the capacity to store approximately 170,000 cubic metres (m^3) of LNG. The FSRU would receive LNG from visiting LNG carriers and store it onboard in cryogenic storage tanks at about -160 °C.

The FSRU would receive up to 160 PJ per annum (approximately 45 LNG carriers) depending on demand. The number of LNG carriers would also depend on their storage capacity, which could vary from 140,000 to 170,000 m^3.

When gas is needed, the FSRU would convert the LNG back into a gaseous state by heating the LNG using seawater (a process known as regasification). The natural gas would then be transferred through the 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 adjusted (diluted) to meet local specifications. Odorant is added as a safety requirement so that the normally odourless gas can be smelt when in use. From the treatment facility, the underground section of the pipeline would transfer the natural gas to the tie-in point to the SWP at Lara.

1.4.1 Key construction activities

Construction of the project would occur over a period of up to 18 months. The key construction activities relate to:

- Localised dredging of seabed sediments to enable the FSRU and LNG carriers to berth at Refinery Pier and excavation of a shallow trench for the seawater transfer pipe
- Construction of a temporary loadout facility at Lascelles Wharf
- Construction of the new pier arm and berthing infrastructure, and aboveground pipeline along Refinery Pier and through the refinery
- Construction of the treatment facility on a laydown area at the northern boundary of the refinery site
- Construction of the buried pipeline
- Construction at the tie-in point to the SWP at Lara

There are no construction activities required for the FSRU component of the project. The vessel would be built, commissioned and all production and safety systems verified prior to being brought to site.

An estimated 490,000 cubic metres (m^3) of dredging would be required, over an area of 12 hectares (ha), adjacent to the existing shipping channel to provide sufficient water depth at the new berth and within the swing basin for visiting LNG carriers to turn. Dredging within the new berth would be undertaken to a depth of 13.1 metres and the swing basin would be dredged to a depth of 12.7 metres. The dredging footprint is shown in Figure 1-1. It is planned to deposit the dredged material within the existing dredged material ground (DMG) in Port Phillip Bay to the east of Point Wilson, approximately 26 km from Refinery Pier.

The temporary loadout facility at Lascelles Wharf would be the first construction activity to take place in order to facilitate the Refinery Pier extension. This would involve the installation of 10 piles using hydraulic hammers.

Construction of the pier arm would be carried out once dredging was complete, primarily from the water using barge-mounted cranes. Steel piles would be driven into the seabed by barge-mounted cranes and pre-cast concrete and prefabricated steel components would be transported to site by barge and lifted into position. The installation of pier infrastructure such as the marine loading arms (MLAs), piping from the FSRU to the existing refinery seawater intake (SWI) and aboveground pipeline would also be undertaken from the water using barge-mounted cranes and construction support boats.

Installation of the 3 km above ground pipeline along the pier and through the refinery is anticipated to take 3.5 months to complete. The above ground pipeline would run along the pier to the existing pipe track east of Shell Parade within the pier foreshore compound. It would then pass through a road under-crossing to the existing refinery pipe track. The pipeline would then run north along the existing refinery pipe track to an existing laydown area where the treatment facility would be located.

The treatment facility would be located within an existing laydown area in the refinery site and cover an area of approximately 80m x 120m. Construction of the treatment facility would take approximately 18 months and would be undertaken by specialist crews across distinct phases of work. These would include initial earthworks and civil construction, mechanical installation and electrical and instrumentation works.

The 4 km underground pipeline would be installed in stages over an approximate 4 month period within a corridor which has been selected so as to avoid watercourses or other environmental sensitivities, where possible. Firstly, a construction right of way (ROW) would be established, clearly identified and fenced off where required. Typically, this would be between 15 and 20 m wide, and minimised where possible to reduce disturbance. Once the construction ROW is established, vegetation would be removed, and a trench excavated to a maximum depth of 2m and a maximum width of 1m for the pipeline to be placed. Following the placement of the pipeline, the construction ROW would be rehabilitated to its pre-existing condition as far as practicable for the purposes for which it was used immediately before the construction of that part of the pipeline.

Trenchless construction (including thrust boring or horizontal directional drilling (HDD)) would be used to install the underground pipeline in areas that are not suited to open trenching techniques, such as at intersections with major roads. Trenchless construction would involve boring or drilling a hole beneath the ground surface at a shallow angle and then pushing or pulling a welded length of pipe through the hole without disturbing the surface. It is anticipated that the maximum depth of the trenchless section would be 25 m.

The anticipated trenching, HDD and thrust bore locations are presented in Figure 1-2. It is possible that along the northern section of Macgregor Court the pipeline would also be constructed using HDD, however, this would be confirmed during detailed design.

Construction at the tie-in point to the SWP at Lara would be undertaken by specialist crews across the distinct phases of works, as with the treatment facility.

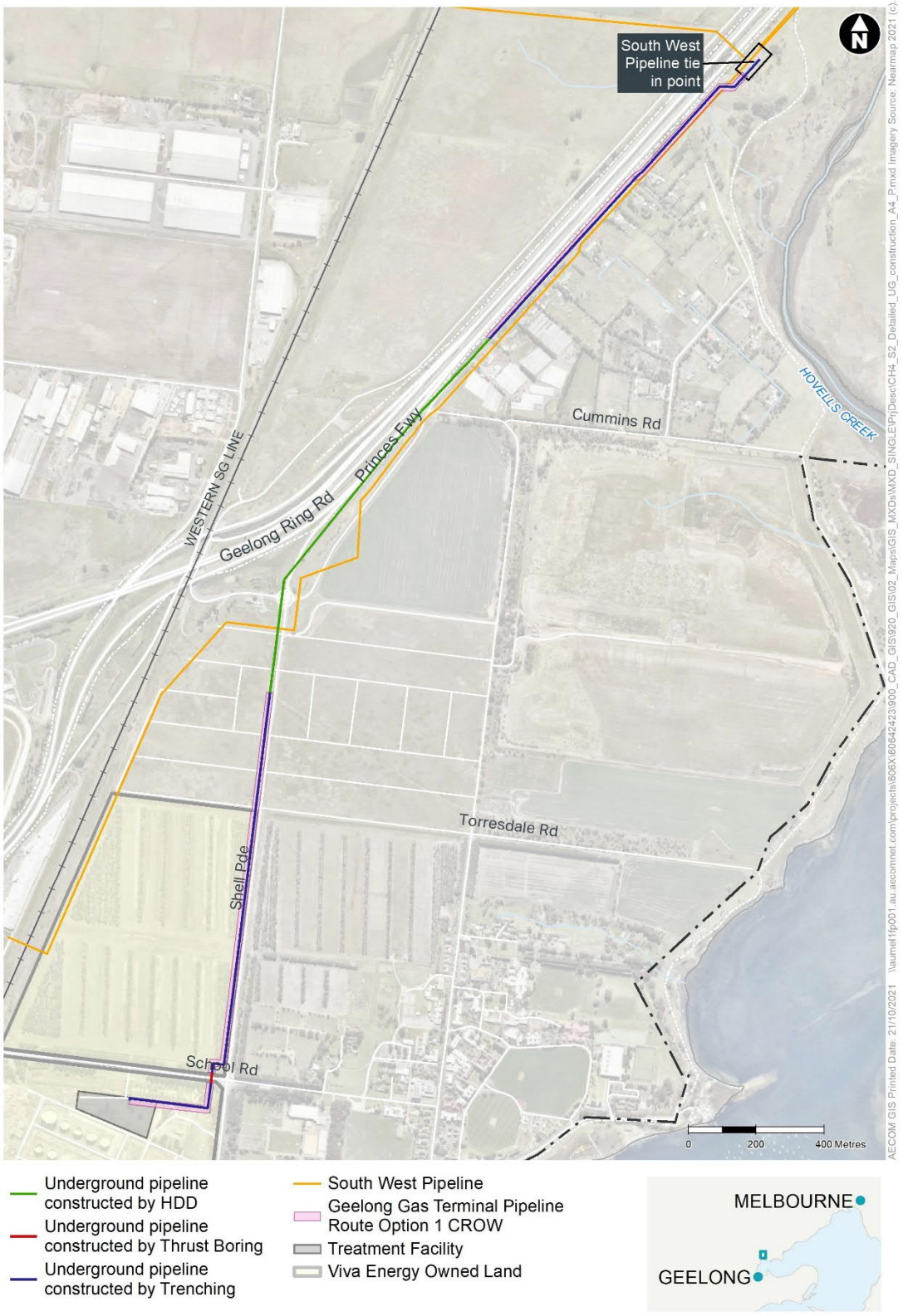

Figure 1-2 Proposed construction methods for the underground pipeline

1.4.2 Key operation activities

The project is expected to be in operation for approximately 20 years. Key activities relating to project operation include:

- receipt of up to 45 LNG carriers each year at Refinery Pier – the number and frequency of LNG carriers arriving each year would depend on their storage capacity and gas demand
- regasification of LNG onboard the FSRU using seawater as a heat source, which would then be reused within the refinery as cooling water
- injection of nitrogen and odorant into the gas prior to distribution via the VTS
- monitoring and maintenance of the pipeline easement.

1.4.3 Key decommissioning activities

The FSRU, which continues to be an ocean-going vessel throughout the operation of the project, would leave Corio Bay on completion of the project life to be used elsewhere.

It is anticipated that the Refinery Pier berth and facilities would be retained for other port related uses. The underground pipeline would likely remain in situ subject to landholder agreements and either decommissioned completely or placed into care and maintenance arrangements.

Decommissioning activities may be subject to change, subject to legislative requirements at the time and potential repurposing of the infrastructure at the end of the project.

1.4.4 Light Spill Impact Assessment considerations in the design

The following construction and operational activities are relevant to the light spill impact assessment:

- Lighting on vessels used during dredging, temporary lighting for pipeline HDD construction compounds (near the Rennie Street - Shell Parade roundabout adjacent to the Princes Freeway off ramp, and potentially also along Macgregor Court) and temporary lighting for the construction compound at the treatment facility
- Lighting from project infrastructure including the pier extension, FSRU, LNG carrier and treatment facility.

2.0 Scoping requirements

The scoping requirements for the EES set out the specific environmental matters to be investigated in the EES. The scoping requirements include a set of evaluation objectives. These objectives identify the desired outcomes to be achieved in managing the potential impacts of constructing and operating the project.

The following evaluation objectives are relevant to the light spill impact assessment:

- **Biodiversity** - To avoid, minimise or offset potential adverse effects on native flora and fauna and their habitats, especially listed threatened or migratory species and listed threatened communities as well as on the marine environment, including intertidal and marine species and habitat values
- **Social, economic, amenity and land use** – to minimise potential adverse social, economic, amenity and land use effects at local and regional scales

The scoping requirements of relevance to this light spill impact assessment and where they are addressed in the report are shown in Table 2-1.

Table 2-1 Scoping requirements relevant to light spill impact assessment

Aspect	Scoping requirement	Section addressed
Existing environment	Identify flora and fauna that could be affected by the project's potential effects on air quality, noise (above and below water) or vibration, or could be disoriented or otherwise impacted by project lighting	Technical Report D: *Terrestrial ecology impact assessment*
Likely effects	Indirect loss of vegetation or habitat quality, that may support any listed species or other protected fauna, resulting from changes to the local hydrology (terrestrial) or hydrodynamics (marine), edge effects, habitat fragmentation, loss of connectivity, or other disturbance impacts arising from construction or operation, including noise, vibration and lights.	Technical Report D: *Terrestrial ecology impact assessment*
	Assess likely direct and indirect effects of the project on the ecological character and habitat values of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site, including but not limited to effects of entrainment, dredging and sediment mobilisation, potential introduction of exotic organisms, wastewater discharges, other waste streams, noise, vibration and light.	Technical Report D: *Terrestrial ecology impact assessment*
	Assess likely noise, vibration, traffic, lighting and visual impacts at sensitive receptors adjacent to the project during project construction and operation (both with and in the absence of the proposed mitigation measures), relative to standards.	Section 6.0 Section 7.0 Section 8.0
Mitigation measures	Identify potential and proposed design responses and/or other mitigation measures to avoid, reduce and/or manage any significant effects for sensitive receptors during project construction and operation arising from specified air pollution indicators, noise, vibration, traffic and lighting, in the context of applicable policy and standards and the anticipated increase in shipping traffic in Corio Bay resulting from the project.	Section 9.0

3.0 Legislation, policy and guidelines

Table 3-1 summarises the key environmental legislation and policy that apply to the project in the context of this Light Spill impact assessment, as well as the implications for the project and the required approvals (if any).

Table 3-1: Primary environmental legislation and associated information

Legislation/policy	Description	Implications for the project	Approval required
Commonwealth			
Guideline			
National Light Pollution Guidelines for Wildlife Including marine turtles, seabirds and migratory shorebirds January 2020 Version 1.0	This guideline outlines the process that should be followed where there is the potential for artificial lighting to affect wildlife. The guidelines apply to new projects, lighting upgrades (retrofitting) and where there is evidence of wildlife being affected by existing artificial light. There are five steps involved in assessing the potential effects of artificial light on wildlife, and the adaptive management of artificial light requires a continuing improvement process. The amount of detail included in each step depends on the scale of the proposed activity and the susceptibility of wildlife to artificial light. The first three steps of the impact assessment process should be undertaken as early as possible in the project's life cycle and the resulting information used to inform the project design phase.	The management principles for best practice lighting design to ensure that wildlife is not disrupted should be considered in design of lighting for the project.	No approval required
Standard			
AS/NZS 4282: 2019 - Control of the Obtrusive Effects of Outdoor Lighting	This standard sets out the requirements for the control of the obtrusive effects of outdoor lighting. This standard is referenced by Designers of outdoor lighting as an aid to producing lighting systems that control obtrusive effects to an acceptable degree.	The design of outdoor lighting should comply with the principles and requirements presented in these standards	No approval required

Legislation/policy	Description	Implications for the project	Approval required
AS/NZS 1680.5 Interior and workplace lighting: Outdoor workplace lighting	This standard sets out requirements, general principles and recommendations for the permanent lighting of exterior workplaces. It applies to exteriors in which specific visual tasks are undertaken. It applies only when this area is being used as a workplace. The provisions have the object of producing a visual environment in which essential task details are made easy to see and adverse factors that may cause visual discomfort are either excluded or appropriately controlled.	The design of lighting should comply with the principles and requirements presented in these standards.	No approval required

4.0 Methodology

This section describes how the light spill impact assessment was conducted in order to understand the existing conditions and potential impacts as a result of the construction, operation and decommissioning of the project. The following sections outline the study methodology.

4.1 Existing conditions assessment method

4.1.1 Study area

The existing conditions assessment considered the existing light spill at the proposed light source locations to develop an understanding of the current conditions. The following general locations were considered:

- Refinery Pier and the proposed mooring location of the FSRU and LNG carrier
- The proposed location for the treatment facility within the existing refinery

The existing conditions assessment method involved night-time lighting observations with photographs taken at key markers or viewing points as identified in Section 5.0 to understand the existing light sources and the existing light spill in the area. The site visits were coordinated with the berthing schedule for vessels visiting the existing Refinery Pier berths to ensure that current ship lighting conditions were considered in the assessment. The vessels berthed during the site visits provided a view of existing ship lighting associated with Refinery Pier.

Clear weather conditions were observed during both site visits, with no local atmospheric conditions hindering the line of sight to the pier structure, vessels or land zones.

4.2 Risk screening method

A risk-based screening approach has been used for the EES assessment in accordance with the requirements outlined in the 'Ministerial guidelines for assessment of Environmental Effects under the *Environment Effects Act 1978 (Vic)'* (page 14). The risk screening is undertaken to ensure that the level of investigation conducted in each technical study is adequate to inform an assessment of the significance and acceptability of the project's potential environmental impacts.

An environmental, social and economic issues risk screening tool has been used to prioritise and focus the proposed investigations, assessments and approaches to avoiding, minimising or managing potential impacts. The issue screening process involved an evaluation of the potential environmental, social and economic issues associated with the project based on the information collected through a series of initial assessments undertaken into the potential effects of the project.

A risk workshop convened by a qualified risk practitioner and comprising technical specialists from the proponent, project design team and EES team conducted the initial risk screening. The risk screening process utilised knowledge of the project infrastructure and design, existing environment and land use setting to assess potential risks based on the specialised knowledge of the technical experts.

The purpose of the issues screening approach was to assist in identifying:

- Significant issues, uncertainties and/or potential impacts that require more detailed characterisation and/or assessment within the EES
- Matters or potential impacts considered to be already well understood or less significant.

A high, medium, or low screening value was assigned to potential issues to determine the level of assessment required to identify and investigate impacts.

Each potential issue was given a score (1, 2 or 3) against the categories of:

- Community and stakeholder interest
- Significance of assets, values and uses
- Potential impact (spatial, temporal and severity).

The scores were added together, or the highest score across the three contributing categories was used, to give a 'screening value' of high, medium or low, which gives an indication of the level of impact assessment that is required. Issues that were assigned a screening value of high or medium required detailed assessment in the EES at a level commensurate with them being considered primary level issues.

Issues that were assigned a screening value of low were proposed to be documented and managed with some investigation and assessment in the EES at a level commensurate with them being considered secondary level issues.

4.2.1 Criteria and consequence ratings

Risks, issues, and potential impact pathways were identified for both construction and operation of the project. Table 4-1 defines the criteria and consequence ratings for each of the three categories that have been used to inform the issues screening. The sum of the scores against each of the three categories or the highest rating across any of the three contributing categories gives the 'screening value'.

Table 4-1 Issues screening criteria and consequence ratings

Rating	Community and stakeholder interest	Significance of assets, values and uses	Potential impact (spatial, temporal and severity)
1	Low interest and perceived impact	Locally significant asset, value or use	Potential for localised, temporary impact
2	Some interest and targeted perceived impacts	Regionally significant asset, value or use	Potential for significant temporary, or localised permanent impact
3	Broad community and stakeholder interest or impacts	State or nationally significant asset, value or use	Potential for significant permanent impact

The screening values are then used to determine the level of assessment required as shown in Table 4-2.

Table 4-2 Issue investigation categories

Screening score	Screening value	Potential consequences	Complexity of mitigation	Level of assessment
7, 8 or 9 or the highest rating across any one of the three contributing categories is 3	High	Potential for elevated, longer term impacts, significant assets or values may be affected with enduring changes. Considers both impacts and benefits, or Issue may not be well defined and insufficient information is available for the impact assessment, or High level of community interest.	Stringent management measures may be required	Detailed assessment required

Screening score	Screening value	Potential consequences	Complexity of mitigation	Level of assessment
4, 5 or 6 or the highest rating across any one of the three contributing categories is 2	Medium	Potential for moderate level impacts, significant assets or values may be affected over an extended time frame with some resultant changes. Considers both impacts and benefits, or Issue may be moderately understood, and some information is available, however more is required for the impact assessment, or Medium level of community interest.	Standard management measures are available that can be adopted with some modification	Moderate assessment required
3 or the highest rating across any one of the three contributing categories is 1	Low	Potential for short term and localised impact. Asset or values may be temporarily affected but recovery expected, or Issue is well understood and there is enough information available for the impact assessment, or Low level of community interest.	Standard management measures are available.	Some assessment required

Further information about the risk screening process is detailed in Chapter 7: *Assessment framework.*

Outcomes from the risk screening process are outlined in Section 4.2.2 below.

4.2.2 Risk screening results

Table 4-3 provides the key potential issues related to changes in light spill identified as part of the risk screening process for the project and presents the screening value for each issue.

Table 4-3 Light spill issues screening result

Aspect	Issue	Community & stakeholder perceived impacts	Significance of assets, values & uses	Potential impact (spatial, temporal & severity)	Screening Score	Screening Value
Construction						
Terrestrial ecology	Night lighting disturbing native fauna	1	1	1	3	Low
Operation						
Terrestrial ecology	Operational activities (including noise and lighting) impact on non-marine fauna	1	2	2	5	Medium
Landscape character and visual amenity	Impact of light emissions from the gas terminal on community	2	1	2	5	Medium
Social	Potential amenity impacts (odour, dust, noise, vibration, lighting) on communities and community facilities including recreational areas	2	1	2	5	Medium
Marine ecology	Operational activities (including noise, vibration and lighting) impact on marine fauna	2	2	2	6	Medium

4.3 Impact assessment method

Given that construction contractors have not yet been appointed for the construction of the project, construction lighting design and luminaire specifications are not yet available. For the purpose of the construction impact assessment, impacts were assessed and discussed with consideration of the existing conditions of the project area and proposed construction activities including the type of activity based lighting that would be required. Recommendations and mitigation measures were developed using the guidance and standards presented in Section 3.0.

Specifications obtained from Glamox Co Ltd (South Korea) for the vessel HHI HOEGH 170,000 CBM CLASS LNG FSRU were used for light spill modelling to determine potential impacts. Calculations from this vessel are expected to be consistent with the FSRU chosen for the project. Similarly, luminaire specifications for the LNG carrier were based on the Arctic Lady LNG carrier which would be representative of those which would visit Refinery Pier during operation. Where any existing luminaire data was not available due to aged technology (i.e., metal halide), LED lighting technology was assumed for light spill modelling. Further information is provided in Section 4.5.

In order to produce the lighting design calculations and determine the extent of light spill, lighting software AGI32 was used. Model inputs included the assumed luminaire specifications. For the proposed Refinery Pier extension, Viva Energy conducted their own lighting design calculations, which were used as part of this assessment.

4.4 Stakeholder and community engagement

Stakeholders and the community were consulted to support the preparation of the project's EES and to inform the development of the project and understanding of its potential impacts.

An extensive engagement and consultation program was undertaken to ensure that the community and interested stakeholders were informed, involved and able to actively contribute to the development of the project and preparation of the EES. The following issues related to light spill were raised by stakeholders and the community:

- Concerns around the potential impacts on the Ramsar site including Limeburners Bay and light spill impacts on light sensitive species such as birds.
- Concerns around how light spill from the project could affect boarding students at Geelong Grammar School and their ability to sleep

In accordance with the scoping requirements, a Technical Reference Group (TRG) was convened and chaired by DELWP on behalf of the Minister for Planning. The TRG has provided input throughout the EES process. EES Chapter 6: *Stakeholder and community engagement* provides a summary of the project's key engagement activities.

4.5 Assumptions and limitations

The assumptions and limitations are listed in four key groups below.

FRSU and LNG carrier:

- Luminaire specifications for the proposed FRSU to be berthed at Refinery Pier were not available so a proxy vessel was adopted.
- Archive luminaire data and lighting calculations have been obtained from Glamox Co Ltd (South Korea) for the following vessel calculation: HHI HOEGH 170,000 CBM CLASS LNG FSRU. These calculations have a creation / author date of 07/09/15. This data is the proxy vessel (as noted in bullet point above) and would be similar to any FRSU vessel and one which would be potentially selected by Viva Energy.
- Desktop archive data cannot be verified against the current as installed lighting on the FRSU vessel noted above. It has been assumed that the lighting on the typical FRSU has not changed from the desktop archive data. The above calculations were the best available benchmark of data available to conduct the light spill impact assessment but are considered to be representative of FSRU's in general.
- Luminaire specifications for the LNG carrier (Arctic Lady) which is representative of the type of carriers which would visit Refinery Pier were available.
- For the LNG carrier - not all archive luminaire data could be obtained from the lighting manufacturer (Glamox Co Ltd). The existing luminaire specification lighting (ies) data is not available due to the aged technology. LED lighting technology (ies) data has been used as a similar substitute for the calculations on the LNG carrier using similar lighting outputs (lumens).

  Definition note: ["IES data files are a standardised data file which expresses the light output of a luminaire as luminous intensity versus angle along with sufficient descriptive and documentary test information it is derived from the acronym for the Illuminating Engineering Society of North America (IESNA)].
- AECOM has retrieved and utilised the manufacturer's available luminaire data and up to date IES (luminaire light properties / characteristics) files for design software that can be used for calculations.
- AECOM has used lighting design software - AGI32 – for the light spill impact assessment. The software inputs used the above IES data files (from Glamox) for the calculations.

Existing and Proposed Pier Structures:

- The existing pier structure utilises aged ‘metal halide’ lighting technology that is in the process of being replaced with LED technology suitable for the marine / hazardous environments.
- Viva Energy is conducting their own lighting design and replacement exercises for the Gas Terminal Project lighting design and calculation has been made available in a pdf format with outputs that contribute to and are appropriate for the Light Spill assessment.

Proposed temporary pipeline construction compounds:

- These are temporary construction zones that do not have a pre-ordained lighting design and luminaire specification as construction contractors have not been appointed at this point of the project and detailed construction approaches are not available.
- Lighting design and specification would be determined through the final arrangement and co-ordination of construction activities with Viva Energy
- The light spill impact assessment for the pipeline construction phase of the project can only be executed through making recommendations and mitigation measures to ensure compliance with standards (noting the temporary duration of construction).

General Commentary:

- Existing conditions have been assessed based on modelled data using either actual or similar lighting specifications that have similar photometric data (accounting for the change in technology from original specification)
- No atmospheric or weather data has been integrated into this assessment. All resultant outputs are based on there being clear unobstructed weather clarity to simulate the outputs through modelling.
- Existing conditions ‘lighting observations’ were undertaken on two separate independent evenings where both time durations experienced clear cloudless skies.
- The lighting modelling (for the maritime component) has assessed the various ‘activators’ of the design in their singular components. There is no one singular composite lighting model for the vessels and pier structures due to complexity and size of computation.

4.5.1 Linkages to other EES technical studies

This report informs the following technical studies:

- EES Technical Report A: *Marine ecology and water quality impact assessment*
- EES Technical Report D: *Terrestrial ecology impact assessment*
- EES Technical Report J: *Landscape and visual impact assessment*.

5.0 Existing conditions

As a basis for assessment of potential impacts, the existing conditions were considered for three zones:

- Zone 1 – South of Geelong Grammar School – looking south to the existing Refinery Pier and the location of the proposed pier extension, FSRU and LNG carriers (Markers #01 and #02)
- Zone 2 – Along Shell Parade, adjacent to the refinery – looking south east to the existing Refinery Pier and the proposed pier extension, FSRU and LNG carriers (Markers #03 and #04)
- Zone 3 – North of the proposed treatment facility – looking north and south (Marker #05).

5.1 Zone 1 – South of Geelong Grammar School

Two viewpoints (Markers #01 and #02 shown in Figure 5-1) were used to observe the existing night time lighting from south of Geelong Grammar School. Marker #01 has a greater vertical datum above sea level (i.e., sits at a higher elevation) than Marker #02 which sits between the roadway and sea.

Marker #01 is in a small car parking facility adjacent to Foreshore Road and immediately south of Geelong Grammar School buildings. This location was selected on the basis that it is proximal to sensitive receptors such as Geelong Grammar School and the nearby yacht club and is a publicly accessible foreshore. Marker #01 is considered to be representative of potential impacts to Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site, including Limeburners Bay. Marker #02 was selected as this location was at a lower elevation than Marker #01 and contained dense vegetation at the foreshore which could provide potential habitat for fauna. Distances to both the closest and furthermost existing pier from Marker #01 and #02 are shown in Figure 5-1. These distances are shown so that they can be compared with light spill extent from the project discussed in Section 7.0.

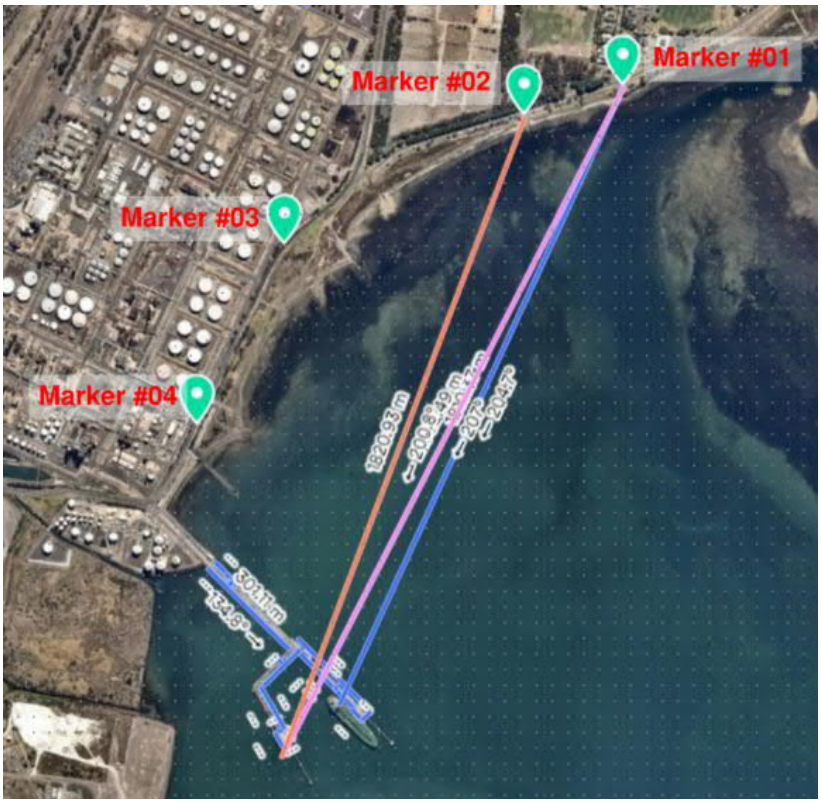

Figure 5-1: Position and distance to the project from Markers #01 and #02

As shown in Figure 5-1 the distance to the closest pier from Marker #01 is approximately 1812m and the distance to the furthermost pier is approximately 2000m. The line of sight from Geelong Grammar School to the existing Refinery Pier is through two small gaps in the existing vegetation of approximately 2m and 6m width. The existing view from the 6m vegetation gap is shown in Figure 5-2.

Figure 5-2: The existing view from Marker #01 to Refinery Pier and the refinery

Marker #02 is also located in a small car park adjacent to Foreshore Road immediately south of Geelong Grammar School buildings. The distance to the furthermost pier from Marker #02 is approximately 1820m.

The existing view from Marker #02 is shown in Figure 5-3. Immediately north of the car park / Foreshore Road is an existing and established vegetation and tree screen and 150m deep scrub bushland before reaching the two Geelong Grammar School playing fields. This means that there is some level of screening of the view to Refinery Pier and the refinery from Geelong Grammar School grounds.

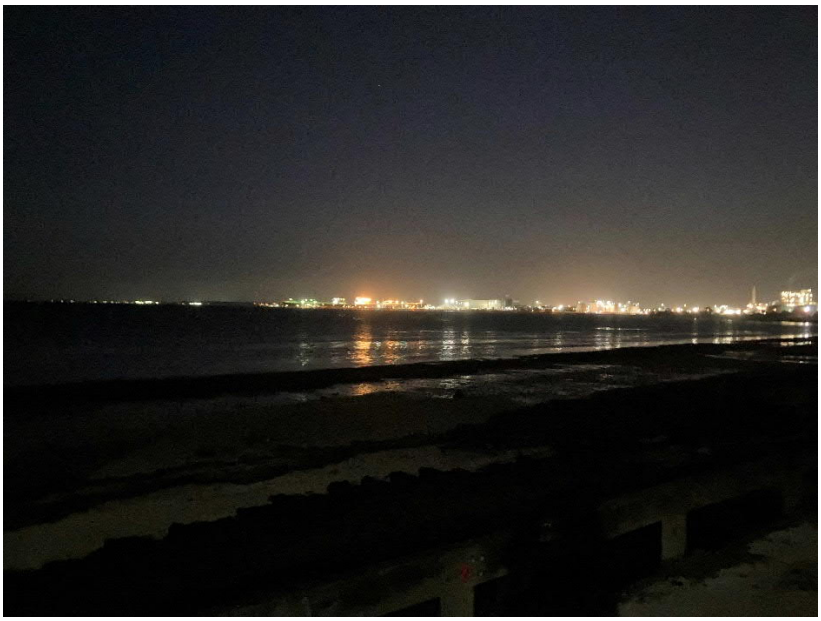

Figure 5-3: The existing view from Marker #02 to Refinery Pier and the refinery

As shown in the photos above, the existing view from Marker #01 and #02 contains extensive lighting from the refinery and port zone as well as other industrial facilities.

5.2 Zone 2 – Along Shell Parade and adjacent to the Refinery

Markers #03 and #04 are located along Shell Parade adjacent to the refinery and the foreshore. These locations were selected to determine the existing light spill towards the foreshore from Refinery Pier and towards the road from the refinery.

As shown in Figure 5-4, the existing refinery contains extensive lighting and while the light spill is largely contained within the boundary of the facility there is light spill from these existing sources along Shell Parade.

Figure 5-4 Looking west into the refinery from Shell Parade

5.3 Zone 3 – North of the proposed Treatment Facility

A single viewpoint was used for this night-time existing lighting observation (Marker #05 shown in Figure 5-5). Marker #05 is located on a small off-road gravel strip adjacent to School Road. This location affords an uninterrupted view through a break in existing screen planting along School Road looking south towards the existing refinery and proposed treatment facility location. It is noted that the Landscape and Visual Impact Assessment has recommended additional screening planting in the gap opposite Marker #05 which would result in a reduction in potential lighting impacts from this point (see Technical Report J: *Landscape and visual impact assessment* for further details).

Figure 5-5: Nearmap image showing scale and location of proposed Treatment Facility with marker #05

The distance from Marker #05 to the boundary of the proposed treatment facility is approximately 102m. Figure 5-6 shows the background of lighting at the existing refinery site (looking south). As can be seen there are already extensive light sources and light spill which can be seen from this location and surrounding areas.

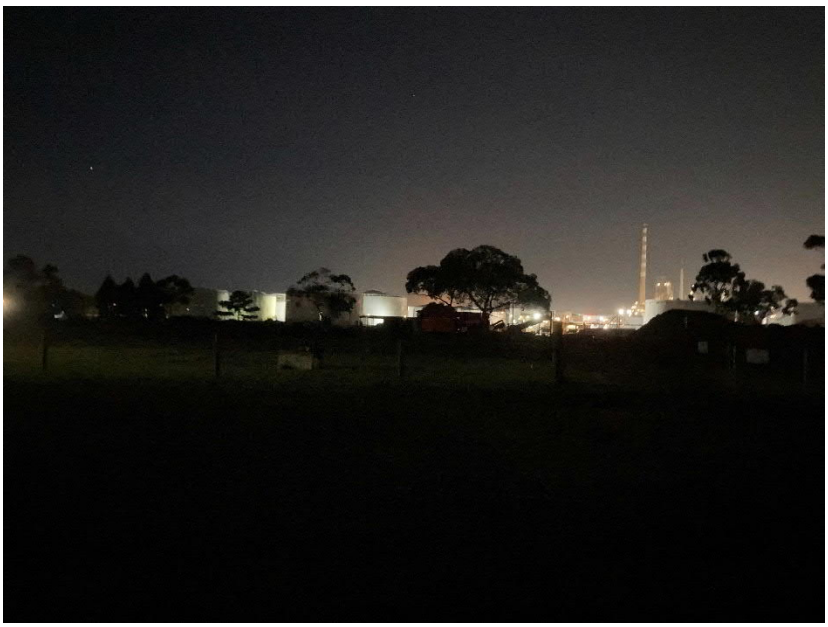

Figure 5-6: Looking south to existing refinery zone from Marker #05

Figure 5-7 shows an existing roadway light (looking east from Marker #05) on School Road. The established and mature trees along School Road provide a natural barrier to light spill from the existing refinery light sources.

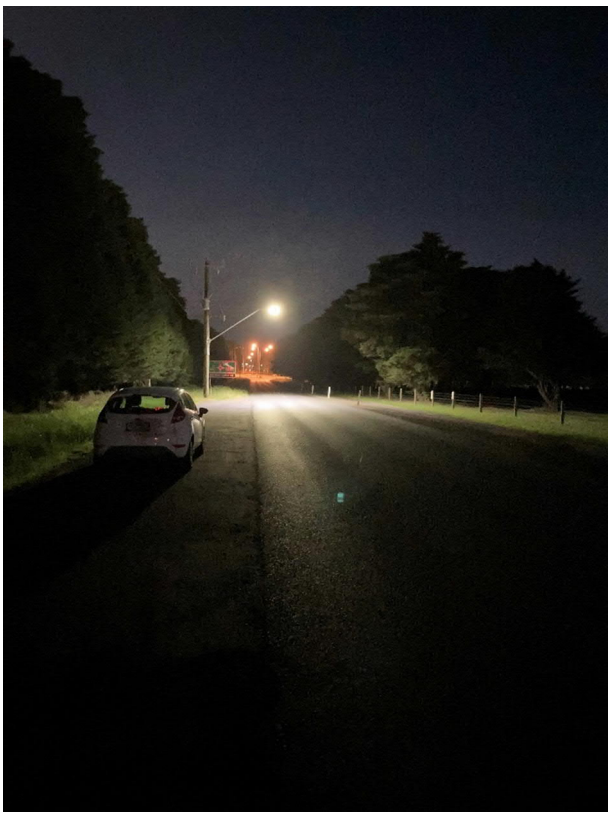

Figure 5-7: Looking east on School Rd at Marker #05

The existing conditions outlined in this section form the basis for the following assessment of potential lighting impacts associated with the project.

6.0 Construction impacts

Potential temporary light spill impacts related to the construction of the project have been considered for the following activities:

- Construction of the new pier extension (dredging)
- Construction of the pipeline (Horizontal Directional Drilling (HDD))
- Construction of the treatment facility (note that construction of the treatment facility would not occur at night, however, there would be a temporary construction compound established at this location which would require temporary lighting)

All other construction activities would occur during daylight hours and are not anticipated to result in temporary light spill impacts.

6.1 Construction of the new pier extension

In relation to construction of the new pier extension and berths at Refinery Pier, the only night time activities would be the proposed dredging which would operate 24 hours per day, 7 days per week, for an eight-week period. It is envisaged that temporary lighting would be erected around the temporary loadout facility at Lascelles Wharf which would support the offshore construction works, however, this would be for security and not for work at night.

There is no light specification requirements for dredging operation, however, management of light sources would be required.

There are typically three areas of light sensitivity:

1. The terrestrial fauna environment (e.g., shorebirds);
2. The marine fauna environment; and
3. Nearby residential areas.

Lighting on the dredging equipment is designed to provide a safe working environment for the crew working on the dredge and tugs.

Generally, all lights should be located, directed or shielded to avoid light spill outside of the target object or area and unnecessary lights should be turned off when not needed. Operators on the dredge require lights on the excavator to ensure that dredged material is safely placed into the hopper barges which produces a mobile light spill that would be localised and unlikely to have any unacceptable impact on sensitive receptors on the land.

Tugs which would be used to tow the hoppers from the dredge area to the proposed disposal site at the Point Wilson disposal ground require minimal lighting. Overall, it is considered that the offshore location of the dredging and the transport of spoil to the Point Wilson Disposal Ground would have minimal adverse lighting impacts on any sensitive receptors based on distance to the land closest to these activities.

The configuration of navigation lights on the vessels proposed for use must display (red/white/green) during the following activities as shown below in Figure 6-1 to be compliant with international rules on navigation lights:

- Backhoe Dredging (BHD): Restricted in ability to manoeuvre plus safe passing/obstruction lights
- BHD being moved around with a tug in the dredge area: Steaming Lights
- BHD on its spuds / at anchor: All round white
- Split hopper barge (SHB) being loaded: Restricted in ability to manoeuvre
- SHB sailing (loaded/empty): Steaming lights
- SHB dumping at spoil grounds: Restricted in ability to manoeuvre
- SHB at anchor: All round white

Based on the offshore location of the vessels proposed for use on the project and the distance from adjacent land, it is considered that navigational lights required under law would not have any adverse impacts on sensitive receptors.

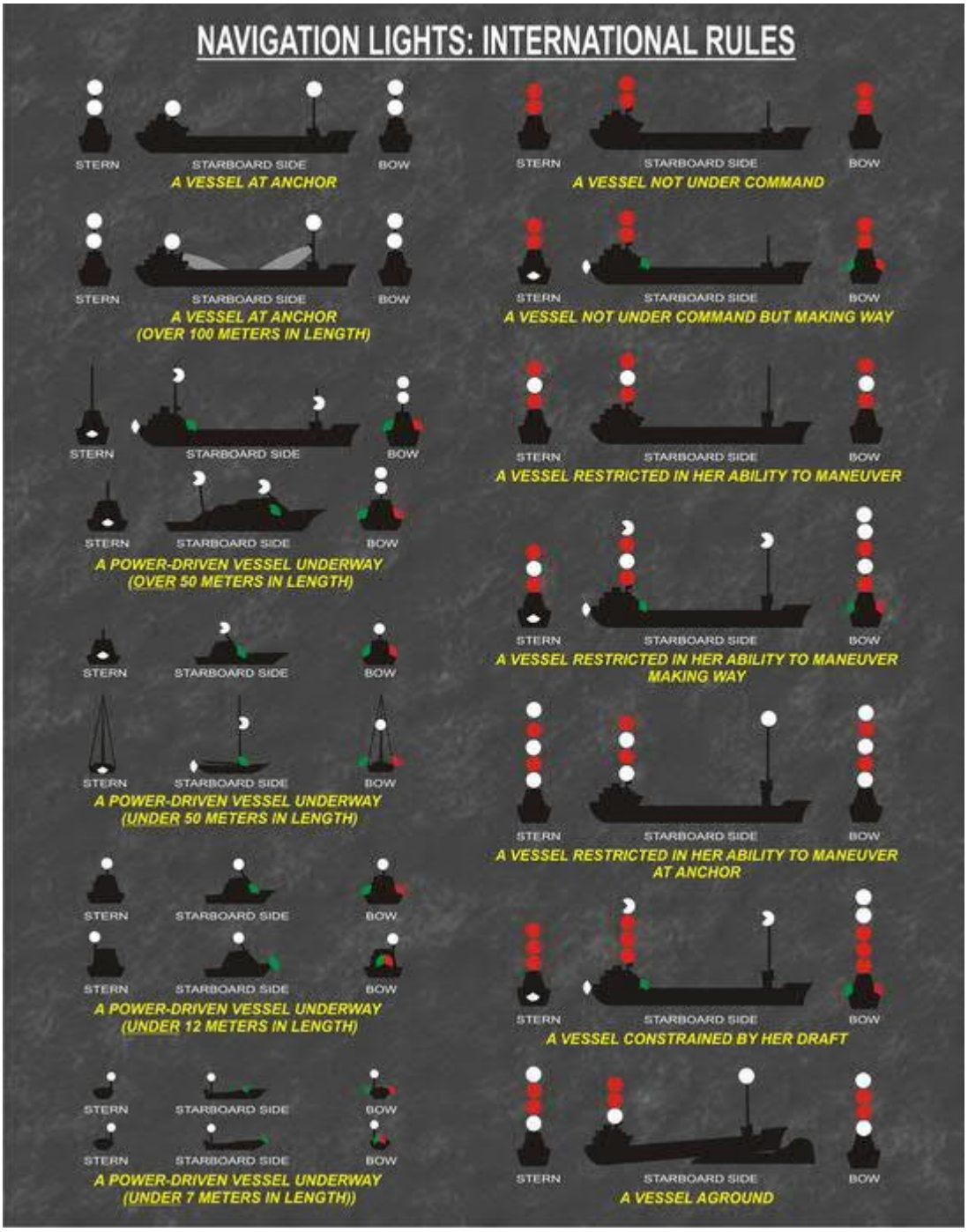

Figure 6-1 Navigation Lighting: International Rules

6.2 Temporary Pipeline Construction Zone

Construction of some sections of the underground pipeline from the treatment facility to the tie-in point at Lara City Gate would involve Horizontal Directional Drilling (HDD). Unlike the open trenching which would occur during daylight hours, HDD requires 24-hour operation to ensure the integrity of the tunnelling and pipeline installation. Figure 1-2 shows the proposed construction methods for the underground pipeline and the sections in which HDD would occur. HDD is also being evaluated for the section further north along Macgregor Court which could result in additional workspaces being located opposite the residential properties on the eastern side of Macgregor Court.

As HDD could occur on a 24-hour basis, this activity would require a construction compound with night time lighting as shown in Figure 6-2.

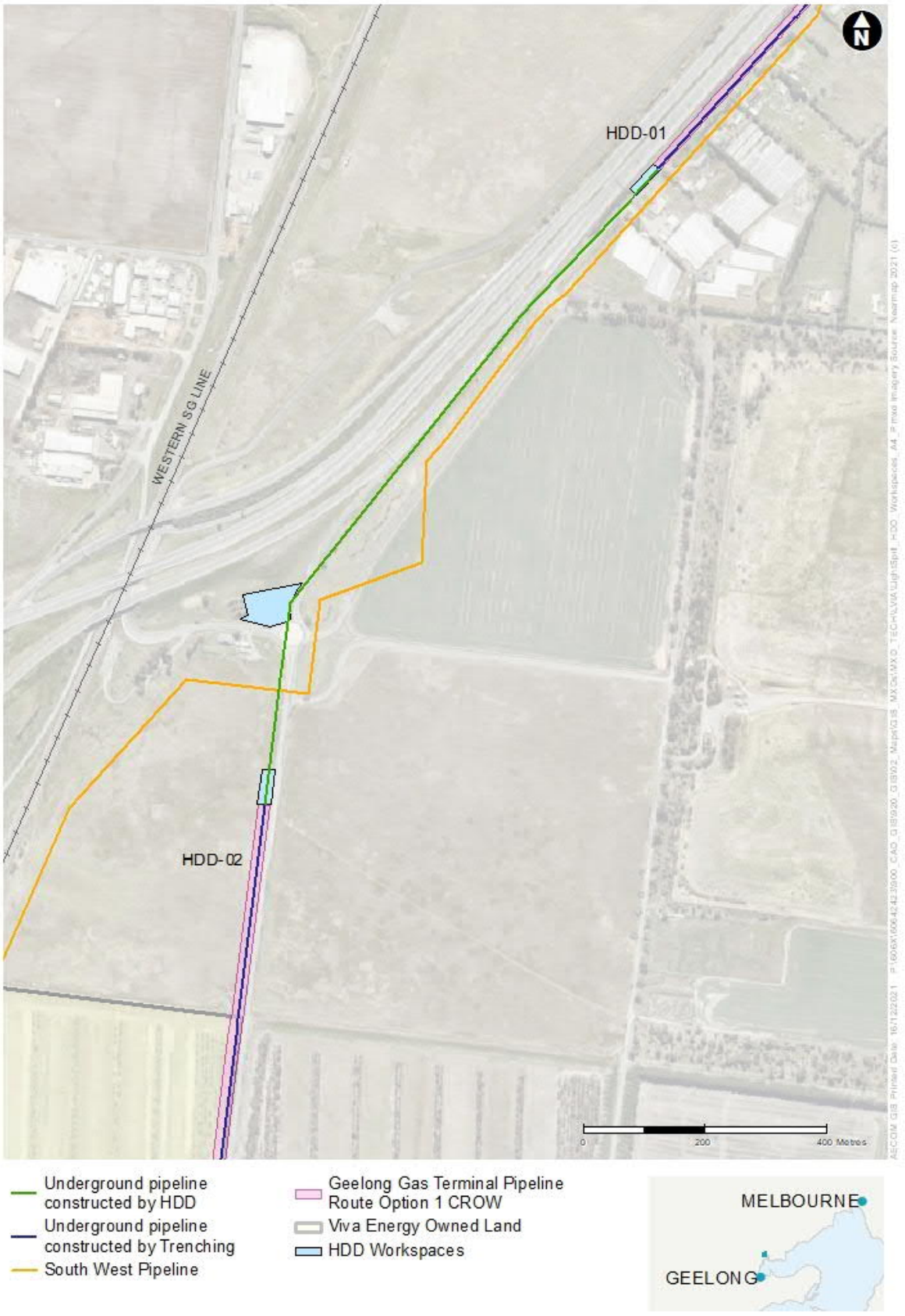

Figure 6-2 Temporary HDD construction zones

HDD-01 as shown in Figure 6-2 is approximately 850 metres (m) long and would run north east beneath the Princes Freeway – Shell Parade Off Ramp and parallel with the freeway and Macgregor Court. HDD-02 as shown in Figure 6-2 is approximately 200 m long and would run to the south beneath the Rennie Street – Shell Parade roundabout and parallel with Shell Parade. It is anticipated that HDD-01 would take up to 35 days to complete while HDD-02 would take up to 25 days to complete. Night time works could be required on a few days during this period.

The main temporary construction compound near the Rennie Street – Shell Parade roundabout would be used for a period of up to 4 months and night time lighting would be provided for this compound. Lighting would only be used where night time works are required during HDD. For the light spill assessment, the compound would be classified as a temporary activity and not a permanent activity.

Construction activity lighting is split into two functions: (i) task focused; and (ii) general construction activity and movement focused. Lighting levels would need to be in accordance with Standards assigned for construction activities to ensure work, health and safety (WHS) standards are maintained for the types of activities being undertaken. It is anticipated that all lighting would be of a downward type beam angle and would not illuminate any zones external to the construction compound to create light spill beyond the compound boundary.

Lighting, for vehicular access from the adjacent C115 Rennie Street roadway, would need to be designed so as to not create a hazard to non-construction traffic using the roadway or create a hazard to traffic using the A10 slip roadway (north of compound) from the M1 Princes Freeway.

HDD exit points located to the south of the Rennie Street - Shell Parade roundabout and on the northern section of Macgregor Court would not require night time lighting. If night time works are required during HDD, activity based lighting would be used. As with construction lighting at the construction compound near the Rennie Street – Shell Parade roundabout, activity-based lighting would be designed to not result in light spill at residential properties located on the eastern side of Macgregor Court.

Lighting within this workspace should also be in accordance with requirements set out in standards and guidelines including AS 4282: 2019 Control of the Obtrusive Effects of Outdoor Lighting and AS/NZS 1680.5 Interior and workplace lighting: Outdoor workplace lighting (refer to MM-LS01).

6.3 Construction compound at the Treatment Facility

The project would involve construction of a treatment facility within the existing refinery on an existing laydown area known as Nerita Gardens as shown in Figure 6-3. It is anticipated that a construction compound would also be located in the Nerita Gardens area and this is shown in Figure 6-3.

For ‘construction’ light spill assessment, the compound would be classified as a temporary activity and not a permanent activity.

As outlined in the previous section, construction activity lighting is split into two functions: (i) task focused; and (ii) general construction activity and movement focused. Lighting levels would need to be in accordance with standards assigned for construction activities to ensure WHS standards are maintained for the types of activities being undertaken. It is anticipated that all lighting would be of a downward type beam angle and would not illuminate any zones external to the construction compound to create spill light beyond the compound boundary.

Lighting, for vehicular access from the adjacent School Road should be designed so as to not to create a hazard to non-construction traffic using the roadway.

It is noted that there is significant existing screening to the north, north-east, northwest, east and west of the proposed treatment facility and associated construction compound as a result of established vegetation which would reduce light spill into adjoining areas. To the south, the existing refinery complex creates a highly lighted backdrop to the treatment facility and construction compound and entirely screens the location when viewed from south of the refinery.

Lighting within this workspace should also be in accordance with requirements set out in standards and guidelines including AS 4282: 2019 Control of the Obtrusive Effects of Outdoor Lighting and AS/NZS 1680.5 Interior and workplace lighting: Outdoor workplace lighting (refer to MM-LS01).

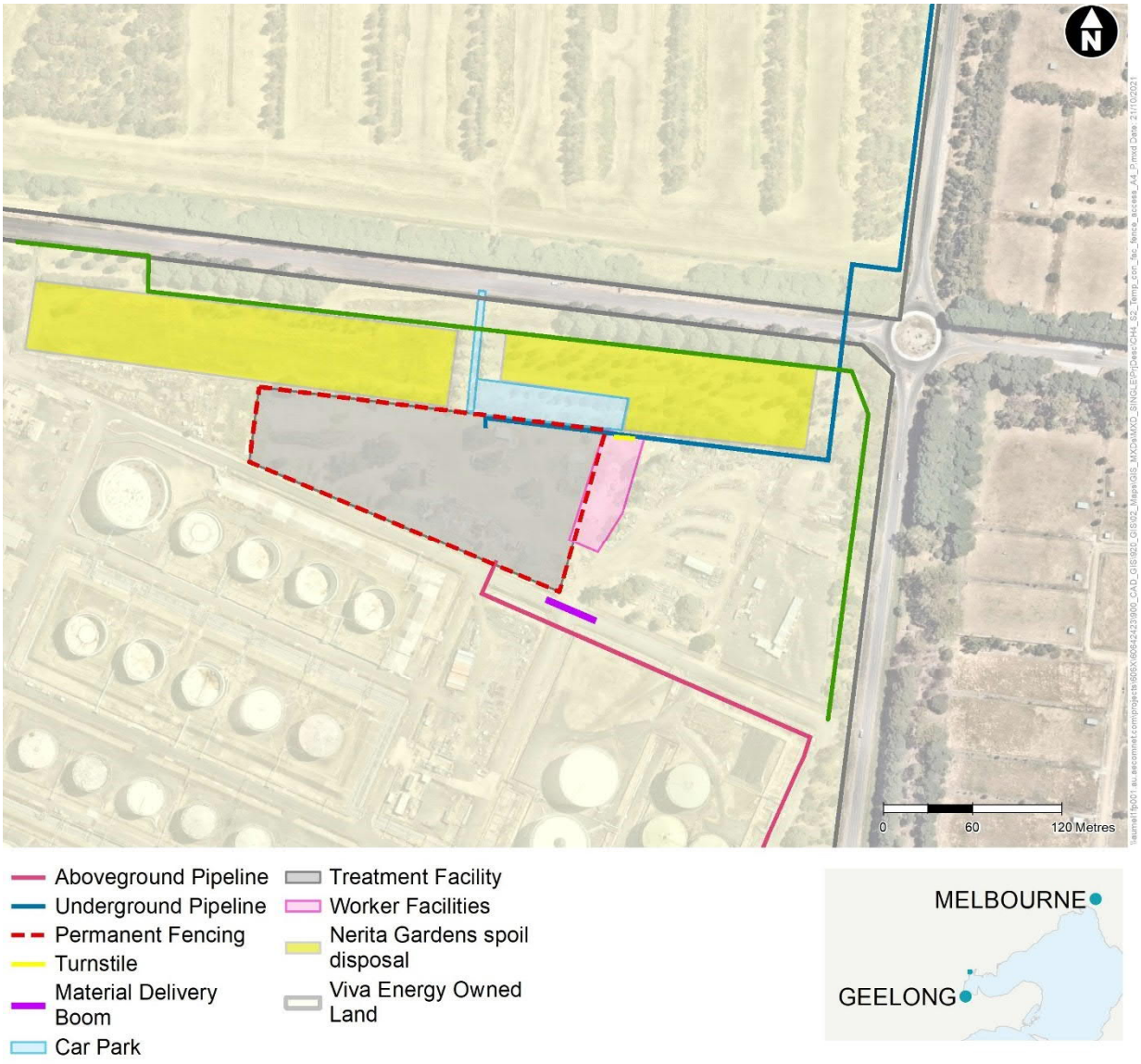

Figure 6-3 Proposed construction compound at the treatment facility location

6.4 Summary of residual construction impacts

In summary, residual impacts associated with construction of the pier extension, treatment facility and pipeline are considered to be minor. Potential light spill impacts arise from construction compounds and activities such as dredging and pipeline construction. Impacts are considered minor based on:

- The offshore location of dredging activities and the distance from any potential land-based receptors
- The location of the proposed treatment facility and associated construction compound within the refinery complex which already has existing and extensive lighting
- The temporary nature of the proposed construction compounds associated with pipeline HDD activities.

It is assumed that lighting requirements would be compliant with WHS standards and that lighting would be compliant with the various lighting guidelines and standards outlined earlier in this report.

7.0 Operation impacts

Potential light spill impacts related to the operation of the project have been considered for:

- existing Refinery Pier lighting
- lighting from the proposed Refinery Pier extension
- single vessel (the continuous mooring of the FSRU) and double vessel (an LNG carrier temporarily moored next to the FSRU) lighting
- treatment facility lighting

7.1 Light Spill from the Existing Refinery Pier

Calculating the light spill from the existing Refinery Pier helps to establish a benchmark to measure the lighting from operation of the project.

At the time of writing this report, technical drawings of the existing Refinery Pier were not available. The main source of lighting at the existing Refinery Pier is from light poles. Aerial imagery was used to determine the physical dimensions of the existing Pier and the locations of the light poles. Upgrades to the existing lighting at Refinery Pier is currently being undertaken by Viva Energy. These upgrades include the replacement of existing metal halide lights with LED lighting suitable for marine and hazardous environments. The existing light poles on Refinery Pier are shown in Figure 7-1.

Figure 7-1 Existing light poles on Refinery Pier

Light spill from the existing Refinery Pier was calculated and modelled considering LED lighting. Calculations accounted for the existing Refinery Pier level and changes in sea level due to tides at 3 m and 5 m below pier level. The model measurement zone surrounding the existing pier was extended to 60 m each side of the pier to account for the pipework running parallel to the pier. Figure 7-2 shows the lighting modelling for Refinery Pier

The model indicated that light levels would reach 0 illuminance (lux) approximately 20 m from the edge of the pier, meaning that the extent of light spill from the existing pier is 20 m.

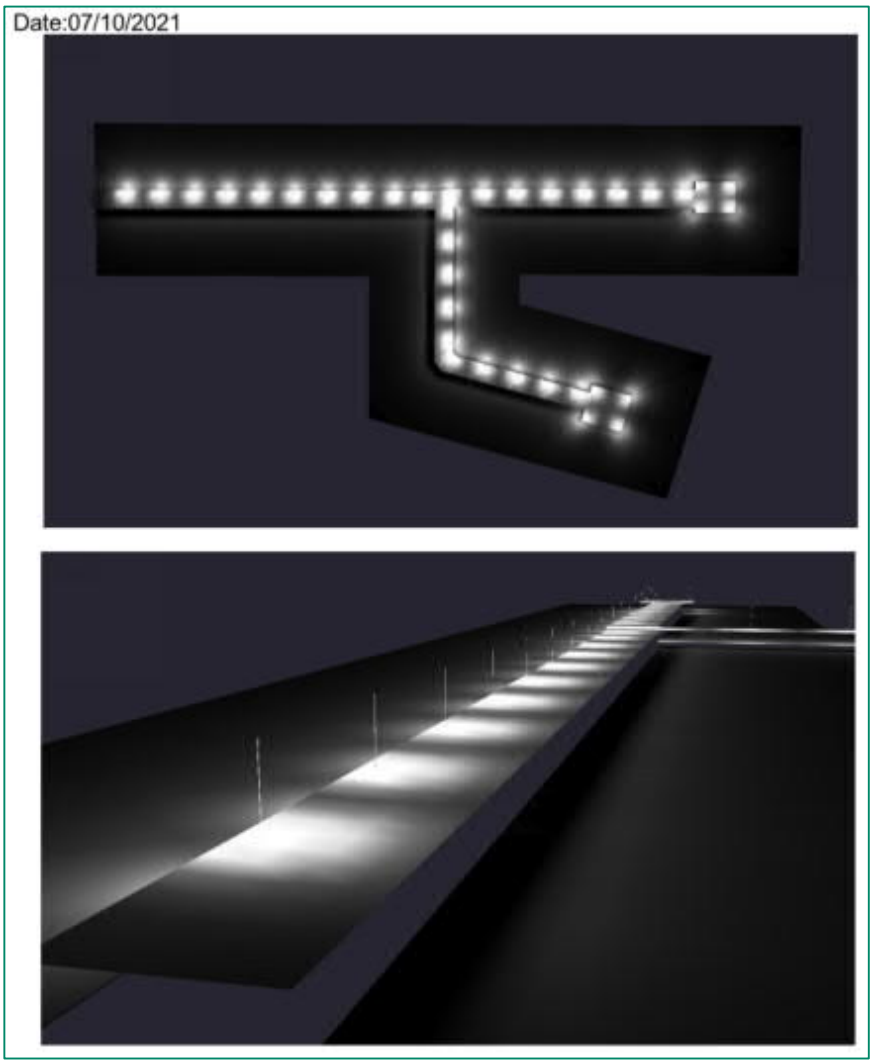

Figure 7-2 Lighting modelling (3D AGI32 visualisation) for the existing Refinery Pier

7.2 Light Spill from the Proposed Refinery Pier Extension

Light spill calculations for the proposed Refinery Pier extension were completed by Worley Parsons Ltd (Worley) on behalf of Viva Energy and are presented in Appendix D. These calculations have been used in the modelling undertaken for this light spill assessment to determine the light spill extent at the proposed Pier extension.

Above zero angle cut-off lighting was gathered and measured as part of the model for the pier extension. The model created four vertical face measurements surrounding the pier extension to demonstrate the vertical luminance that is captured and measured. This is presented in Figure 7-3.

It was determined that all light spill from night-time operation of the proposed pier extension would be retained in the immediate vicinity of the pier extension. Light spill would not be visible to the south of the pier extension, along the foreshore reserve, as light would be obstructed and captured by the permanently moored FSRU. Viewpoints to the north and west, including sensitive receptors located approximately 1.8 km north of the pier extension, along Foreshore Road (Markers #01 and #02), would not experience light spill from the pier extension, with light levels falling to 0.1 lux after approximately 100 m.

To the east, towards Corio Bay light levels would also fall to 0.1 lux after 100 m.

Considering this, light spill from operation of the pier extension is not expected to have any impacts on nearby sensitive receptors.

The National Light Pollution Guidelines for Wildlife describes best practice for wildlife sensitive lighting design. Lighting on the extension to Refinery Pier will be in accordance with the design principles outlined in the guidelines which would minimise potential impacts to light sensitive species (refer to MM-LS02).

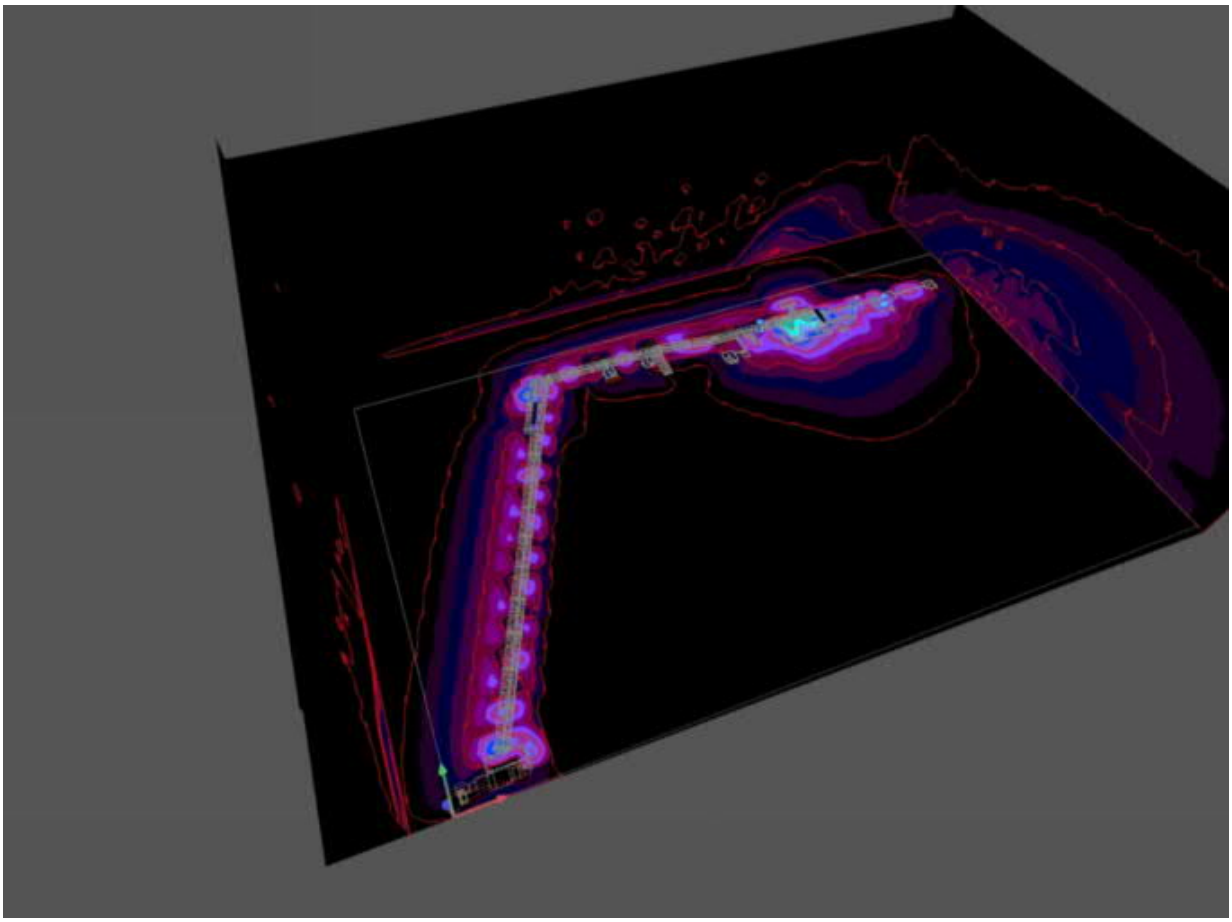

Figure 7-3 Lighting modelling (3D Dialux visualization) for proposed Geelong Refinery Pier

7.3 Calculation of Light Spill from the FSRU and LNG Carrier

To determine potential light spill impacts from the FSRU and from an LNG carrier temporarily moored adjacent to the FSRU, luminaire specifications from a proxy vessel have been adopted. As specified in Section 4.5, archive luminaire data and lighting calculations have been obtained from Glamox Co Ltd (South Korea) for the following vessel calculation: HHI HOEGH 170,000 CBM CLASS LNG FSRU. For the purpose of this light spill assessment, it is considered unlikely that the FSRU lighting specifications would vary materially with the final FSRU selected for the project.

Similarly, the luminaire specifications for the LNG carrier (Arctic Lady) have been adopted and are considered representative of the type of carriers that would visit Refinery Pier during operation of the project. It is noted however, that not all archive luminaire data could be obtained from the lighting manufacturer for the LNG carrier. The existing luminaire specification lighting (ies) data was not available due to the aged technology. Instead, LED lighting has been used for modelling in AGI32 as a substitute for the purpose of this light spill assessment. LED lighting uses similar lighting outputs (lumens).

FSRU Lighting

Single vessel light spill from the FSRU was determined with reference to the design calculations presented in Appendix A.

The lighting model was mapped to all boundaries of the FSRU, both at sea level and on the vertical planes surrounding the FSRU. Modelling indicated that light levels would be up to 10 lux over 70 m.

LNG Carrier and FSRU Lighting

To determine the cumulative light spill from the FSRU and an LNG carrier, the light spill extent of a single vessel LNG carrier was first modelled with reference to the design calculations presented in Appendix B, including LED lighting as a substitute for the existing aged technology. Modelling indicated that the light spill extent of a single vessel LNG carrier is 100 m.

In determining the cumulative light spill from the FSRU and an LNG carrier moored adjacent to the FSRU, the lighting model was mapped to all boundaries of the two vessels, both at sea level and on the vertical planes surrounding the vessels. The extent of light spill from the concurrent operation of the FSRU and the LNG carrier was determined to be 400 m. The light spill extent from the FSRU with an adjacently moored LNG carrier is presented in Figure 7-4.

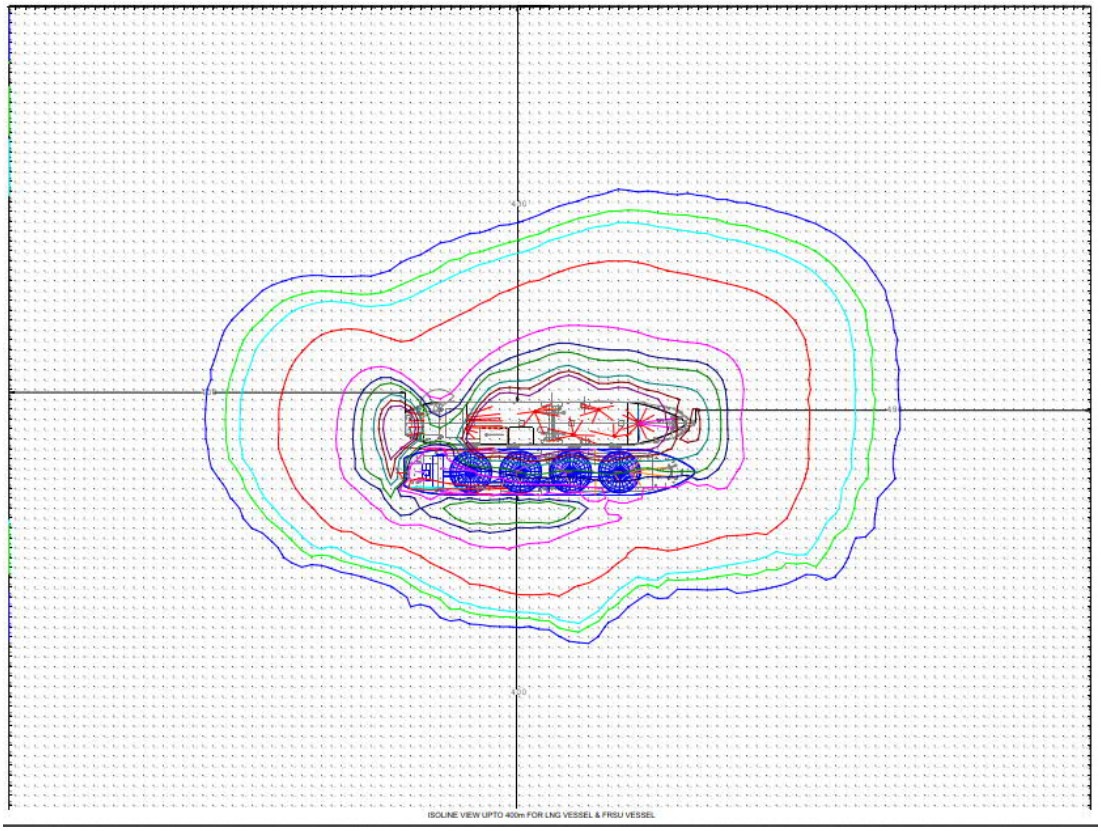

Figure 7-4 FRSU and LNG carrier vessels plan view lux contours

Given that the extent of light spill from the concurrent operation of the FSRU and an LNG carrier moored adjacent to the FSRU is 400 m, light spill would not reach the surrounding land (refer Figure 7-5).

The most prominent lighting on the LNG carrier is at high level across the 'Bridge' of the vessel. This lighting faces downward on to the foredeck. The orientation of the vessels, with bows facing south east, results in more prominent lighting facing south east towards Corio Bay, according to the model. This would significantly reduce any potential impact on the sensitive receptors located approximately 1.8 km north of the FSRU, along Foreshore Road (Markers #01 and #02). It is also noted that this model represents a worst-case scenario. An LNG carrier would not always be present at Refinery Pier. It is expected that LNG carriers would visit Refinery Pier at a frequency of approximately every 20 days to every 9 days depending on demand.

The operation of the FSRU and an adjacently moored LNG carrier may also affect local fauna. This is discussed in Technical Report A: *Marine ecology and water quality impact assessment* and Technical Report D: *Terrestrial ecology impact assessment.* The environment of Corio Bay is already subject to artificial light from the existing refinery and the urban Geelong shoreline. Best practice lighting will be used in the design of the new pier, including AS 4282: 2019 *Control of the Obtrusive Effects of Outdoor Lighting* and the *National Light Pollution Guidelines for Wildlife* (Jan 2020). The guidelines apply to new projects where wildlife could be affected by artificial light to ensure that wildlife is not disrupted or displaced from habitat, and able to forage and disperse. As such, the minor increase in artificial light from the project, which would implement best practice lighting design, is considered to result in negligible impacts to marine biota and terrestrial ecology.

In summary, the potential light spill impacts from operation of the FSRU, including an LNG carrier moored alongside it, is considered to be low.

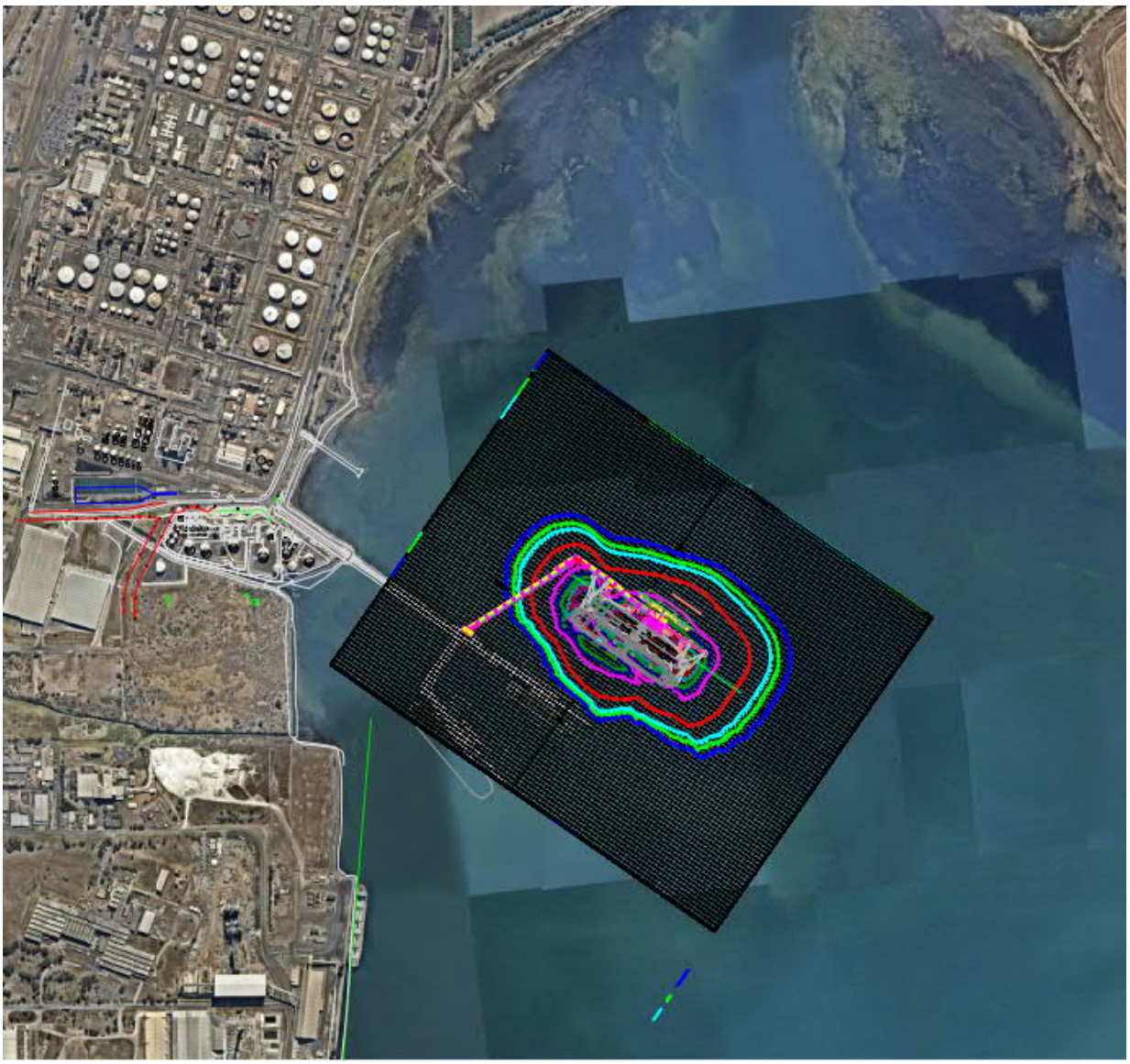

Figure 7-5 Lighting Distribution superimposed on Nearmap image for LNG and FRSU Vessels (up to 400m)

7.4 Light Spill from the treatment facility

Viva Energy conducted their own lighting design for the treatment facility. The design has been used as part of this light spill assessment (refer to Appendix E). It is noted that the location of the treatment facility was revised following completion of the lighting design, however the lighting design itself has not changed and is still applicable.

The proposed treatment facility would be located within the existing refinery boundary at Nerita Gardens, towards its northern extent. Existing vegetation planted along the boundary of the refinery would provide significant screening of the treatment facility to the north, east and west of its proposed location and to the south, the infrastructure within refinery itself would screen the treatment facility (refer to Figure 7-6).

Figure 7-6 Proposed treatment facility location

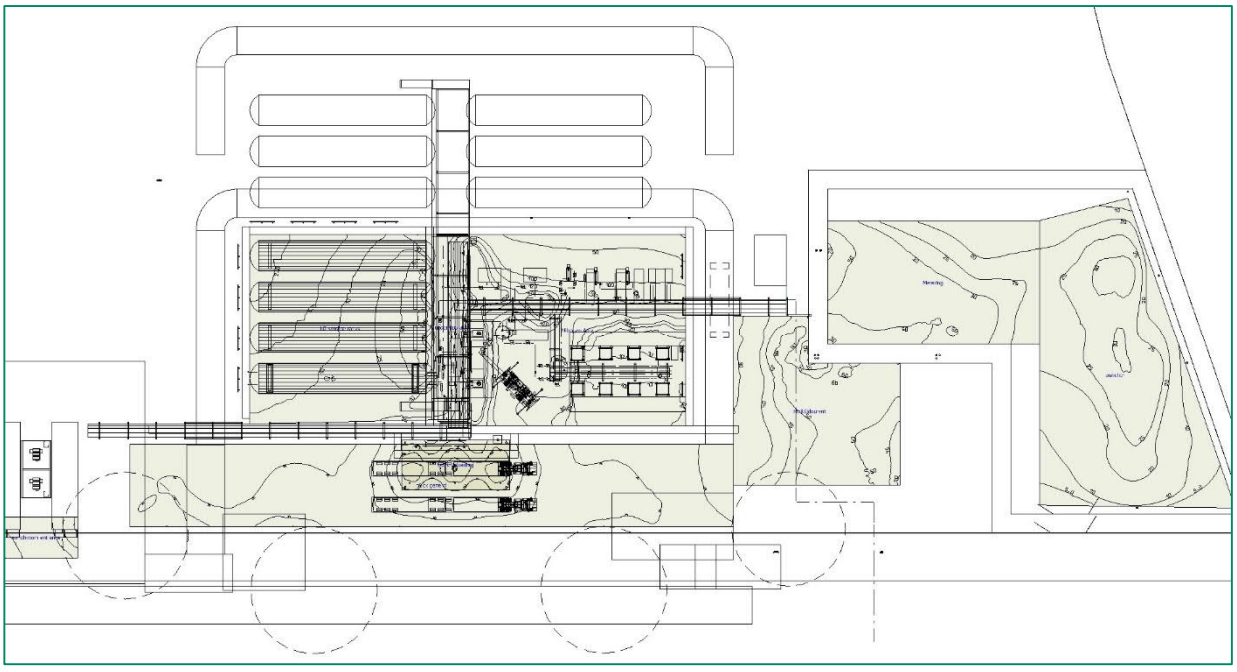

Figure 7-7 Lighting modelling (Dialux Isolux overall plan view) for proposed Treatment Facility

The modelling completed for the treatment facility indicates that lighting would be contained within the boundary of the treatment facility, mainly focusing on areas of activity (refer to Figure 7-7). Any light spill from the treatment facility would only be observed directly adjacent to the facility, within the existing boundary of the refinery. It is noted that the final lighting design and luminaire selection has yet to be confirmed, however it is anticipated that zero angle cut-off lighting would be used at the treatment facility. Viewpoints beyond the boundary of the refinery would be screened by vegetation and the existing luminance of the refinery itself would have higher visibility over the proposed treatment facility in the immediate area. Given the low potential for luminance from the treatment facility to be visible in surrounding areas, the potential light spill impact of the treatment facility is considered to be low.

7.5 Summary of Residual Operation Impacts

In summary, residual impacts associated with night-time operation of the pier extension, FSRU and LNG carrier, and the treatment facility are considered minor. This is based on:

- light spill from the pier extension would not be visible to the south, as it would be obstructed and captured by the FSRU
- the extent of light spill from the concurrent operation of the FSRU and an LNG carrier moored adjacent to the FSRU is 400 m. This would not reach the surrounding land and the most prominent lighting would be facing south east towards Corio Bay, meaning any potential impact on the sensitive receptors located approximately 1.8 km north of the FSRU, along Foreshore Road (Markers #01 and #02) would be reduced
- best practice lighting design would be implemented
- at the treatment facility, lighting would be containing within the boundary of the treatment facility itself.

The National Light Pollution Guidelines for Wildlife describes best practice for wildlife sensitive lighting design. Lighting on the extension to Refinery Pier will be in accordance with the design principles outlined in the guidelines which would minimise potential impacts to light sensitive species.

8.0 Decommissioning impacts

8.1 Summary of residual decommissioning impacts

With the Light Spill Assessment, it is not anticipated that there will be any residual decommissioning impact as the FSRU would leave the port post-project, the Refinery Pier extension would remain in-situ for other purposes and, in the event that the treatment facility was decommissioned, no lighting impacts would be anticipated due to its location within the existing, brightly lit refinery complex.

9.0 Recommended mitigation measures

Mitigation measures recommended to avoid, minimise and manage potential adverse impacts related to light spill are listed in Table 9-1.

Table 9-1 Recommended mitigation measures

MM ID	Mitigation measure	Project phase
MM LS01	**AS 4282: 2019 Control of the Obtrusive Effects of Outdoor Lighting and AS/NZS 1680.5 Interior and workplace lighting: Outdoor workplace lighting** Lighting within outdoor workspaces will be in accordance with requirements set out in standards and guidelines including AS 4282: 2019 and AS/NZS 1680.5.	Construction Operation
MM LS02	**National Light Pollution Guidelines for Wildlife Including marine turtles, seabirds and migratory shorebirds January 2020 Version 1.0** The *National Light Pollution Guidelines for Wildlife* describes best practice for wildlife sensitive lighting design. Lighting on the extension to Refinery Pier will be in accordance with the design principles outlined in the guidelines which would result in reduced material requirements and energy use, minimise potential impacts to light sensitive species and lead to a reduction in greenhouse gas emissions.	Operation

AS 4282: 2019 Control of the Obtrusive Effects of Outdoor Lighting standard sets out the requirements for the control of the obtrusive effects of outdoor lighting. This standard is referenced by Designers of outdoor lighting, as an aid to producing lighting systems that control obtrusive effects to an acceptable degree. The following mitigation methodology is recommended in accordance with this standard:

- Determination of applicable limits
- Different classification of local and adjacent environmental zones (incl.):
  - Intrinsically dark
  - Dark
  - Low district brightness
  - Medium district brightness
  - High district brightness
- Assessment of conformance against those zones
- Application of lighting limits

AS/NZS 1680.5 Interior and workplace lighting: Outdoor workplace lighting standard sets out requirements, general principles and recommendations for the permanent lighting of exterior workplaces. It applies to exteriors in which specific visual tasks are undertaken. It applies only when this area is being used as a workplace. The provisions have the object of producing a visual environment in which essential task details are made easy to see and adverse factors that may cause visual discomfort are either excluded or appropriately controlled.

National Light Pollution Guidelines for Wildlife January 2020 Version 1.0 outline the process to be followed where there is the potential for artificial lighting to affect wildlife. They apply to new projects, lighting upgrades (retrofitting) and where there is evidence of wildlife being affected by existing artificial light. Appendix A ‘Best Practice Lighting Design’ of this Guideline sets out the management principles to be used to reduce lighting pollution, including:

- Start with natural darkness and only add light for specific purposes.
- Use adaptive light controls to manage light timing, intensity and colour.
- Light only the object or area intended – keep lights close to the ground, direct and shielded to avoid spill light.
- Use the lowest intensity lighting appropriate for the task.
- Use non-reflective, dark-coloured surfaces.
- Use lights with reduced or filtered blue, violet and ultra-violet wavelengths.

9.1 Performance monitoring

Performance monitoring would be achieved through four executable tasks:

- Independent verification of the lighting modelling simulation methodologies and results.
- Site visits during construction and installation to ensure that the lighting design is being installed in accordance with the design and specification requirements.
- Post completion of the installation and attendance of the testing and commissioning of the lighting system to ensure accordance with the design and specification requirements. An Independent Commissioning Agent (ICA) can also be appointed for external verification.
- Operational site visits to ensure lighting system performance is in accordance with the design and standards performance requirements.

It is recommended that ‘work methodologies’ be set up and verified pre-execution of the tasks to ensure and manage expectations against all requirements and standards. This may involve a number of different stakeholders including trade contractors, site operatives and operational staff.

10.0 Conclusion

The Viva Energy Gas Terminal Project would establish a gas terminal with a FSRU continuously moored at Refinery Pier in Corio Bay, and install a gas transmission line to transfer the gas from the FSRU to the VTS at Lara.

Lighting on vessels used during dredging, temporary lighting for the pipeline HDD construction compounds (near the Rennie Street - Shell Parade roundabout adjacent to the Princes Freeway off ramp, and potentially also along Macgregor Court) and temporary lighting for the construction compound at the treatment facility could potentially result in light spill impacts on sensitive receptors. Light spill impacts could occur during operation of the project as a result of lighting from project infrastructure including the pier extension, FSRU, LNG carrier and treatment facility.

Lighting during construction should be compliant with work, health and safety (WHS) standards and requirements and should be in accordance with various lighting guidelines and standards to avoid and minimise potential light spill impacts. Lighting at construction compounds and workspaces would be safety and task-focused and would not result in light spill reaching residential properties.

Overall, the residual light spill impacts from construction of the project are considered to be minor due to the industrial port setting of the project which has a considerable amount of existing lighting, the temporary nature of the construction compounds and workspaces, and the significant distance between the offshore dredging activities that would occur on a 24-hour basis and potential land-based receptors.

The extent of existing light spill from Refinery Pier is 20 m from the edge of the Pier. Modelling indicates that light spill from the proposed pier extension would be localised and contained within the immediate vicinity of the pier extension in the offshore environment and would not reach onshore locations. Viewpoints to the north and west, including sensitive receptors located approximately 1.8 km north of the pier extension, along Foreshore Road would not experience light spill from the pier extension, as light levels would fall to 0.1 lux after approximately 100 m.

The extent of light spill from the FSRU and an LNG carrier moored adjacent to the FSRU is 400 m from the edge of the vessels. The light spill would be contained within the offshore environment and would not reach surrounding land-based receptors.

The proposed treatment facility would be located within the existing refinery boundary at Nerita Gardens, towards its northern extent. Light spill from the treatment facility would only be observed from locations adjacent to the facility and within the existing boundary of the refinery. Viewpoints beyond the boundary of the refinery would be screened by vegetation and the existing luminance of the refinery itself would have higher visibility over the proposed treatment facility in the immediate area. Given the low potential for luminance from the treatment facility to be visible in surrounding areas, the potential light spill impact of the treatment facility is considered to be low.

The light spill impact assessment found that with appropriate design of lighting in accordance with standards and guidelines to avoid and minimise light spill the potential impacts from construction and operation of the project would be low and the relevant EES evaluation objective can be met.

11.0 References

Draft Scoping Requirements Viva Energy Gas Terminal Environment Effects Statement April 2021.

LNG Tanker 'Arctic Lady' – Arrangement of Electrical Equipment and Isolux Curves - 2006

Port Lighting at Viva – Wharf Lighting Viva Geelong Dialux Lighting Calculations – 12-June 2020.

Worley – Viva Energy Australia: Viva Energy Gas Terminal Project Jetty Lighting Design (Rev.A: 411010-00168-PM-DSP-0008) 27-Jul 21 (incl. drawings GRN 95110 Sheets 015 + 016).

Worley – Viva Energy Australia: Viva Energy Gas Terminal Project Jetty Lighting Design Jetty Extension Report (Dialux Calculations).

Worley – Viva Energy Australia: Viva Energy Gas Terminal Project Jetty Lighting Design Nerita Gardens Report (Dialux Calculations).